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INITIAL ENVIRONMENTAL EXAMINATION (IEE)


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2:39
PM

I have reviewed the USAID Haiti Mission wide PERSUAP amendment for 2013 that includes additional crops and pesticides under the WINNER/FTF West activity. I find the PERSUAP, that was prepared by Sun Mountain Int., to be in compliance with the Reg 216 PERSUAP direction. This email serves as my recommendation for approval and signature for the PERSUAP.

Joe Torres
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2/20/2013

Proposed Amendment to the USAID, Haiti Mission-Wide PERSUAP



Prepared for:



Prepared by:



January 2013

Prepared for: USAID/Chemonics WINNER

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Sun Mountain International

Disclaimer

The use of trade or firm names in this publication is for reader information only and does not imply any product or service endorsement by the U.S. Agency for International Development (USAID).

Pesticides used in activities funded by USAID must be registered by the U.S. Environmental Protection Agency and must be applied only in strict accordance with the label.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and wildlife if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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List of Acronyms

AMWP	Amendment to the Mission-Wide PERSUAP
Bt	<i>Bacillus thuringiensis</i>
CRDD	Centres ruraux de développement durable
D	Dust formulation
EC	Emulsifiable concentrate formulation
ED	Endocrine disruptor potential
EMMP	Environmental Mitigation and Monitoring Plan
F	Flowable formulation
FC	Flowable concentrate formulation
FFS	Farmer Field Schools
G	Granule formulation
GAPs	Good Agricultural Practices
GUP	General Use Pesticide
GoH	Government of Haiti
HT	Highly toxic
IPM	Integrated Pest Management
KC	Known carcinogen
MARNDR	The Ministry of Agriculture, Natural Resources and Rural Development
MT	Moderately toxic
MWP	Mission-Wide PERSUAP
NAT	Not acutely toxic
NT	Neurotoxin
PC	Possible carcinogen
PERSUAP	Pesticides Evaluation Report and Safer Use Action Plan
PHI	Pre-harvest Interval
PNT	Practically non-toxic
PPE	Personal Protective Equipment
RD	Reproductive or development toxin potential
RUP	Restricted Use Pesticide
REI	Restricted Entry Interval
SC	Soluble concentrate formulation
ST	Slightly toxic
VHT	Very highly toxic
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
WDG	Water-dispersable granules formulation
WP	Wettable powder formulation
WHO	World Health Organization

I. Introduction

Sun Mountain International (SMTN) was competitively selected in the Spring of 2010, as the contractor hired for the development of the USAID Haiti Mission-Wide PERSUAP (MWP). The MWP was designed to cover all major USAID agricultural programs that were then currently in, or planned for, implementation in Haiti. More recently, SMTN was sub-contracted by Chemonics International through the USAID Haiti WINNER program to carry out technical assistance in order to increase WINNER program stakeholders' capacities to implement the recommendations of the Mission-Wide PERSUAP and promote integrated pest management solutions among target farmers. An amendment to the MWP was included as one of these subcontract activities in order to ensure the PERSUAP covers the complete scope of the WINNER program's pest management activities and promotes, to the greatest extent possible, integrated pest management strategies targeted at the local level and with the aim to lower farmers' and ecological risks.

Over the past two years of WINNER's implementation, on the ground experience and increasing programmatic focus on additional crops has revealed that all such activities are not sufficiently covered by the current scope of the MWP. Key needs and gaps were identified in the existing PERSUAP analysis, addressing these deficiencies and gaps is the main scope of this USAID/CHEMONICS Proposed Amendment to the MWP (AMWP). The focus areas of the AMWP, are outlined below:

- Floriculture production inputs such as plant growth regulators and bactericides for the control of crown gall disease;
- Mite control for various vegetable crops (particularly beans, tomatoes, eggplant, and cherries);
- Slug control in vegetable crops (particularly leafy vegetables);
- Fungicides for the fungal diseases *Phytophthora* spp., *Pythium* spp., anthracnose, of beans, corn, rice, tomato, pepper, leeks, melon, black sigatoka of plantains and silver scurf and *Rhizoctonia* spp. in potatoes.
- Stored grain pest controls;
- Cockroach controls for food processing facilities;
- Investigation of nematode controls for potatoes and plantains;
- Herbicides for grasses and broadleaf weeds of rice;
- Insecticides for rice pests i.e. stink bugs, rice stem stink bug, plant hopper and leaf miner;
- Bird repellent strategies for rice and corn.

This AMWP reviewed the target pest control issues, listed above, and an associated set of proposed control options. The proposed controls were compared with other available alternative products as well as any existing products currently recommended in the MWP. The following chemical active ingredients were screened and analyzed by this amendment for the uses proposed:

Acaricides: For mite control in vegetable (beans, tomato, peppers, eggplant) and fruit tree crops (mango, citrus, avocados):

1. **Chlorpyrifos 40%**¹ common trade name 'Nuphos 4E'
2. **Dicofol 42%** common trade name 'Dicofol 4E'
3. **Neem extracts**²
4. **Petroleum oils, paraffin base (petroleum oil 98%)** common trade names: Bonide Horticultural and Dormant Spray oils, Omni oil 6E, Safe-t-cide
5. **Potassium salts 47%**³ common trade names: M-pede, Zohar
6. **Spirodiclofen 22.3%** common trade name (Envidor 2SC)
7. **Spiromesifen 23.1%** common trade name (Oberon 2 SC)

Bactericides: For floriculture the following bactericides for prevention and suppression of crown gall disease in roses were screened:

8. **Agro-bacterium radiobacter strain K84 99%** common trade name Gall-troll
9. **Agro-bacterium radiobacter strain K1026 0.25%** common trade name No-Gall
10. **2,4 xyleneol 0.463% + meta cresol 0.466%** common trade name Gallex

Bird repellent: For experimental use in protection of corn and rice fields from crows, black birds and *Tisserin* spp.

11. **Methyl anthranilate 20-28%**⁴, common trade name Avian Control and Rejex-it

Fungicides: For management of fungal disease reported by WINNER agronomist, FAMV and MARNDER representatives during field work for the AMWP as well as the MWP. These include: rust (*Uromyces appendiculatus*), *pythophthora* spp, *pythium* rots, anthracnose, yellow/black sigatoka, and powdery mildew for plantains, corn and beans, in particular. Some of these diseases can also affect leeks, tomato, and peppers and fruit tree crops-mango, citrus, avocado, (see Section III, D of the Pesticide Evaluation Report for usage details on recommended fungicides). The following fungicides were screened for the above types of use:

1. **Azoxystrobin**⁵ **22.9%**, common trade names Quadris.
2. **Copper oxychloride 17%-50%**⁶+ **mancozeb 30%**⁷ common trade name: US products 'Badge SC' and 'C-O-C-S WDG', Haitian product 'Cuprosan.'

¹ Not recommended for mite control in vegetable, given the availability of less toxic alternatives likely to be effective.

² Recommended in MWP.

³ Recommended in MWP.

⁴ Methyl anthranilate is available in products with EPA Toxicity Class II and III. Products such as 'Avian Control' and 'Rejex-it' are Class III and should be favored over 'Bird Shield' which is a Class II product.

⁵ Recommended in MWP.

3. **Fludioxonil 0.5% + Mancozeb 5.7%** common trade name Maxim MZ seed treatment for potato fungal diseases.
4. **Fosetyl aluminum 80%**⁸ common trade names: Aliette, Legion and Linebacker WDG.
5. **Pyraclostrobin 20%**⁹ common trade name: Cabrio EG.
6. **Thiophanate methyl 70%** common trade name: Topsin.

Herbicides: For control of weed pests in corn and beans and of transplanted and direct seeded rice:

i. Herbicides for corn, beans:

7. **Bentazon 44%** common trade name: Basagran
8. **Carfentrazone-ethyl 50%**¹⁰ common trade name: Aim 50 DF
9. **Halosulfuron-methyl 75%** common trade names: Sandea
10. **Sethoxydim 13%** common trade name: Segment

ii. Herbicides for SRI rice:

The above listed chemicals are also recommended for use in rice: Bentazon 44% common trade name: Basagran/ **Carfentrazone-ethyl 50%** common trade name: Aim 50 DF/ **halosulfuron-methyl 75%** common trade name: Halosulfuron 75 WDG

11. **2, 4-D acids and salts 46-47%**, common trade names: 2-4, D Amine, Savana, Hardball.
12. **bispyribac-sodium 80%**; common trade name: Regiment
13. **butachlor**¹¹

⁶ Available in products of EPA Toxicity Class II and III. The active ingredient(s) is registered in the US, but the product formulation and concentrations of the Haitian and US products vary. The product names are from closest concentration/formulation of an EPA registered product since the exact same product is not always found marketed in the US. Products such as 'Badge SC' and 'C-O-C-S WDG' are in toxicity Class III and should be favored.

⁷ Recommended in the MWP.

⁸ Fosetyl-Al is available in a product named 'Autograph DF' which is in EPA Toxicity Class II and should be avoided. The WDG formulated products such as 'Aliette' and 'Linebacker WDG' in toxicity Class III should be favored.

⁹ Pyraclostrobin is available in products of EPA toxicity Class II and III. The product Headline (23%) is Class II and should be avoided, whereas the product Cabrio EG (20%) is Class III and should be favored.

¹⁰ Carfentrazone-ethyl is available in products of EPA toxicity Class II and III. Products in Class III such as Aim 50 DF should be prioritized for use over other Class II products.

¹¹ Butachlor is a known carcinogen, not EPA registered and is in the chloroacetanilide family that contains several active ingredients (propachlor, acetochlor, alachlor) that pose reproductive toxicity, carcinogenic and groundwater contamination risks. Given the lack of certainty that pretilachlor does not share these same toxicities and pose a threat to groundwater, as well as the availability of alternatives, pretilachlor is not recommended. The chemical compound alachlor has a similar mode of toxicity and is registered as a RUP by the EPA.

14. **cyhaliofop-butyl 18.2%**¹² common trade name: Clincher EZ
15. **fenoxaprop-p-ethyl 6.9%**; common trade name: Ricestar
16. **MCPA**¹³
17. **molinate**¹⁴
18. **oxadiargyl**¹⁵
19. **pendimethalin 33-40%**¹⁶, common trade names: Pendimax, Prowl
20. **pretilachlor**¹⁷
21. **propanil 16.6-41.4%**; common trade names: Stam 4 SC
22. **thiobencarb 15%** common trade name: Bolero 10G
23. **triclopyr triethylamine salt (TEA) 44.4%** common trade name: Grandstand R
24. **sodium chlorate 52%** common trade name: Drexel defol 750

Insecticides:

For control of cockroaches the following products were screened:

25. **Avermectin 0.001-0.05%** common trade name: Avion Prescription Treatment
26. **Boric acid 1%** common trade names: Advantage 1000
27. **Jodfenphos/Iodfenphos**¹⁸
28. **Fipronil 0.05%** common trade name: Max Force Roach Killer
29. **Flufenoxuron**¹⁹
30. **Permethrin + Allethrin + Piperonal butoxide + chlorpyrifos + propoxur 1-4%**, common trade names: Dragon, Baygon²⁰

For control of stored grain pests:

31. **Diatomaceous earth/silicon dioxide 90-99%**²¹ common trade names: Insecto / Perma-guard/Dryacide

¹² Other products with similar trade names (Clincher CA or SF) but higher concentrations of a.i. (29%). These products are EPA Toxicity Class II and should be avoided.

¹³ The EPA in their most recent registration of MCPA cancelled its rice uses due to unacceptable human and ecological risks.

¹⁴ Not recommended because EPA registration cancelled and as result of high acute and chronic toxicities

¹⁵ Oxadiargyl is not EPA registered and is in the oxadiazole chemical family and is related to oxadiazon which poses reproductive toxicity, carcinogenic risks, and can bio-accumulate in surface waters. Given the lack of certainty that oxadiargyl does not share these same toxicity risks, and the availability of alternatives, oxadiargyl is not recommended.

¹⁶ Pendimethalin is available in the product, Squadron, which is a Toxicity Class I, RUP that should not be used.

¹⁷ Pretilachlor is also not EPA registered and is in the chloroacetanilide family that contains several active ingredients (propachlor, acetochlor, alachlor) that pose reproductive toxicity, carcinogenic and groundwater contamination risks. Given the lack of certainty that pretilachlor does not share these same toxicities and pose a threat to groundwater, as well as the availability of alternatives, pretilachlor is not recommended.

¹⁸ This product is not recommended as it is a WHO obsolete pesticide with high toxicities

¹⁹ This product is not recommended as it is no longer EPA registered.

²⁰ This product is not recommended as it is no longer EPA registered.

²¹ Diatomaceous earth and silicon based products are recommended for protection of stored grains in the MWP.

32. Pirimiphos-methyl 50-57%²², common trade name: Actellic 5E

For control of rice insect pests:

33. Buprofezin 70%, common trade name: Applaud

34. Spinetoram *Saccharopolyspora spinosa* 25%, common trade name: **Delegate** and **Spinosad**,
Saccharopolyspora spinosa 80%, common trade name: Entrust

35. Thiamethoxam 25%, common trade name: Actara²³

Molluscicides: For slug control in vegetable production (leafy green vegetables in particular)

36. Iron phosphate 1%, common trade name: Sluggo Snail and Slug Bait

37. Methiocarb 2%²⁴ common trade name: Mesurol

38. Metaldehyde 5%²⁵ common trade names: Metarex, Mesurol

Nematicides:²⁶ For nematode control in sweet potato and plantain

39. Cadusafos common trade name: Rugby

40. Dazomet common trade name: Dazomet

41. Fosthiazate common trade name: Nemathorin

42. Vydate common trade name: Oxamyl

Plant Growth Regulators: For floriculture indoors in greenhouses and outdoor containerized greenhouses the following plant growth regulators were screened:

43. Chlormequat chloride 11.8%, common trade name: Cycocel

44. Damonizide 85%,²⁷ common trade name: B-Nine

45. Ethephon phosphonic acid 3.9%, common trade name: Florel

46. Gibberellic acid 4%, common trade name: ProGibb T&O

47. N6-Benzyladenine (N-1H-purine 6-amine), common trade name: Configure; **1.8% + Gibberellic acid 1.8%** common trade name: Pro Gibb Plus

48. Paclobutrazol 0.4 %, common trade name: Bonzi

49. Uniconazole-P .055%, common trade name: Sumagic

Rodenticides: For rodent control in and around farm buildings, storage structures and fields.

50. Brodifacoum 0.005%** common trade name: Final All-Weather blox

²² This product is recommended in the MWP, the use restrictions for this product are expanded under this amendment to ensure reduced risk of potential use by small-scale farmers.

²³ Recommended in MWP.

²⁴ Methiocarb is not recommended for snail control in farm/food growing areas due to its high toxicity.

²⁵ Metaldehyde is not recommended for snail control in farm/food growing areas due to its high toxicity.

²⁶ No nematicides are recommended as they are highly toxic and their uses are heavily restricted by EPA registration.

²⁷ Not recommended for carcinogenicity

- 51. **Bromadiolone** 0.005%** common trade name: Maki
- 52. **Chlorophacinone** 0.005%** common trade name: Rozol
- 53. **Warfarin 0.025%**²⁸** common trade name: Kaput

The AMWP should be considered a supplement to the existing recommendations and findings of the MWP. The MWP's Safer Use Action Plan and EMMP requirements for training and promotion of safer pesticide use are still relevant and should continue to be applied through the WINNER program's agricultural pest management activities. Supplemental EMMP and safer use requirements, as needed, for the AMWP recommended products are described in the respective sections of the Pesticide Evaluation Report (Section III) and also in Annex 1A: AMWP Proposed Additions to EMMP

Summary of RECOMMENDED Pesticides:

What follows is a list of pesticide products that are recommended for promotion and use by WINNER, in accordance with the findings of this PERSUAP amendment.

Acaricides: For mite control in vegetable (beans, tomato, peppers, eggplant) and fruit tree crops (mango, citrus, avocados):

- 1. **Dicofol 42%** common trade name 'Dicofol 4E'. EPA Registration **No. 66222-56**
- 2. **Neem extracts (azadirachtin)²⁹** common trade name: Agroneem. EPA Registration **No. 70310-2**
- 3. **Petroleum oils, paraffin base (petroleum oil 98%)** common trade names: Bonide Horticultural and Dormant Spray oils, Omni oil 6E, Safe-t-side. EPA Registration **No. 4-80.**
- 4. **Potassium salts 47%³⁰** common trade names: M-pede, Zohar. EPA Registration **No. 62719-515.**
- 5. **Spirodiclofen 22.3%** common trade name: Envidor 2SC. EPA Registration **No. 264-831.**
- 6. **Spiromesifen 23.1%** common trade name: Oberon 2 SC. EPA Registration **No. 264-719.**

Bactericides: For floriculture the following bactericides for prevention and suppression of crown gall disease in roses are approved:

- 12. ***Agro-bacterium radiobacter* strain K84 99%** common trade name Galtrol. EPA Registration **No. 40230-1.**
- 13. ***Agro-bacterium radiobacter* strain K1026 0.25%** common trade name No-Gall. EPA Registration **No. 62388-1.**
- 14. **2,4 xyleneol 0.463% + meta cresol 0.466%** common trade name Gallex. EPA Registration **No. 40230-2.**

²⁸ ** While all rodenticide active ingredients are classified by WHO in class I for acute toxicity the end use products are EPA Toxicity Class III due to the very low concentrations of A.I. that they contain.

²⁹ Recommended in MWP.

³⁰ Recommended in MWP.

Bird repellent: For experimental use in protection of corn and rice fields from crows, black birds and *Tisserin* spp.

- 15. Methyl anthranilate 20-28%**, common trade name Avian Control and Rejex-it. **Rejex-it EPA Registration No. 58035-9 / Avian Control EPA REG. NO. 33162-1**

Fungicides: For management of fungal disease including: rust (*Uromyces appendiculatus*), *pytophthora* spp, *pythium* rots, anthracnose, yellow/black sigatoka, and powdery mildew for plantains, corn and beans, in particular. Some of these diseases can also affect leeks, tomato, and peppers and fruit tree crops-mango, citrus, avocado, (see Section III, D of the Pesticide Evaluation Report for usage details on recommended fungicides). The following fungicides are recommended for the above types of use:

- 16. Azoxystrobin³¹ 22.9%**, common trade names Quadris. **EPA Registration No. 100-1222**
- 17. Copper oxychloride 17%-50%³² + mancozeb 30%³³** common trade name: US products 'Badge SC' and 'C-O-C-S WDG', Haitian product 'Cuprosan.' **'Badge SC' EPA REG. NO. 80289-3 / C-O-C-S WDG EPA REG. NO. 34704-326**
- 18. Fludioxonil 0.5% + Mancozeb 5.7%** common trade name Maxim MZ seed treatment for potato fungal diseases. **EPA REG. NO. 100-1158.**
- 19. Fosetyl aluminum 80%³⁴** common trade names: Aliette, Legion and Linebacker WDG. **EPA REG. NO. 264-467**
- 20. Pyraclostrobin 20%³⁵** common trade name: Cabrio EG. **EPA REG. NO. 7969-187**
- 21. Thiophanate methyl 70%** common trade name: Topsin. **Topsin WP EPA REG. NO. 73545-11 / Systec EPA. REG. NO. 48234-12.**

Herbicides: For control of weed pests in corn and beans and of transplanted and direct seeded rice these products are recommended:

i. Herbicides for corn, beans:

- 22. Bentazon 44%** common trade name: Basagran. **EPA REG. NO. 7969-45**
- 23. Carfentrazone-ethyl 50%³⁶** common trade name: Aim 50 DF. **EPA REG. NO. 279-3182**

³¹ Recommended in MWP.

³² Available in products of EPA Toxicity Class II and III. The active ingredient(s) is registered in the US, but the product formulation and concentrations of the Haitian and US products vary. The product names are from closest concentration/formulation of an EPA registered product since the exact same product is not always found marketed in the US. Products such as 'Badge SC' and 'C-O-C-S WDG' are in toxicity Class III and should be favored.

³³ Recommended in the MWP.

³⁴ Fosetyl-Al is available in a product named 'Autograph DF' which is in EPA Toxicity Class II and should be avoided. The WDG formulated products such as 'Aliette' and 'Linebacker WDG' in toxicity Class III should be favored.

³⁵ Pyraclostrobin is available in products of EPA toxicity Class II and III. The product Headline (23%) is Class II and should be avoided, whereas the product Cabrio EG (20%) is Class III and should be favored.

³⁶ Carfentrazone-ethyl is available in products of EPA toxicity Class II and III. Products in Class III such as Aim 50 DF should be prioritized for use over other Class II products.

- 24. Halosulfuron-methyl 75%** common trade names: Sandea. **EPA REG. NO. 81880-18**
- 25. Pendimethalin 33-40%**³⁷ common trade names: Pendimax 3.3 and Prowl 3.3 EC. **EPA REG. NO. 68156-6 and 241-337.**
- 26. Sethoxydim 13%** common trade name: Segment. **EPA REG. NO. 7969-88**

ii. Herbicides for SRI rice:

The above listed chemicals are also recommended for use in rice: **Bentazon 44%** common trade name: Basagran/ **Carfentrazone-ethyl 50%** common trade name: Aim 50 DF/ **halosulfuron-methyl 75%** common trade name: Halosulfuron 75 WDG; and **Pendimethalin 33-40%**, common trade names: Pendimax, Prowl

- 27. 2, 4-D acids and salts 46-47%**, common trade names: 2-4, D Amine, Savana, Hardball. **EPA REG. NO. 62575-1**
- 28. bispyribac-sodium 80%**; common trade name: Regiment. **EPA REG. NO. 59639-105**
- 29. cyhaliofop-butyl 18.2%**³⁸ common trade name: Clincher EZ. **EPA REG. NO. 62719-605**
- 30. fenoxaprop-p-ethyl 6.9%**; common trade name: Ricestar. **EPA REG. NO. 264-682**
- 31. propanil 16.6-41.4%**; common trade names: Stam 4 SC. **EPA REG. NO. 70506-167**
- 32. sodium chlorate 52%** common trade name: Drexel defol 750. **EPA REG. NO. 19713-486**
- 33. thiobencarb 15%** common trade name: Bolero 10G. **EPA REG. NO. 63588-14**
- 34. triclopyr triethylamine salt (TEA) 44.4%** common trade name: Grandstand R. **EPA REG. NO. 62719-215**

Insecticides:

For control of cockroaches the following products are recommended:

- 35. Avermectin 0.001-0.05%** common trade name: Avion Prescription Treatment. **EPA REG. NO. 499-406**
- 36. Boric acid 1%** common trade names: Advantage 1000. **EPA REG. NO. 68592-1 / Advance Liquid (Haitian Product)**
- 37. Fipronil 0.05%** common trade name: Max Force Roach Killer. **EPA REG. NO. 432-1460.**

For control of stored grain pests the products below are recommended:

³⁷ Pendimethalin is available in the product, Squadron, which is a Toxicity Class I, RUP that should not be used.

³⁸ Other products with similar trade names (Clincher CA or SF) but higher concentrations of a.i. (29%). These products are EPA Toxicity Class II and should be avoided.

38. Diatomaceous earth/silicon dioxide 90-99%³⁹ common trade names: Insecto / Perma-guard/Dryacide. **EPA REG. NO. 48598-1.**

39. Pirimiphos-methyl 50-57%⁴⁰, common trade name: Actellic 5E. **EPA REG. NO. 1381-170.**

For control of rice insect pests the following products are recommended:

40. Buprofezin 70%, common trade name: Applaud 70 WP. **EPA REG. NO. 71711-15.**

41. Spinetoram/Saccharopolyspora spinosa 25%, common trade name: Delegate and Spinosad, *Saccharopolyspora spinosa* **80%,** common trade name: Entrust. **EPA REG. NO. 62719-282.**

42. Thiamethoxam 25%, common trade name: Actara⁴¹. **EPA REG. NO. 62719-314.**

Molluscicides: For slug control in vegetable production (leafy green vegetables in particular) the following products are recommended:

43. Iron phosphate 1%, common trade name: Sluggo Snail and Slug Bait. **EPA REG. NO. 67702-3.**

Plant Growth Regulators: For floriculture indoors in greenhouses and outdoor containerized greenhouses the following plant growth regulators are recommended:

44. Chlormequat chloride 11.8%, common trade name: Cycocel. **EPA REG. NO. 241-74.**

45. Ethephon phosphonic acid 3.9%, common trade name: Florel. **EPA REG. NO. 264-263.**

46. Gibberellic acid 4%, common trade name: ProGibb T&O. **EPA REG. NO. 73049-16.**

47. N6-Benzyladenine (N-1H-purine 6-amine), common trade name: Configure; **1.8% + Gibberellic acid 1.8%** common trade name: Pro Gibb Plus. Configure **EPA REG. NO. 62097-19.**

48. Paclobutrazol 0.4 %, common trade name: Bonzi. **EPA REG. NO. 100-1079.**

49. Uniconazole-P .055%, common trade name: Sumagic. **EPA REG. NO. 59639-37**

Rodenticides: For rodent control in and around farm buildings, storage structures and fields these products are recommended:

50. Brodifacoum 0.005%** common trade name: Final All-Weather blox. **EPA REG. NO. 12455-89**

51. Bromadiolone 0.005%** common trade name: Maki. **EPA REG. NO. 7173-202**

52. Chlorophacinone 0.005%** common trade name: Rozol. **EPA REG. NO. 7173-243**

53. Warfarin 0.025%⁴²** common trade name: Kaput. **EPA REG. NO. 72500-18.**

³⁹ Diatomaceous earth and silicon based products are recommended for protection of stored grains in the MWP.

⁴⁰ This product is recommended in the MWP, the use restrictions for this product are expanded under this amendment to ensure reduced risk of potential use by small-scale farmers.

⁴¹ Recommended in MWP.

⁴² ** While all rodenticide active ingredients are classified by WHO in class I for acute toxicity the end use products are EPA Toxicity Class III due to the very low concentrations of A.I. that they contain.

A. SUMMARY OF FINDINGS

The PERSUAP product screening selects the least toxic control options for a given pest of a specific crop, or set of crops. This screening avoids products with high acute and or chronic toxicities to humans and a non-target species of potentially affected habitats. Products classified as US Environmental Protection Agency's (USEPA) Toxicity Class I and II, as well as products containing chemicals with carcinogenic, developmental or reproductive toxicities, cholinesterase inhibitors or endocrine disruptors are not recommended unless there were no other options found for effective control. Tables 1 and 2 that follow present summaries of the AMWP recommended and not recommended chemical active ingredients and a summary of their registration and toxicity information.

1. Table 1: Summary of Findings: Recommended Product Toxicity Reference Chart

Active Ingredients and 'Trade Name'	Class	EPA Registraion (EPA Reg.)	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
ACARICIDES														
Dicofol (48%) 'Dicofol 4E'	Organochlorine	Yes, 66222-56	No	Slightly hazardous	III	ED, PC, NT	Low risk	VHT	ST	MT		VHT	VHT	
Horticultural oil (98%) 'Bonide hort. oil'	Petroleum derivative	Yes, 4-80	No	Not listed	III	Low risk	Low risk		MT	MT			MT	
Insecticidal soap ⁴³ (47%) 'M-pede, Zohar'	Potassium salts	Yes, 62719-515	No	Not listed	III	Low risk	Low risk		PNT				MT	
Azadirachtin, Neem 'Agroneem', ⁴⁴	Botanical	Yes, 70310-2	No	Not listed	III	Low risk	Low risk	MT	MT				MT	

⁴³ Recommended in MWP, see the relevant PER sections.

⁴⁴ Recommended in MWP, see the relevant PER sections in this document.

Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
Spirodiclofen (22.3%) 'Envidor 2SC'	tetronic acid	Yes, 264-831	No	Not listed	III, IV	KC	Potential	MT	NAT	PNT		MT	MT	
Spiromesifen (21.3%) 'Oberon 2SC'	tetronic acid	Yes, 264-719	No	Not listed	III, IV	Low risk	Potential	ST	PNT	PNT		ST	ST	
BACTERICIDES Floriculture for crown gall bacteria														
2,4 xyleneol (0.46%) 'Gallex' ⁴⁵	Petroleum based	Yes, 40230-2	No	Not listed	EUP =IV	None	Not required	Not required						
Agrobacterium radiobacter strain K84 (99%) 'Galtrol'	Microbial	Yes, 40230-1	No	Not listed	III	None	Low risk	NAT	NAT	NAT	NAT	NAT	NAT	NAT
Agrobacterium radiobacter strain K1026 (0.025%) 'No-Gall'	Microbial	Yes, 62388-1	No	Not listed	III	None	Low risk	NAT	NAT	NAT	NAT	NAT	NAT	NAT

⁴⁵ Gallex is a trade name for the formulated plant growth regulator product that contains two active ingredients, 2,4-xyleneol at 0.46% concentration and meta-cresol at 0.47% concentration.

Meta-cresol (0.47%) 'Gallex'	Petroleum based	Yes, 40230-2	No	Not listed	EUP-IV	PC	Not required	Not required						
Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
BIRD REPELLENT														
Methyl anthranilate (20-28%) 'Rejex-it'	natural ester	Yes, 58035-9	No	Not listed	III, IV	None	No	ST-MT	PNT	NT			ST	NT
FUNGICIDES														
Copper oxychloride, (17 EC/74% WDG) 'Badge SC' "	Inorganic	Yes, 264-467	No	Not listed	I for eyes, II, III	None		HT	PNT		HT			HT
Fosetyl-aluminum (80%) 'Aliette'	Unclassified	Yes, 264-467	No	Unlisted	I (eyes), III	PC; low risk	Potential	NT	PNT	NAT				
Pyraclostrobin (20%) 'Cabrio EG'	strobilin	Yes, 7969-187	No	Not listed	III, IV	None	Potential	VHT	PNT	MT		VHT	VHT	
Thiophanate methyl (70%) 'Topsin'	Benzimidazole precursor	Yes, 73545-11	No	U - Unlikely to be Hazardous	III, IV	RD, KC	Low risk	MT	PNT	PNT		MT	MT	PNT

Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
SEED TREATMENTS														
Fludioxonil (0.5%) 'Maxim MZ'	Phenylpyrrole	Yes, 100-1158	No	Unlikely hazardous	III-IV	None	Low risk	HT	ST	PNT			HT	
Mancozeb (5.7%) 'Maxim MZ'	Dithiocarbamate,	Yes, 100-1158	No	Unlikely hazardous	III	KC, RD	Low risk	HT	PNT	ST	HT		HT	
HERBICIDES														
2, 4-D acid and salts (46-47%) '2-4, D Amine 4'	Chlorophenoxy	Yes, 62575-1	No	Not listed	I (eye), III	ED	Potential (low risk)	PNT	PNT	MT-PNT	PNT		ST-PNT	NAT
Bentazon, sodium salt (44%) 'Basagran'	Benzothiadiazine	Yes, 7969-45	No	II	III	RD low risk	Known pollutant	NAT	ST	ST			PNT	NAT
Bispyribac sodium-80% 'Regiment'	Pyrimidinyl benzoate	Yes, 59639-105	No	III	NA	None	Potential ; low risk	PNT	PNT	ST		PNT	PNT	

Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
Carfentrazone-ethyl (21.3%) 'Aim 50 DF'	Triazolone	Yes, 279-3182	No	Unlisted	III, IV	None	No data	ST	ST					MT
Cyhalifop-butyl (29.6%) 'Clincher'	Aryloxyphenoxypionic acid	Yes, 62719-605	No	Unlisted	III	No	Potential	HT	NT	PNT		HT	HT	
Fenoxaprop-P-ethyl (6.9%) 'Ricestar'	Aryloxyphenoxypionic acid	Yes, 264-682	No	II	III		Insufficient Data	HT	ST		0	MT	MT	
Halosulfuron-methyl (75%) 'Sandeal', 'Halosulf. 75 WDG'	Sulfonylurea	Yes, 81880-18	No	Not listed	III	Slight RD	Potential	PNT		ST			PNT	
Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton

Pendimethalin (0.7-33%) 'Pendimax'		Yes, 68156-6	No	III	III; IV	PC		MT	NAT			MT		
Propanil (16.6-81%) 'Stam'	analide	Yes, 70506-167	No	III	III, IV		Low risk	MT	NAT		ST	ST		
Sethoxydim (13%) 'Segment'	Cyclohexanedione	Yes, 7969-88	No	III	III IV	Liver toxin	Potential	ST	PNT	PNT	MT		ST	ST
Sodium chlorate (52%) 'Drexel defol 750'	Inorganic salt	Yes, 19713-486	No	Not listed	III, IV	Thyroid toxin	No	NAT		NAT		NAT		
Thiobencarb (10-15%) 'Bolero 10G'	thiocarbamate	Yes, 63588-14	No	II	III, IV	CI	Low risk	MT-HT	Not required	PNT	MT	MT-HT	HT	
Triclopyr (BEE/TEA) (44.4%) 'Grandstand'	Chloropyridinyl	Yes, 62719-215	No	III	III, IV	RD	Potential	ST (TEA) HT (BEE)	PNT (BEE and TEA)	ST (TEA + BEE)	NAT		PNT (TEA) MT (BEE)	NAT
Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton

INSECTICIDES														
Avermectin (0.05%) 'Avion Prescription Treatment'	Macrocyclic lactone	Yes, 499-406	No	Not listed	III	RD	Low risk	Indoor uses are not expected to expose non-target organisms						
Boric acid (1%) 'Advantage 1000'	Inorganic	Yes, 68592-1	No	Not listed	III	RD	Low risk	Indoor uses are not expected to expose non-target organisms						
Buprofezin (70%) 'Applaud'	thiadiazine	Yes, 71711-15	No	Unlikely hazardous	III	PC	Potential	MT-HT	PNT		NAT		MT-HT	
Fipronil (0.001-0.05%) 'Max Force Roach Killer'	pyrazole	Yes, 432-1460	No	II	III	PC	Low risk	Indoor uses are not expected to expose non-target organisms						
Primiphos methyl (57%) 'Actellic 5E'	Organophosphate	Yes, 1381-170	No	Not listed	III	ED	Low risk	Mt	HT	MT			VHT	
Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
Spinetoram/spinosad (80-25%) 'Delegate'	Spinosyn	Yes, 62719-282	No	Unlikely hazardous	III-IV	None	Potential	MT-HT	HT	PNT		HT	MT	

Thiamethoxam (25%) 'Actara'	neonicotinoid	Yes, 62719-314	No	Not listed	III		Low risk	NAT	HT	ST	0		HT	
MOLLUSCICIDES														
Iron phosphate (1%) 'Sluggo Snail'	inorganic	Yes, 67702-3	No	Not listed	III, IV		Low risk	NAT	NAT	PNT			NAT	
PLANT GROWTH REGULATORS														
N6-benzal-adenine (1.8%) 'Configure'	botanical	Yes, 62097-19	Yes	Not listed	III, IV	RD	Low risk	ST	PNT	PNT			ST	
Chlormequat chloride (11.8%) 'Cycocel'	Quaternary Ammonium	Yes, 241-74	No	Not rated	III	PC	Low risk	ST		ST	ST			
Active Ingredients and 'Trade Name'	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity*	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton
Ethephon phosphonic acid (3.9%) 'Florel'	Organophosphorous	Yes, 264-263	No	U	III	Low risk	Low potential	ST		ST			ST	
Gibberellic acid (1.8-4%) 'Pro-Gibb Plus'	Botanical	Yes, 73049-16	No	Not rated	III, IV	Low risk	Low potential	PNT	PNT	PNT				

Paclobutrazol (0.4%) 'Bonzi'	Azole	Yes, 100-1079	No	Not rated	0.4% is III ⁴⁶	Low risk	Low potential	ST		PNT	ST		ST	ST
Uniconazole-P (4%) 'Sumagic'	Azole	Yes, 100-1079	No	III	III	PC	Potential	MT	ST	NAT	NAT		NAT	NAT
RODENTICIDES														
Brodifacoum (0.005%) 'All-weather blox'	coumarin	Yes, 12455-89	No	Ia	III		Low risk	MT		HT			HT	
Bromadiolone (0.005%) 'Maki'	coumarin	Yes, 7173-202	No	Ia	III		Low risk	MT		HT			HT	
Chlorophacinone (0.005%) 'Rozol'	1,3-Indandione	Yes, 7173-243	No	Ia	III		Low risk	HT		MT			HT	
Warfarin (0.025%) 'Kaput'	coumarin	Yes, 72500-18	No	Ib	III	DR	Low risk	NAT		PNT-MT			NAT	
NOTATIONS: WHO Acute Toxicity (Class Ia = Extremely Hazardous, Ib = Highly Hazardous, II = Moderately Hazardous, III = Slightly Hazardous, U = Unlikely to Present Acute Hazard in Normal Use) EPA Acute Toxicity Classes (Class I = Extremely Toxic, II = Highly Toxic, III = Moderately Toxic, IV = Slightly Toxic) Chronic Toxicity (KC=Known Carcinogen; PC=Possible Carcinogen; ED=Endocrine Disruptor potential; RD=Reproductive or Developmental Toxin potential; NT=Neurotoxin) G-water contaminant = Groundwater contamination risks (known contaminant, potential risk due to uncertainty of data or suggestive evidence of contamination, low risk due to rapid breakdown, low leachability, low toxicity profile, etc.) Ecotoxicity (VHT=Very Highly Toxic; HT=Highly Toxic; MT=Moderately Toxic; ST=Slightly Toxic; PNT=Practically Not Toxic; NAT=Not Acutely Toxic)														

⁴⁶ WINNER should use the 0.4% product which is registered for use in floriculture. The 50% formulation of paclobutrazol is Tox. Class II and for agricultural uses in field crops.

2. Table 2: Summary Not Recommended Products Toxicity Reference Table

WINNER PERSUAP Amendment 2012: Not Recommended Product Toxicity Summary Chart																
Active Ingredients	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity *	G-water contaminant	ECO-TOXICITY							Rationale	Alternatives
								Fish	Bees	Birds	Amphibian	Crustaceans	Aquatic Insects	Plankton		
INSECTICIDES																
Chlorpyrifos	Organophosphorus	Yes	Yes	II	II, III, IV	ED	Insufficient data	HT	HT						RUP EC formulations are most common in Haiti and should not be promoted	Sulfur, horticultural oils (Refined paraffin oils), tetrionic acids (Envidor, Oberon) dicofol, dimethoate,
cypermethrin	Pyrethroid	Yes	Yes		II, III	PC	No	HT	HT		HT	VHT			RUP and probable carcinogen.	
profenofos	Organophosphorus	Yes	Yes	II	I for eyes, II	CI	Potential	HT	HT	HT		VHT	VHT		RUP for acute human and eco-toxicity; use registration only for use on non-food crops (cotton)	
Jodfenphos (Iodofenphos)	Organophosphate	No	No	U	No information									WHO obsolete pesticide, No EPA reg.	Boric acid Fipronil Avermectin	
Flufenoxuron	Insect growth	No	No	III	No information									No EPA reg.		

	regulator															
Active Ingredients	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity *	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton	Rationale	Alternatives
Dragon/Baygon	Multiple organophosphates	No		Not listed	III	ED, RD		HT	HT	HT					Not EPA registered	Boric acid Fipronil Avermectin
HERBICIDES																
Acetochlor	chloroacetanilide	No	No	III	II, III	KC	Potential	MT	MT						No EPA reg., KC, G-water concern	carfentrazone-ethyl, halosulfuron-methyl, bentazon, pendimethalin, propanil, triclopyr, sodium chlorate, thiobencarb, bispyribac, cyhalofop-butyl, fenoxaprop-ethyl
Alachlor	Chloroacetanilide	Yes	Yes	III	I, III, IV	KC, RD	Yes	MT	NAT		MT	ST			RUP, KC, RD, G-water concern	
Butachlor	chloroacetanilide	No	No	Unlikely hazardous	No info.	KC	No data	HT			MT	MT	HT	MT	No EPA reg. KC, G-water concern	
MCPA	chlorophenoxy acid/ester	Yes	No	I	I (eye) III, IV	CI	Potential	ST	PN-T	PN-MT	ST	NAT			No EPA reg. for rice use	
Active Ingredients	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity *	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton	Rationale	Alternatives

Molinate	thiocarbamate	Canceled		III			HT; PC, ED, CI, RD	-	-						EPA cancelled for health risks	carfentrazon-e-ethyl, halosulfuron-methyl, bentazon, pendimethalin, propanil, triclopyr, sodium chlorate, thiobencarb, bispyribac, cyhalofop-butyl, fenoxaprop-ethyl
Oxadiargyl		No	Not listed	Not listed	No information	No information	No data								Not EPA registered, in same family as other chemicals with PC, RD and bio-accumulation concerns	
Pretilachlor	Chloroacetanilide	No				PC, RD	Yes								Not EPA registered, PC, RD G-water concern	
MOLLUSCICIDES																
Active Ingredients	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity *	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton	Rationale	Alternative
Metaldehyde (Metarex, Mesurol)	aldehyde	Yes	Yes	II	II, III, IV	PC, RD	Potential	ST		MT			NAT		RUP for ecotoxicity	Cultural and mechanical controls,

Methiocarb (Mesurol)	Carbamate	Yes	Yes	IB	I, II, III	CI	Potential	HT	VHT	HT			VHT		RUP for ecotoxicity, no longer registered for use on food crops	Iron phosphosphate (Sluggo)
NEMATOCIDES																
Cadusafos* (Rugby)	Organophosphorus	No		IB	na	CI		MT	HT	HT		HT	HT		Not US EPA Registered	Cultural controls, soil solarization, <i>Bacillus firmus</i> (Chancellor see MWP)
Dazomet	Dithiocarbamate	Yes	Yes	II	III		Potential	VHT		MT			VHT		RUP, not registered for proposed uses	
Active Ingredients	Class	EPA Registered	RUP	WHO Acute Toxicity Class	EPA Acute Toxicity Classes	Chronic Toxicity *	G-water contaminant	Fish	Bees	Birds	Amphibian	Crustacea	Aquatic Insect	Plankton	Rationale	Alternatives
Fosthiazate (Nemathorin)	Organophosphorus	Yes	Some	II	II, III, IV	CI, RD	No info.	NAT	HT	HT		HT	HT		RUP, acute toxicity and CI; only registered for control of nematodes in tomatoes	Soil solarization, <i>Bacillus firmus</i> (Chancellor see MWP)

Oxamyl (Vydate)	N-Methyl Carbamate	Yes	Yes	IB	I, II, IV	CI	Potential	ST	HT	HT		ST			RUP for acute human and eco-toxicity.	<i>Bacillus firmus</i> (Chancellor see MWP),
PLANT GROWTH REGULATOR																
Daminozide (85%)	Un- classified	Yes	No	Not rated	III	Metab o-lite is PC	Low potent ial	PN T		PN T			ST		Carcinogenic and lower toxicity alternatives recommended	Florex, Bonzi, Cycocel, Sumagic, Fascination
NOTATIONS: WHO Acute Toxicity (Class Ia = Extremely Hazardous, Ib = Highly Hazardous, II = Moderately Hazardous, III = Slightly Hazardous, U = Unlikely to Present Acute Hazard in Normal Use) EPA Acute Toxicity (Class I = Extremely Toxic, II = Highly Toxic, III = Moderately Toxic, IV = Slightly Toxic) Chronic Toxicity (KC=Known Carcinogen; PC=Possible Carcinogen; ED=Endocrine Disruptor potential; RD=Reproductive or Developmental Toxin potential; NT=Neurotoxin) Ecotoxicity (VHT=Very Highly Toxic; HT=Highly Toxic; MT=Moderately Toxic; ST=Slightly Toxic; PNT=Practically Not Toxic; NAT=Not Acutely Toxic)																

3. Table 3: Amended PERSUAP IPM Control Options Table

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
Table General Pests	Whiteflies	<p>Coordinate planting calendars with other farmers in the area planting whitefly host crops.</p> <p>Adjust planting dates based on historical whitefly outbreaks – delaying planting 3 weeks can help disrupt whitefly reproduction cycles.</p> <p>During periods of heavy whitefly migration, avoid planting susceptible crops such as tomato and cole crops.</p> <p>Install yellow sticky traps mounted on stakes next to plants</p> <p>Remove/destroy/use as feed all crop residues as soon as possible after harvest.</p> <p>Monitoring: Starting after emergence, check field margins for whiteflies, which are usually infested first. When nearby host crops are in decline, monitor twice per week for rapid population buildup. If field margins are areas of concern but field centers are not highly infested, treat only field margins to allow beneficial insects to survive and control whiteflies.</p> <p>Note: Early control is critical; once populations build up they are difficult to suppress.</p>	<p>Sticky traps</p> <p>Tetronic acids</p> <p>spiromesifen (Oberon 2SC), spiroticlofen (Envidor 2SC)</p>	<p>Thiamethoxam (Actara),</p> <p>Imidacloprid (Gaucho FS, Admire)</p>

⁴⁷ Chemical active ingredient is listed first followed by the common trade name of commercial product in parentheses.

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
	Aphids	<p>If populations are localized, prune and dispose of infested areas.</p> <p>Knock aphids off with a strong stream of water.</p> <p>Monitoring: Monitor plants from bloom to early fruit set by picking the highest open flower on 20-30 plants selected at random throughout the field. Inspect leaves for live aphids, as well as mummies. Treatment is necessary if roughly half of the leaves are infested.</p> <p>During late fruit set, pick the leaf below the highest open flower on 20-30 randomly selected plants. Monitoring is critical during the period 6-8 weeks before harvest – as a rule of thumb if 50% of leaves are infested during this time, treatment is necessary to avoid yield losses.</p>	<p>Wood ash (dust plants with ash when leaves are not too dry nor too wet).</p> <p>Insecticidal soaps (Safer Soap) or homemade: 1 ½ teaspoons liquid soap, i.e. dish detergent, per quart of water). Garlic and chili spray Neem Oil (Agroneem).</p>	Actara (thiamethoxam)
	Caterpillars	<p>Hand-pick caterpillar larvae and kill by dropping into a container with soap and water or a salt solution.</p> <p>Disc fields after harvest</p> <p>Otherwise, bury or use any remaining plant matter as animal feed to destroy any eggs and larvae that may remain.</p> <p>Rotate with less susceptible crops such as carrot or green onion.</p>	<i>Bacillus thuringensis</i> var. <i>kurstaki</i> (Dipel)	Carbaryl (Sevin)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		Do not rotate with cabbage, swiss chard, spinach, tomato, or eggplant. Monitoring: Inspections for caterpillars should begin during the vegetative growth period and continue from flower bud to bloom and during pod fill. Plants should be inspected to observe early signs of damage to foliage and presence of caterpillars on plants when young pods are forming.		
	Anthracnose	Select fields with lowest or no recent incidence of Anthracnose. Prune out dead limbs and twigs with visible infections. Avoid over-irrigation during growth. Prune low branches 60 cm off the ground to reduce humidity. Prune and harvest preferably during dry conditions. Inter-crop with fruit-bearing shrubs and annual vegetables to help conserve biodiversity and reduce pest population Monitoring: The decision to apply product should be based in the following factors: High Humidity Zones ; High incidence of Anthracnose in the area; Prolonged periods of rain forecasted	Copper compounds (copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)	Azoxystrobin (Quadris) , mancozeb (Dithane) Thiophanate-methyl (Topsin)
	Rodents (common rats and mice)	Improved sanitation practices (i.e. removal of potential rodent attractants, rotting crop, seed, fruit or crop residues) Mechanical controls Monitoring:	Warfarin (Kaput)* Least acutely toxic	Chlorphacinone (Rozol) (indoor or outdoor uses) Brodifacoum(Kle Rat)-indoor/

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
				building exterior uses only bromadiolone (Maki)-residential indoor uses only
	Cockroaches (in food processing plants)	Improved sanitation practices (i.e. removal of potential cockroach food attractants and water sources, and hiding places) Monitoring: through sticky traps	Boric acid (Advantage 1000)	Fipronil (Max Force Roach Killer) Avermectin (Avert Prescription Treatment)
Avocado	Mites	Reduce dust around field Good weed management Remove all excess plant debris Avoid rotating, or planting near, plots with other host crops such as banana, plantain, cassava, cocoa, avocado Monitoring: Leaves should be frequently checked for bronzing and defoliation.	Sulfur (Crystal Sulflox 720) Insecticidal soaps (M- pede) Horticultural oils (Omni- oil) Spiromesifen (Oberon 2SC) , spiroticlofen (Envirdor 2SC) Yellow sticky traps	Dicofol (Dicofol 4E EC) Dimethoate (Dime 2.67 EC)
	Lace bug	Provide proper irrigation and plant care to ensure crop vigor. Damaged foliage should be removed. Pruning should be done carefully so as not to expose the plant to too much sunlight.	<i>Saccharopolyspora</i> <i>spinosa</i> (Spinosa Entrust) (partial control)	Permethrin (Pounce 25 WP), Imidacloprid (Gaucho FS, Admire) (

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		Clean all bins and receptacles used for harvesting avocados Monitoring: It is important to check the underside of leaves frequently for lace bugs. Control should be applied when adults are found on foliage.		
	Phytophthora Root Rot	Avoid soils that are poorly drained, or pathogen-infested and high in saline. Do not work in infested groves when the soil surface is wet Begin harvesting and other activities in healthy areas of the grove; work in diseased areas last to minimize pathogen movement. Skirt pruning Monitoring: Monitor trees for symptoms and when conditions favor disease preventative applications of fungicides may be justified in areas with histories of phytophthora fungal problems.	Copper compounds (copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)Organic acids (Biolife 20 SL)	Mefenoxam/metala xyl-m (Ridomil Gold) Fosetyl aluminum (Aliette) ()
Beets	Cercospora	Remove infected material Provide adequate distance between plants Monitoring: Monitor fruit for infection with cercospora and intervene when disease levels reach economically damaging levels. Apply preventative applications of Sulfur when conditions favor disease.	Sulfur (Crystal Sulflox 720) Organic acids (Biolife 20 SL)	Mefenoxam (Ridomil Gold)
Banana / Plantain	Nematodes	Nematode-suppressive green manure/fallow crops Remove all weeds and excess plant matterSoil	Sticky board traps Organic soil amendments (Neem or Jatropa	

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		solarization Monitoring: When sampling nematode populations it is best to take root and soil samples. Samples should not be taken when the soil is very dry or very wet.	seed cakes mixed into soil) Neem (Agroneem) <i>Bacillus firmus</i> (Chancellor SC) ()	
	Yellow and Black Sigatoka	Remove infected plants quickly. Promote air flow among crops. Monitoring: When 50% of the leaf is affected it should be trimmed to remove all infection. When over 75% of the leaf is infected it should be entirely removed	Organic acids (Biolife 20 SL)	Copper compounds (copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)Thiophanate-methyl (Topsin)
	Root Borer	Transportation of planting material from infested fields to uninfested ones should be avoided to prevent rapid dispersal of this pest to uninfested areas. Monitoring: Plants should be monitored occasionally especially at low altitudes. Root borer populations are slow to increase and are unlikely to cause significant damage in early stages as long as plants are kept healthy. Adults are attracted to freshly cut corms, and population estimates can easily be made using traps consisting of these plant parts.	Imidacloprid (Admire 2 , Gaucho 600)	
Beans	Damping- Off	Suspected plants should be carefully dug and washed,	Sulfur Dust (Crystal Sulflox	Mefenoxam

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		because pulling plants may leave tissues with characteristic symptoms in the soil. Use rhizobium seed dressing and do not over-fertilize with N. Prepare raised planting beds so that the soil has good drainage Monitoring: The base and stalk of the plant should be routinely checked, especially in areas with poor irrigation and drainage.	720) Organic acids (Biolife 20 SL) Seed treatment with fludioxonil (Maxim), mefenoxam/metalxyl-m (Maxim), mancozeb (Dithane), I.	(Ridomil Gold) Mancozeb (Dithane)
	Anthracnose	Use anthracnose free seed; Minimize entry in fields when the plants are wet from rains or early morning dew. Avoiding unnecessary movement in infested fields will minimize the spread of the disease; Tools and equipment used in infested fields should be sterilized; Fields with infestations should be cultivated, harvested and sprayed last. Monitoring: Bean debris in infected fields should be plowed under immediately after harvest. Because the fungus is primarily a pathogen of common bean (but also infects lima bean and scarlet runner bean) crop rotations of 2 to 3 years are effective.	Seed treatment with fludioxonil (Maxim), mefenoxam/metalxyl-m (Maxim), mancozeb (Dithane), I.	Pyraclostrobin (Cabrio EG) Azoxystrobin (Quadris) , Mancozeb (Dithane) Thiophanate-methyl (Topsin)
	Bean leaf Beetle	Manually remove beetles and utilize row covers if feasible. Spraying a mixture of crushed turnips mixed with corn	Sulfur (Crystal Sulflox 720) Mixture of turnips and corn oil	Chlorpyrifos (Lorsban 4E) , Dimethoate

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		oil, has been proven affective. Monitoring: Beginning checking for beetles as soon as crops begin to sprout. Late season infestations are usually insignificant.		(Dimethoate 2.67)
	Powdery Mildew	Avoid over-crowding Orient rows in same direction as prevailing winds Good weed management Disc fields after harvest Monitoring: Begin monitoring early in the season. Chemical treatment is not warranted unless infection occurs very early in the season. Check leaf surfaces often especially among older plants and areas of the field with poor air circulation. Unlike most fungi, powdery mildew does not require accumulated moisture on the plant in order to grow.	Sulfur (Crystal Sulflox 720)	Mefenoxam (Ridomil Gold) Mancozeb (Dithane), Thiophanate-methyl (Topsin)
	Grassy weeds (i.e. itch grass, johnsongrass, Bermuda grass)	Use cover crops such as legumes, Inter-cropping with corn, post-harvest flooding, crop rotation, the use of stale seed beds, solarisation, crop spacing to increase shading, use of mechanical weeding tools (i.e. hula-hoe), and flame-weeding.	fluazifop-p-butyl (Fusilade) sethoxydim (Segment) glyphosate (Glysell, Accord)- for weed burn down	
	Broad leaf weeds and sedges (i.e. cheese weed, morning glory, stork's bill, yellow nutsedge)		carfentrazone-ethyl (Aim 50 DF), halosulfuron-methyl (Sanda), bentazon (Basagran)	

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
	Mustia Fungus	<p>Avoid irrigation immediately after planting and avoid over-irrigation during growth.</p> <p>Use drip-irrigation</p> <p>Suspected plants should be carefully dug and washed, because pulling plants may leave tissues with characteristic symptoms in the soil.</p> <p>Monitoring: When symptoms appear it is usually too late to treat. Preventative treatments are most effective. The decision to apply a product should be based on the following factors:</p> <ul style="list-style-type: none"> - History of high incidence of mustia in the area - High-humidity zones - Prolonged periods of rain forecasted 	Sulfur Dust (Crystal Sulflox 720)	Mefenoxam (Ridomil Gold) , Mancozeb (Dithane)
	Golden Mosaic Virus	<p>Remove/use as feed crop residue post-harvest</p> <p>Control aphids and leafhoppers</p> <p>Monitoring: Care should be taken in inspecting the primary and trifoliolate leaves of the crop for small redish-brown spots surrounded by dark veins. Look for light green-yellow and dark green mosaic pattern; puckering, blistering, distortion, downward curling, and rolling.</p>	See controls for aphids (general pest controls) and leafhoppers (peanuts)	
	Rust	<p>Plant resistant varieties. Space plants to allow for adequate air circulation. Avoid overhead watering, as rust spores are spread by wind and splashing water.</p> <p>Rogue infected leaves and shoots as soon as they appear. Plow or otherwise dispatch of infected crop residues. Avoid over application of nitrogen and ensure adequate potassium fertilization.</p>	<p>Pyraclostrobin (Cabrio EG)</p> <p>Azoxystrobin (Quadris)</p> <p>Mancozeb (Dithane)</p>	

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
Broccoli	Downy Mildew	Remove infected plant material before spores can develop. A few broccoli varieties are available that are resistant to downy mildew. Fungicide treatment of susceptible varieties is needed when the disease occurs on transplants or early in crop development in the field; repeated applications may be required, depending on weather. Treatment during early flowering is required on seed crops.	Sulfur (Crystal Sulflox 720)	Azoxystrobin (Quadris), Fosetyl-al (Aliette) Mefenoxam (Ridomil Gold EC) , Mancozeb (Dithane), Thiophanate-methyl (Topsin)
	Diamondback Moths	Remove all excess plant material Use sprinkle irrigation to reduce activity Monitoring: Check fields during the seedling stage, at thinning, and just before heading. Also, record diamondback larvae numbers when you make your twice-weekly samples for other caterpillar pests. In cabbage fields, regularly monitor wrapper leaves for damage after heading. Adult moths frequently migrate from fields being harvested or disced under, so carefully check border rows if populations were high in adjacent fields.		Permethrin (Pounce 25 WP)
	Alternaria leaf spot	Remove infected parts of leaves before sporulation occurs. Use clean seed and practice crop rotation. Fungicides applied as foliar sprays will control this disease. Monitoring: Look for small, dark specks first on leaves or circular, tan spots (0.25-0.5 inch in diameter). Old	Sulfur (Crystal Sulflox 720), Copper compounds (copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate	Azoxystrobin (Quadris) Pyraclostrobin (Cabrio EG)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		leafspots become papery in texture and may tear. When the dry tissue falls out, a shothole effect results.	pentahydrate (Phyton-016-b) Biolife 20 SL	
Cabbage	Diamondback Moths	Sprinkler irrigation may reduce the number of caterpillars in the field. If it is applied at dusk, it may limit the activity of adults. Monitoring: Check fields during the seedling stage, at thinning, and just before heading. Also, record diamondback larvae numbers when you make your twice-weekly samples for other caterpillar pests. In cabbage fields, regularly monitor wrapper leaves for damage after heading. Adult moths frequently migrate from fields being harvested or disced under, so carefully check border rows if populations were high in adjacent fields.	<i>Bacillus Thuringensis</i> , <i>Kurstaki</i> , (Dipel)	Permethrin (Pounce 25 WP)
	Fusarium yellows	Clean all farm equipment regularly to reduce the risk of spreading the fungus. Monitoring: Look for yellow coloration on the lower leaves, often on one side of the plant. These leaves later turn brown and drop off.	Fludioxonil+mefenoxam (Maxim XL) (seed treatment) Organic acids (Biolife 20 SL)	Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
Carrot	Powdery mildew	Overhead sprinkling can help wash spores off of the plant and reduce mildew. However, overhead sprinklers should be used with caution on vegetables because their use may contribute to other pest problems. Avoid over-crowding and keep plantings free of weeds as long as is practical. Monitoring: Begin monitoring early in the season. Chemical treatment is not warranted unless infection occurs very early in the season. Check leaf surfaces often especially among older plants and areas of the field with poor air circulation. Unlike most fungi, powdery mildew does not require accumulated moisture on the plant in order to grow.	Sulfur (Crystal Sulflox 720)	Mefenoxam (Ridomil Gold), Mancozeb (Dithane) Thiophanate-methyl (Topsin)
	Snails	Surround crops with loose material such as sand, sawdust and eggshells. Hand picking.	Traps (See Annex 1 of MWP, in IPM plans for specifics) Salts	Iron phosphate (Sluggo)
Cassava	Rats	Wooden snap traps can be placed both indoors and outdoors. Create fences and other barriers around the crop field. Eliminate habitats and water sources (leaky pipes, etc.) Improved sanitation Monitoring: Rat populations should be monitored year-round. Action should be taken as soon as rats are observed. If rats are found outdoors and in the field, they are likely to move indoors within a short period of	Warfarin (Kaput)- for outdoor use and indoor food storage or processing areas	chlorophacinone- (Rozol) for outdoor use and indoor food storage or processing areas Brodifacoum (Kle Rat)- indoor food storage or processing areas

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		time. Look for rat droppings, nests and holes.		
Cauliflower	Aphids	See General pest section above		
Citrus	Citrus Root weevil	Plant in areas with good drainage (sandy soils are best) Regular irrigation and fertilization are important to promote root grow back Skirt pruning and trunk banding. Monitoring: Monitor presence of adult weevils in canopy visually and sticky trap substance applications to tree trunk can be used to monitor weevils as they emerge from the ground.		Carbaryl (Sevin WSP)
	Ants	Tilling Reduction of plant material, aphids and whiteflies Monitoring: Citrus trees should be monitored in the spring or whenever honeydew-producing insects, such as aphids are expected to appear. The underside of ants descending the citrus trees should be checked. If the abdomen is swollen, this identifies them as a species that collects honeydew.	Soap mixture (M-pede Zohar)	Chlorpyrifos (Lorsban 4E)
	Scales	Maintain adequate space between branches of adjacent plants. Pruning Monitoring: Scales are cyclical pests that only require intervention every 5-10 years. Monitor for newly settled scales and apply natural oils as soon as possible after a major hatch.	Natural soaps (M-pede) and oil (Omni-oil)	Carbaryl (Sevin WSP)
Cocoa	Monilla	Regular complete harvesting of pods is almost certainly the most effective cultural technique.	Horticultural soaps and oils (Omni-oil)	Copper compounds copper oxychloride

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		Other techniques include enforcing a break in pod production and removal/burying/enclosing husks. Infected pods must be removed before sporulation begins. Monitoring: Sweeps of the crop field should be conducted every 7-10 days. Pods are especially susceptible to rot during the first 90 days after fruit set and should be monitored carefully during this period.		(Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)
	Phytophthora	Use natural barriers, such as are oil palm, coffee and citrus to prevent or slow-down the spread of the mealy bugs within cocoa farms. Reduce humidity levels and amount of shade by pruning. Monitoring:	Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)	Mefenoxam (Ridomil Gold)
Coffee	Anthracnose	Harvest fruit when in early maturity, destroying infected fruit and branches and even leaves on trees around infected fruit, avoid overhead irrigation. Clean up all harvesting bins and anything that the fruit will touch using a 1:5 bleach to water solution. Monitoring:	Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)	
	Berry Borer, Cercospora	Remove any berries that have fallen to the ground. Pruning Monitoring:	Beauveria bassiana (Brocaril 50 WP)	
	Rust Rot (<i>Hemileia</i>	Adjust shading to reduce frequency and intensity of conditions favoring sporulation	Copper compounds copper oxychloride (Badge	

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
	<i>vastatrix</i>)	Pruning and sufficient row spacing Aggressive weed management Monitoring:	SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)	
	Root Rot	Avoid soils that are poorly drained, or pathogen-infested and high in saline. Do not work in infested groves when the soil surface is wet Begin harvesting and other activities in healthy areas of the grove; work in diseased areas last to minimize pathogen movement. Skirt pruning Monitoring:	Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b) Organic acids (Biolife 20 SL)	Mefenoxam (Ridomil Gold)
Corn	Birds	Coating rice seed with clay to make more difficult for birds to handle once planted and seed is muddled; Seed treated with fungicide can also repel birds; Provision of alternative food sources during times of particularly high bird crop damage; Scare crows; Sprays of insecticide to reduce insect populations that attract birds; Diluted sprays of copper fungicides that lead to detectable copper residues that birds associate with physiological effects from copper toxicity;		Methyl anthranilate (Rejex-it)
	Green stink bugs	Tilling fields significantly reduces stink bug population by removing all host foliage. Monitoring: Regular field scouting before planting and		Chlorpyrifos (Lorsban 75 WG)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)		<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		crop emergence is recommended.			
	Grassy weeds (i.e. itch grass, johnsongrass, Bermuda grass)	Use cover crops such as legumes, Inter-cropping with corn, post-harvest flooding, crop rotation, the use of stale seed beds, solarisation, crop spacing to increase shading, use of mechanical weeding tools (i.e. hula-hoe), and flame-weeding.		fluazifop-p-butyl (Fusilade) glyphosate (Glysell) -burn-down treatment pendimethalin (Pendimax)	
	Broad leaf weeds and sedges (i.e. cheese weed, morning glory, stork's bill, yellow nutsedge)			carfentrazone-ethyl (Aim 50), halosulfuron-methyl (Sandea), bentazon (Basagran), pendimethalin (Pendimax)	
	Damping-off	Suspected plants should be carefully dug and washed, because pulling plants may leave tissues with characteristic symptoms in the soil. Improve soil irrigation. Monitoring: The base and stalk of each crop should be routinely checked, especially in areas with poor water drainage.		Sulfur (Crystal Sulflox 720) Seed treatment with fludioxonil, (Maxim), mefenoxam/metalxyl-m (Maxim), mancozeb (Dithane), I	Mefenoxam (Ridomil Gold) , Mancozeb (Dithane)
	Corn Borer	Corn residues should be plowed under/removed/ used for feed to lessen chances of the borers surviving the non-growing season. Late planting can be effective in reducing first generation borer populations. Monitoring: Samples of 20 corn plants should be		<i>Saccharopolyspora spinosa</i> (Spinosad, Entrust)	Imidacloprid (Gaucho 600, Admire) chlorpyrifos (Lorsban, Pounce)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		conducted in 5 randomly selected quadrants. Check for larvae as well as instances of leaf damage. The larvae of subsequent generations are usually laid in the middle third of the tallest and greenest corn plants.		
	Mites	Reduce dust around field Good weed management Remove all excess plant debris Avoid rotating, or planting near, plots with other host crops such as banana, plantain, cassava, cocoa, avocado Monitoring: Infestations usually begin on the lower portions of the plants and move upward as mite numbers increase. Evaluating spider mite infestations is most efficient if randomly selected, older, lower leaves are picked and inspected for stippling on the upper surface and webbing, mites, and feeding scars on the lower surface. Spider mite infestations that reach the ear leaf are most damaging.	Sulfur (Crystal Sulflox 720) Insecticidal soaps (M-pede) Horticultural oils (Omni-oil) Tetrionic acids spiromesifen (Oberon 2SC), spiroadiclofen (Envidor 2SC) Yellow sticky traps	Dicofol (Dicofol 4E) Dimethoate (Dime 2.67)
	Rust	Use resistance varieties; Select disease free seed; Early planting relative to other farmers; Crop rotation after years of heavy infestation; Weed management to improve air flow around crop and rapid drying of crop's canopy. Monitoring: Look for pustules that may appear on any aboveground part of the corn plant and on leaves. The pustules, which may erupt and become powdery, occur	Treat seeds with dilute Clorox water solution	Mancozeb (Dithane)

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
		nearly simultaneously on both leaf surfaces. They are golden brown to cinnamon brown, becoming black as the spores mature.		
Eggplant	Mites	Reduce dust around field Good weed management Remove all excess plant debris Avoid rotating, or planting near, plots with other host crops such as banana, plantain, cassava, cocoa, avocado Monitoring: Monitor fields weekly. Look for plants with yellowish leaves or defoliated plants. Examine plant leaves for webbing, especially on older leaves in the middle of the plant with symptoms.	Sulfur (Crystal Sulfox 720) Insecticidal soaps (M-pede) Horticultural oils Tetronic acids (spiromesifen, spiroadiclofen) Yellow sticky traps	Dicofol (Dicofol 4E) Dimethoate (Dime 2.67)
	Green stink bugs	Tilling fields significantly reduces stink bug population by removing all host foliage. Destroy all weeds and possible hosts such as legumes and mustards. Monitoring: Regular field scouting before planting and crop emergence is recommended.		Thiamethoxam (Actara 240) Carbaryl (Sevin)
	Damping-off	Suspected plants should be carefully dug and washed, because pulling plants may leave tissues with characteristic symptoms in the soil. Improve soil drainage. Monitoring: The base and stalk of each crop should be routinely checked, especially in areas with poor water drainage.	Sulfur (Crystal Sulfox 720)	Mefenoxam (Ridomil Gold) , Mancozeb (Dithane
	Southern Tobacco flea beetle	Consider planting trap crop (i.e. Chinese Southern Giant Mustard) in appropriate growing climates (every 50m per row)	<i>Saccharopolyspora spinosa</i> (Spinosad, Entrust)	Thiamethoxam (Actara 240) Permethrin

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		Covering the crop with gauze or mesh can reduce beetle populations. White or yellow sticky traps. Destroy/remove and/or use as feed all crop residues Monitoring: Monitoring should begin as soon as crops are planted with particular attention paid to the field perimeter. Sample the crop in groups of ten. Action should be taken if there are more than 40 beetles within each group of ten plants.		(Pounce 25 WP)
Flowers	Crown gall disease (roses, chrysanthemums, ornamentals)	Disease free planting stock ; Sanitation of nursery planting equipment, tools and shoes with a bleach solution to prevent disease spread; Removal of infected plants, roots and soils; In areas with infested soils, rotation to a non-susceptible plant, such as grasses, or an solarization (with a double insulation layer) will also provide good control.	2,4 xlenol + meta cresol (Gallex), <i>Agro-bacterium radiobacter</i> (Galtrol, No-Gall)	
	Growth inhibitors	PGRs are not substitutes for good cultural practices and growing techniques.	Cycocel (chlormequat chloride)	Floreel (Ethephon phosphonic acid), Bonzi (paclobutrazol), Sumagic (Uniconazole)
	Growth promoters		Gibberellic acid (Fascination, ProGibb T&O) or N6-Benzyl-adenine	

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
			(Configure)	
Lettuce and Spinach	Fusarium yellows	Clean all farm equipment after use. Monitoring: In seedlings observe red or brown coloration. In older plants, check for yellow leaves and development of tipburn. Plants may be stunted and fail to form heads.	Fludioxonil+mefenoxam/ metalaxyl-m (Maxim XL) Organic acids Biolife 20 SL	Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)
	Aphids, Caterpillars	See general pest controls		
Mango	Mango scales	Pruning Maintain adequate space between plants Monitoring: Scales are cyclical pests that only require intervention every 5-10 years. Minor occurrences of scales can be tolerated. Monitor for newly settled scales and apply natural oils as soon as possible after a major hatch.	Natural soaps (M-pede) and oil (Omni-oil)	Carbaryl (Sevin WSP)
	Cercospora	Remove infected plant material. Provide adequate distance between plants. Monitoring: Monitor fruit for infection with cercospora and intervene when disease levels reach economically damaging levels. Apply preventative applications of Sulfur when conditions favor disease.	Sulfur (Crystal Sulflox 720) Organic acids (Biolife 20 SL)	Mefenoxam (Ridomil Gold)
	Fruit flies	Remove rotten fruit Place lightweight netting over trees		<i>Saccharopolyspora spinosa</i> (Spinosaad

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		Monitoring: Monitor fruit fly populations using traps, if monitoring is done during consecutive years then economically damaging fruit fly levels, that justify intervention, can begin to be defined. Preventative foliar applications are necessary until systematic monitoring has been carried out to determine annual fluctuations in fruit fly populations.		GF 120, Entrust)
	Green stink bugs	Tilling fields significantly reduces stink bug population by removing all host foliage. Destroy all weeds and possible hosts such as legumes and mustards.		Thiamethoxam (Actara 240)
Melon	Downy mildew, <i>Phytophthora</i> fruit rots	Use resistant varieties. Rotate with non-host crops to prevent buildup of soil-borne pathogens. Use clean disease free seed. Plant in well-drained soil, lightening texture with incorporation of mature compost can improve drainage. Orient rows parallel to the direction of the prevailing wind for more air circulation that can help dry leaves faster. Plow under, or otherwise dispatch of infected crop residue after harvest.	Mancozeb (Dithane), fosetyl-al (Aliette) -some suppressive activity)	
Okra	Damping off	Remove infected plant material. Ensure adequate drainage. Monitoring: The base and stalk of each crop should be routinely checked, especially in areas with poor water drainage.	Sulfur (Crystal Sulflox 720)	Mefenoxam (Ridomil Gold) , Mancozeb (Dithane)
	Green stink bugs	Destroy all weeds and excess plant material. Tilling Monitoring: Regular field scouting before planting and crop		Thiamethoxam (Actara 240 SC)

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
		emergence is recommended.		
	Potato Aphid	See general pest controls above		
Onion, Leeks and Shallots	Pythium root rot	Plant in raised beds Improve soil drainage Use drip irrigation where feasible. Monitoring: Pythium is difficult to control once root rot has begun. Treatment should be based on whether preventative measures such as soil treatment were taken, and previous history of Pythium	Sulfur Dust (Crystal Sulflox 720) Organic acids (Biolife 20 SL) Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)	Mefenoxam (Ridomil Gold) , Mancozeb (Dithane)
	Thrips	Till and remove weeds from fields pre-planting Avoid planting near grain fields Destroy/remove and/or use as feed all crop residues. Monitoring:	Neem Oil (Agroneem)	Chlorpyrifos (Lorsban 75 WG)
	Onion Smut	Use nursery grown seedlings Remove and destroy all infected plant matter. Monitoring:	Thiram (Thiram) and Fludioxonil+metalaxyl-m (Maxim) -seed treatments	
Papaya	Papaya fruit fly	Remove rotten fruit Place lightweight netting over trees Monitoring: Monitor fruit fly populations using traps, if monitoring is done during consecutive years then economically damaging fruit fly levels that justify	Sulfur (Crystal Sulflox 720)	<i>Saccharopolyspora spinosa</i> (Spinosad GF 120, Entrust)

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
		intervention, can begin to be defined. Preventative foliar applications are necessary until systematic monitoring has been carried out to determine annual fluctuations in fruit fly populations.		
	Papaya Ringspot Virus (PRV)	PRV resistant varieties Green peach and melon aphid control Rogue infected plants	See aphid controls	
Peanut	Nematodes	Avoid planting in fields previously planted with sweet potato or yam Incorporate organic material and/or jatropha seed cakes into soil Rotate with nematode suppressing crops, i.e. cereal crops, jatropha. Monitoring: When sampling nematode populations it is best to take root and soil samples. Samples should not be taken when the soil is very dry or very wet.	Incorporate Neem or Jatropha seedcakes into soils Neem ((Agroneem) <i>Bacillus firmus</i> (Chancellor SC)	
	Ants	The reduction of aphids and whiteflies will discourage ants, who are attracted by the excretion of honeydew.	Apply the following mixture: 2 tbsp dish washing soap, 2 tsp vegetable oil, 2 tbsp salt a few drops of vinegar and 4 liters of water. Zohar	Permethrin (Pounce 25)
	Leafhoppers	Remove garbage and debris from the field. Floating row covers can be effective if population is not too	A mixture of 100 grams of chopped garlic with 10	Thiamethoxam (Actara 240)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)		<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		large. Monitoring: Leafhoppers can be found primarily on the underside of leaves. Plants affected by the leafhopper often become curled in one direction and covered with a yellowish rash.		liters of water can be applied.	
Peppers	Caterpillars, whiteflies and aphids	See general pest controls above			
	Green Stink bugs	Tilling fields significantly reduces stink bug population by removing all host foliage. Destroy all weeds and possible hosts such as legumes and mustards. Monitoring: Regular field scouting before planting and crop emergence is recommended.			Thiamethoxam (Actara) Carbaryl (Sevin)
	Fusarium yellows/wilt	Clean all farm equipment regularly to reduce the risk of spreading the fungus.	Fludioxonil + metalaxyl-m (Maxim XL) - seed treatments Organic acids (Biolife 20 SL)		Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)
	Nematodes	Avoid planting in fields previously planted with sweet potato or yam Incorporate organic material and/or jatropha seed cakes into soil Rotate with nematode suppressing crops, i.e. cereal crops, jatropha. Monitoring: To make management decisions, it is important to know which nematode species are present. If a previous crop had problems caused by nematodes that are also listed as pests of bell pepper or other solanaceous vegetables, population levels may be high enough to cause damage to subsequent crops. If			

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
		<p>nematode species have not previously been identified, take soil samples and send them to a diagnostic laboratory for identification.</p> <p>Take soil samples soon after harvest or preferably just before harvest, within the root zone of the previous crop. Divide the field into sampling blocks of not more than five acres each that represent cropping history, crop injury, or soil texture. Take several subsamples randomly from a block, mix them thoroughly, and make a composite sample of about 1 quart (1 liter) for each block.</p> <p>Place root systems of suspect plants into plastic bags with soil. Place soil samples in separate plastic bags, seal them, and place a label on the outside with your name, address, location, the current or previous crop, and the crop you intend to grow. Keep samples cool (do not freeze), and transport as soon as possible to a diagnostic laboratory. Contact your Farm Advisor to help you find a laboratory for extracting and identifying nematodes, and for help in interpreting sample results.</p> <p>Reduced Risk Controls (Option 2) Incorporate Neem or Jatropha seedcakes into soils Neem, azadirachtin (Agroneem) <i>Bacillus firmus</i> (Chancellor SC)</p>		
	Red/ Two spotted spider mite	<p>Damaged foliage should be removed.</p> <p>Dust in the crop field should be reduced.</p> <p>Water-stressed plants stimulate spider mite outbreaks</p> <p>Crop should be properly irrigated. Sprinkler irrigation has been known to suppress spider mites.</p> <p>Monitoring: Leaves should be frequently checked for bronzing and defoliation.</p>	<p>Sulfur (Crystal Sulfox 720)</p> <p>Insecticidal soaps (M-pede)</p> <p>Horticultural oils (Omni-oil)</p> <p>Tetronic acids, spiromesifen (Oberon 2SC), spiroticlofen (Envidor 2SC)</p> <p>Yellow sticky traps</p>	<p>Dicofol (Dicofol)</p> <p>Dimethoate (Dimethoate 2.0)</p>

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
Pigeon Pea	Black legume aphid	See general pest controls above		
Pineapple	Ants	Reduction of aphids and whiteflies Monitoring: Pineapple trees should be monitored in the spring or whenever honeydew-producing insects, such as aphids are expected to appear. The underside of ants descending the pineapple trees should be checked. If the abdomen is swollen, this indentifies them as a species that collects honeydew.	Soap mixture (M-pede)	Carbaryl (Sevin WSP) , Chlorpyrifos (Lorsban 4E)
Potato	Powdery Mildew	Avoid over-crowding Orient rows in same direction as prevailing winds Good weed management Disc fields after harvest Monitoring: Begin monitoring early in the season. Chemical treatment is not warranted unless infection occurs very early in the season. Check leaf surfaces often especially among older plants and areas of the field with poor air circulation. Unlike most fungi, powdery mildew does not require accumulated moisture on the plant in order to grow.	Sulfur (Crystal Sulflox 720)	Pyraclostrobin (Cabrio EG), Mefenoxam (Ridomil Gold) , Mancozeb (Dithane)
	Late Blight	Avoid over-crowding Good weed management Monitoring: Late blight monitoring should occur throughout the growing season and during storage, and especially from post-emergence to harvest. Temperatures below 78o F, humidity levels above 90% and free moisture on foliage for	Sulfur (Crystal Sulflox 720)	Pyraclostrobin (Cabrio EG), Mefenoxam (Ridomil Gold) , Mancozeb (Dithane)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		8-12 hour periods are favorable for late blight development. When weather forecast favors disease, a preventative treatment may be necessary. Treat when signs of late blight on stems or foliage appear.		
	Silver scurf	Use of resistant varieties and non-damaged, non-infested seed; Planting schedules according to crop forecasts (delaying if conditions are optimum for fungal disease development); Good drainage and air circulation of greenhouses, fields, and storage facilities; Post-harvest removal, use for animal feed or burial of all crop residues. Do not store early generation seed tubers in the same storage as later-generation seed tubers. Do not repeatedly enter storages over a long period of time and do not begin to remove tubers without completely emptying the storage.	Fludioxonil+mancozeb (Maxim MZ)	
	Nematodes	Avoid planting in fields previously planted with sweet potato or yam Incorporate organic material and/or jatropha seed cakes into soil Rotate with nematode suppressing crops, i.e. cereal crops, jatropha. Monitoring: Take soil samples in fall from within the root zone of the previous crop after harvest or, preferably, just before harvest.	Incorporate Neem or Jatropha seedcakes into soils Neem (Agroneem) <i>Bacillus firmus</i> (Chancellor SC)	
	Crickets	Manual removal		Thiamethoxam

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
		Chickens can be effective in reducing grasshopper populations as long as they don't damage the crop. Monitoring: Treatment is usually necessary if 15 or more nymphs or 8 or more adults are found in one square yard. If crop is stressed do to drought etc., treatment may be needed when lesser populations are present.		(Actara 240), Dimethoate (Dimethoate 2.67)
Rice	Birds	Coating rice seed with clay to make more difficult for birds to handle once planted and seed is muddied; Seed treated with fungicide can also repel birds; Provision of alternative food sources during times of particularly high bird crop damage; Scare crows; Sprays of insecticide to reduce insect populations that attract birds; Diluted sprays of copper fungicides that lead to detectible copper residues that birds associate with physiological effects from copper toxicity;		Methyl anthranilate (Rejex-it)
	Grassy weeds (i.e. itch grass, johnsongrass, Bermuda grass)	Use cover crops such as legumes, Inter-cropping with corn, post-harvest flooding, crop rotation, the use of stale seed beds, solarisation, crop spacing to increase shading, use of mechanical weeding tools (i.e. hula-hoe), and flame-weeding.	fluazifop-p-butyl and glyphosate (Glysell)-burn down treatment pendimethalin (Pendimax), bispiribac-sodium (Regiment), fenoxaprop-p-ethyl (Ricestar), cyhaliofop-butyl (Clincher), thiobencarb (Bolero)	
	Broad leaf weeds and sedges (i.e. cheese weed, morning glory, stork's bill, yellow	Use cover crops such as legumes, Inter-cropping with corn, post-harvest flooding, crop rotation, the use of stale seed beds, solarisation, crop spacing to increase shading, use of mechanical weeding tools (i.e. hula-hoe), and flame-weeding.	2, 4-D (Amine 4), carfentrazone-ethyl (Aim 50), halosulfuron-methyl (Sanda), bentazon (Basagran), pendimethalin (Pendimax), Propanil (Stam), triclopyr (Grandstand), sodium chlorate (Drexel), thiobencarb (Bolero),	

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
	nutsedge)			
	Rice water weevil	Effective weed management Drill seeding Monitoring: Treatment decisions for the water weevil should be based on past history of a particular field, proximity to weevil overwintering sites (ditch banks, riparian areas, weedy canal banks, etc.) and economics. A floating barrier trap can be used and placed in fields immediately after flooding. If one rice water weevil adult per trap per day is collected during the first 7 days after flooding, damaging larval populations will likely develop and a post-flood insecticide application should be considered.		Ethofenprox (Trebon 3G) Foliar application
	Green stink bug	Destroy all weeds and possible hosts such as legumes and mustards.		Thiamethoxam (Actara 240)
	Rice stem stink bug	Plow the field after harvest to kill lingering bugs. Flood to 15 cm to drown eggs Space rows of rice wide apart to allow more sunlight to penetrate to base of plant	Buprofezin (Applaud)	
	Planthoppers, leafhoppers	The use of planthopper resistant varieties, as they become available, is the most effective control. Avoid long maturing rice varieties. Plant early in the growing season to escape pest buildup and neighboring farmers should plant within three weeks of each other. Use selective insecticides against other pests so as to conserve natural enemies. Practice good weed management, leafhoppers infestations have been correlated to weedy fields.	Buprofezin (Applaud)	Thiamethoxam (Actara 240)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		Monitoring: Observe fields weekly from July through August for leafhoppers and their damage. Leaf yellowing and stippling can be associated with other stresses, so always check for the presence of leafhoppers. Leafhopper adults, nymphs, and molted skins are easy to see as you walk slowly through a field. Always inspect fields carefully after broadleaf herbicide treatment; the killing of broadleaf weeds may cause the leafhoppers to move from the dying weeds to the rice plants. Although there are no available treatment thresholds, a good rule of thumb is to treat when young upper leaves become infested and begin to dry.		
	Leaf miner, leaf roller	Providing adequate nutrition to the crop will increase its tolerance of the pest damage. Infestations must be quite severe to necessitate use of controls, as the damage to plants is quite minimal due to the small size of the leafminer. Monitoring: Begin monitoring 2 to 4 weeks after planting, just after most of the rice plants have emerged from beneath the water and the leaves are lying on the water surface. Use a monitoring ring or floating plastic tubing 1 square foot in diameter. Take ten, 1-square-foot samples in a transect of the field or field. Check the plants within the ring for unhatched leafminer eggs on upper leaf surfaces. Unhatched eggs are opaque, while hatched eggs are clear and flat. Also check for larvae of all instars; second and third instar larvae are the easiest to detect because you can	Spray <i>Saccharopolyspora spinosa</i> (Spinosad, Entrust, Spinetoram)	

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		feel the swelling they cause in the leaf.		
	Stem rot and sheath spot	Select most resistant varieties available Avoid overly dense rice stands Do not over fertilize, excess nitrogen fertilization increases stem rot Monitoring: After tilling, examine tillers weekly for presence and progress of aggregate sheath spot lesions in several locations throughout paddies. If lesions are approaching the flag leaf sheath or the leaf sheath below the flag leaf, a treatment may be justified. Treat before lesions spread to the leaf sheath on the leaf below the flag leaf. Crop growth stage should also be considered before treating, lesions represent a graver risk to yields if approaching flag leaf before flowering than after flowering. Chemical treatments for sheath rot have been found not to be economically beneficial.		Azoxystrobin (Quadris) Mancozeb (Dithane)
Sorghum	Sorghum Midge	Coordination of planting calendars Early planting or delayed planting depending on the sorghum midge life cycle Destruction of host weeds such as johnsongrass Monitoring: Monitoring for sorghum midge adults should begin when 25% of the field begins to bloom. Sorghum heads on field edges can be inspected in the morning when winds are low by slowly approaching the plant and placing a plastic bag over the head and shaking vigorously – adult midges can then be counted. An average of more than 1 adult per head is considered the threshold level for economic damage. Inspection during the flowering period should occur every 2 to 3 days until the soft dough stage. Applications of insecticide for sorghum midge control are	Neem Oil (Agroneem)	Carbaryl (Sevin) Chlorpyrifos (Lorsban 75 WG)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
		generally not considered cost-effective because only the adult stage is susceptible - once the larvae are inside the heads, insecticides are ineffective. Any insecticide applications must be well-timed during the adult stage. Cultural controls and well-coordinated planting calendars are the most effective long-term measures to reduce sorghum midge populations.		
Stored grains	Beetles, Granary and rice weevils	Sanitation and humidity controls of storage areas and containers Improved storage structures, hermetic bags, insect proof containers (triple bagging) Sort grains prior to storage and remove broken kernels and foreign materials Do not overfill bins and silos Monitoring: Stored grain should be monitored carefully every 2-4 weeks and samples taken from grain at bottom and top of storage bins. 1 pint / 1000 bushels of grain should be measured.	Incorporation of wood ash Diatomaceous earth (Insecto)	Primiphose-methyl (Actellic 5e) (direct application only on stored seed)
	Rats	Improved sanitation Eliminate habitats and water sources (leaky pipes, etc.) Wooden snap traps can be placed both indoors and outdoors.	Kaput (warfarin) (ok for outdoor use and indoor/building exteriors for food storage or processing areas)	Rozol (chlorophacinone- for outdoor and indoor uses for food storage or processing areas) Kle Rat (brodifacoum)-

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
				indoor food storage or processing areas
Sugar Cane	Ants	Tilling Reduction of plant material, aphids and whiteflies.	Soap mixture (M-pede, Zohar)	Chlorpyrifos (Lorsban 75 WG)
Sweet potato	Sweet potato weevil	Destroy potential host weeds (i.e. morning glory) Use cutting no longer than 30cm Fill in or cover cracks in earth caused by root growth Remove/use for feed all tubers roots and plant debris post-harvest Monitoring: Monitoring should take place during propagation and the entire growth cycle. Pheromone traps are very useful in monitoring adult populations, as growers don't usually catch new infestations until harvest. Chemical treatments for the sweet potato weevil generally are not effective since larvae live within tubers. If found in propagation beds, dip cuttings in an insecticide solution before transplanting. Strict cultural practices are currently the most effective measures against SPW.	Cylas pheromone traps	Thiamethoxam (Actara) Carbaryl (Sevin) (cutting treatment)
	White Grubs	Avoid fields previous planted with sweet potato or used for pastureland Destroy/remove or use all crop residues for feed Monitoring: Monitor vegetative growth for signs of adults or adult damage (notches on leaf edges) and record infestation levels of harvested sweet potatoes. Preventative treatments are most effective, especially	Milk y spore (Bacillus popillae)	Imidacloprid (Admire, Gaucho 600, Imidacloprid 2 FC)

Crop	Pest	Non-Chemical Control Method (Option 1)	Reduced- Risk Controls (Option 2)	Chemical Controls ⁴⁷ (Option 3)
		biological controls which can give good long-term control with as little as one application.		
	Nematodes	Avoid planting in fields previously planted with sweet potato or yam Incorporate organic material and/or jatropha seed cakes into soil Rotate with nematode suppressing crops, i.e. cereal crops, jatropha. Monitoring: Soil testing to determine what species of pathogenic nematodes are present is recommended if nematode symptoms are present. Close inspection of roots at harvest should occur to determine whether an infestation occurred and how severe it was. Growers should also watch for above-ground symptoms and make decisions on future growing seasons as necessary. Prevention is the safest and most effective long-term option for nematode control. The above-mentioned cultural practices should be followed, in addition to the use of green manures or organic soil amendments.	Incorporate Neem or Jatropha seedcakes into soils Neem (Agroneem) <i>Bacillus firmus</i> (Chancellor SC)	
Swiss Chard	Caterpillars, Whiteflies and aphids	See general pest controls		
	Damping-Off	Plant in raised beds in soils with good drainage Do not over water/irrigate Remove and use for feed or bury infected plant material, if buried soil will have to be treated prior to next planting	Sulfur (Crystal Sulflox 720)	Mefenoxam (Ridomil Gold EC) , Mancozeb (Dithane)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		<p>Monitoring: Both Pythium and Rhizoctonia are difficult to control once infection has happened. Treatment should be based on whether preventative measures such as soil treatment were taken, and previous history of Pythium or Rhizoctonia.</p> <p>The base and stalk of each crop should be routinely checked, especially in areas with poor water drainage.</p>		
Tomato	Caterpillars, Whiteflies and aphids	See general pest controls		
	Late Blight	<p>Select resistant varieties</p> <p>Avoid wetting foliage when irrigating</p> <p>Proper spacing and staking of plants</p> <p>Apply fertilizer at planting</p> <p>Destroy any infected plants by burning; Remove or use for feed all remnants of plant matter from field.</p> <p>Monitoring: When severe symptoms appear it is often too late to treat. History of late blight in the field. Weather conditions favorable for late blight development. A protective treatment should be applied before disease development begins; once an outbreak occurs it is necessary to apply additional applications at regular intervals. Resistance development is a concern; fungicides with different modes of action should be rotated to avoid resistance buildup.</p>	Sulfur (Crystal Sulfox 720) Copper compounds copper oxychloride (Badge SC), copper hydroxide (Kocide 4.5 L), copper sulfate pentahydrate (Phyton-016-b)	Mefenoxam (Ridomil Gold EC) , Mancozeb (Dithane)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
	Mildew	Plant rows in direction of prevailing winds Avoid overcrowding of plants Do not apply excess fertilizer Till fields post harvest Monitoring: Fungicides are not needed for control unless the disease becomes extensive or appears very early in the season. If you see early symptoms, check weekly to monitor the progression of the disease.	Sulfur (Crystal Sulflox 720)	Mefenoxam (Ridomil Gold EC) , Mancozeb (Dithane)
	Green stink bugs	Destroy weeds pre-planting Fully cover planted seeds Early planting Till fields post harvest Monitoring: Regular field scouting before planting and crop emergence is recommended.		Thiamethoxam (Actara) , Carbaryl (Sevin)
	Tomato Yellow Leaf Curl Virus (TYLCV)	Manage whiteflies Select resistant varieties Maintain fields weed free Avoid rotating with whitefly or TYLCV hosts Monitoring: Starting after emergence, check field margins for virus, which are usually infested first. When nearby host crops are in decline, monitor twice per week for rapid population buildup. If field margins are areas of concern but field centers are not highly infested, treat only field margins to allow beneficial insects to survive and control whiteflies.	See controls for whiteflies in general control options	
	Tomato	Maintain host free periods in cropping cycle	<i>Saccharopolyspora</i>	Permethrin

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
	pinworm	<p>Destroy/remove or use crop residues for feed</p> <p>Monitoring: Set out pheromone traps at planting. Use one trap for each 10 acres but no fewer than two traps per field. Also place one trap containing no lure as a check on the effectiveness of the pheromone lures. Distribute traps throughout the field. Check traps and remove any trapped moths twice a week from planting to harvest. When you begin trapping pinworm adults, start monitoring foliage for larvae.</p> <p>To survey the foliage, carefully check for mines and folded leaf shelters on all foliage in several sections of row, each 6 feet long, chosen at random throughout the field; record the average number of larvae per row section. Conduct the first survey as soon as seedlings are well established; continue checking weekly until it is necessary to begin treatments. A provisional guideline is to treat when you count an average of 1 to 2 larvae per row section. Also check for parasitization.</p> <p>If pinworm populations reach damaging levels, the narrow-spectrum insecticide abamectin can be used. If broad-spectrum insecticide materials are used, it usually is necessary to continue treating throughout the season until final harvest. The time between treatments depends on population levels. Several materials used to control tomato</p>	<i>spinosa</i> (Entrust, Spinosad)	(Pounce 25 WP)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
		pinworm kill parasites of leafminer, so repeated applications often cause leafminer outbreaks.		
	Red/ Two spotted spider mite	Damaged foliage should be removed. Dust in the crop field should be reduced. Water-stressed plants stimulate spider mite outbreaks Crop should be properly irrigated. Sprinkler irrigation has been known to suppress spider mites. Monitoring: Leaves should be frequently checked for bronzing, defoliation.	Sulfur (Crystal Sulfox 720) Insecticidal soaps (M-pede) Horticultural oils (Omni-oil) Tetronic acids, spiromesifen (Oberon 2SC), spiroadiclofen (Envidor 2SC) Yellow sticky traps	Dicofol (Dicofol 4E) Dimethoate (Dime 2.67)
Yam	White Grubs	Avoid fields previous planted with sweet potato or used for pastureland Destroy all crop residues Monitoring: Monitor vegetative growth for signs of adults or adult damage (notches on leaf edges) and record infestation levels of harvested sweet potatoes. Preventative treatments are most effective, especially biological controls which can give good long-term control with as little as one application.	Milky spore (<i>Bacillus popillae</i>)	Imidaclopride (Gaucho 600, Admire Imidacloprid 2 FC)
	Storage rots	Sanitation and humidity controls in storage areas Gentle handling to avoid damage to tubers Cure yams in sunlight and high humidity	Lime, chalk or wood ash dusted on tubers	Mefenoxam (Ridomil Gold EC), Mancozeb (Dithane)

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)		<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u> ⁴⁷ (Option 3)
	Nematode	Avoid planting in fields previously planted with sweet potato or yam Incorporate organic material and/or jatropha seed cakes into soil Rotate with nematode suppressing crops, i.e. cereal crops, jatropha. Monitoring: Soil testing to determine what species of pathogenic nematodes are present is recommended if nematode symptoms are present. Close inspection of roots at harvest should occur to determine whether an infestation occurred and how severe it was. Growers should also watch for above-ground symptoms and make decisions on future growing seasons as necessary. Prevention is the safest and most effective long-term option for nematode control. The above-mentioned cultural practices should be followed, in addition to the use of green manures or organic soil amendments.		Incorporate Neem or Jatropha seedcakes into soils Neem (Agroneem) <i>Bacillus firmus</i> (Chancellor SC)	
	Root Borer	At planting completely cover yam seed to prevent egg laying on seed. Harvest yams as soon after they have ripened as possible. Monitoring: Adults are attracted to freshly cut plant material and population estimates can easily be made using traps consisting of these plant parts.			Imidacloprid (Gaucho 600, Admire Imidacloprid 2 FC)
Livestock: Cattle, Goat Sheep, Pig, Avian	External parasites: face flies, ear worms	Livestock nutrition Apply a thin coat of vegetable oil to suffocate insects Garlic powder can be used as a topical treatment and incorporated into feed Clean and elevate food and water receptacles		Rub 2 to 3 handfuls of sulfur along the animal's spine Several studies have shown that the use of Insecto (diatomaceous earth) has	Albendazole (Valbazen) Ectoban De-lice Pour-on , Carbaryl (Sevin 85 WP) - for ear worms

Crop	Pest	<u>Non-Chemical Control Method</u> (Option 1)	<u>Reduced- Risk Controls</u> (Option 2)	<u>Chemical Controls</u>⁴⁷ (Option 3)
Food processing sites/buildings		Maintain dung beetle populations Leave the field fallow for 12 months or rotate with crops.	reduced larvae	
	Internal parasites: roundworms, tapeworms, stomach, lung and intestinal worms	Livestock nutrition Clean and elevate food and water receptacles Maintain dung beetle populations Leave the field fallow for 12 months or rotate with crops.	The feeding of garlic can reduce internal parasite counts	Albendazole (Velbazen)
	Rats	Improved sanitation Eliminate habitats and water sources (leaky pipes, etc.) Wooden snap traps can be placed both indoors and outdoors.	Kaput (warfarin) (ok for outdoor use and indoor/building exteriors for food storage or processing areas)	Rozol (chlorophacinone) (ok for outdoor use and indoor/building exterior for food storage or processing areas)

II. Amendment Methodology

The methodology for this “Proposed Amendment to the MWP” (AMWP) uses the same technical approach and data collection activities as were implemented in the research and analysis for the MWP. This amendment also builds upon the substantial field work completed during the development of the MWP and makes use of many of the MWP findings concerning target farmers pest management and pesticide knowledge, attitudes, and practices. The approach for the AMWP was more limited in terms of scope and dedicated time. A total of approximately **64 person days** contributed to the completion of the document.

During development of this AMWP **14 days** of total field work took place intermittently during three different sets of field visits beginning in November 2011 and ending in June of 2012.

November 2011: Issue identification field work (5 days)-

- Bas Boen
 - o Interviews with WINNER agronomist, lab and CRDD staff
 - o Visiting surrounding BIAs (boutiques de intrants) in Bas Boen
- WINNER HQ interviews with key program management stakeholders

April 2012: Surveys targeting AMWP pest management issues (5 days)-

- Bas Boen:
 - o Interview with WINNER agronomists
- Kenscoff :
 - o Interviews with regional CRDD director, managers, agronomists and demonstration plot staff.
- Montrouis:
 - o Interviews with regional CRDD manager and master farmers
- Met with Roosevelt at HQ

May 2012: Duvier site visit for AMWP pest management issues (1 day)-

- Duvier
 - o Interviews with regional CRDD director, managers, agronomists and demonstration plot staff.

June-July 2012: Kenscoff and Duvier Agronomist Surveys, Boutique de Intrants (Input supply stores) and Pesticide Regulator field work (3 days)

- 3 AMWP written surveys were completed by the Bas Boen, Kenscoff and Duvier CRDD managers and agronomists.
- Port au Prince BIAs:

- Interviewed management and agronomist staff at these stores
- Port au Prince: MANDR Direction of Plant Protection (DPV) and College of Agriculture (FAMV) interviews:
 - Interviews with Guito Laureore, Director of DPV/MARNDR (Direction de la Protection des Vegetaux)
 - Interview with Jackson Donis, IPM Professor at the Haitian College of Agronomy and Veterinary Medicine (Faculte d' Agronomie et de Medecine Veterinaire d'Haiti, FAMV)

In all cases the interviews involved semi-structured discussions. In the November surveys a longer structure set of interview questions and discussion areas were used for semi-structure focus group and individual interviews.

A total of **10 days** were spent on desk review of current, to date, EPA pesticide Registration Eligibility Documents (REDs), existing scholarly and reference databases on pesticide toxicities, pest control and integrated pest management extension research and guidance (See Annex 2: Bibliography) were carried out in the preparation of the AMWP. An additional **20 days** were dedicated to the drafting and **20 days** revision process in collaboration with WINNER stakeholders.

A. Amendment Analysis

The AMWP methodology prioritizes finding and promoting the use of Integrated Pest Management (IPM) solutions that pose the lowest toxicity risks to both humans and the environment. This general screening criteria was also used for the purposes of the MWP and is still appropriate. Pesticides are thoroughly screened according to the USAID PERSUAP and Pesticide Procedures and 22 CFR 216 regulatory requirements.

Twelve mandated concerns stipulated in 22 CFR 216 labeled 'a' through 'i' are required to be analyzed in the Pesticide Evaluation Report:

a) USEPA registration and label restrictions including RUP or GUP; b) Basis for selection and proposed use of the pesticide product and active ingredient by the WINNER program; c) Extent to which the proposed pesticides can be promoted as part of an IPM strategy; d) Proposed method of application including necessary safety precautions, personal protective equipment required for handling and use⁴⁸; e) Acute and chronic toxicological hazards, either human, livestock, or environmental,

⁴⁸ **USE**:** Pesticide product use, for the purposes of the required personal protective equipment (PPE), can be defined as including all activities such as the handling, loading, mixing, and application of any plant growth regulator, insecticide, fungicide, or fumigant included in the PERSUAP.

associated with the proposed use, and measures available to minimize such hazards; f) Effectiveness of the requested pesticide for the proposed use; g) Compatibility of the proposed pesticide use with target and non-target organisms; h) Environmental conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils; i) Availability of other pesticides or non-chemical control methods.

The nine topics listed above, **A-I**, are presented in tables for each recommended pesticide within **Section III: Pesticide Evaluation Report Elements a-i**.

Additionally, the remaining four concerns, **J-L**, are found in **Section IV: Pesticide Evaluation Report Elements J-L**. This section includes relevant information and analysis from the MWP concerning; **J) Host country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide; K) Provision for training of users and applicators, and L) Methodology to monitor the use and efficacy of the pesticide**. The corresponding aspects of the analysis are covered in this general section as information contained in these sections is not specific to any particular pesticide, but deals with the national policy context and programmatic aspects of WINNER's pesticide management approach.

The screening process is designed to promote the transition from the use of the following types of chemical products: EPA Banned/Severely Restricted Pesticides, POPs (Persistent Organic Pollutants) PIC Prior Informed Consent Chemicals and PAN 'Dirty Dozen' pesticides. Certain chemicals proposed for use by the WINNER program were determined to present higher than acceptable risks to users, farm families and non-target organisms and ecosystems to be justified by this level of analysis. In other cases the use of a class I product has been recommended based on a lack of less toxic alternative available or due to the severity of pest infestation or economic significance of potential crop losses.

B. Scope and Limitations

This Amendment to the Mission-wide PERSUAP (MWP) has been supported by a wide range of in-country and international expertise in agronomy, entomology, plant pathology, pest management, agricultural development and extension, as well as in environmental management and compliance. None the less, given the lack of well-established agricultural extensions and research centers in Haiti, the analysis has had to rely in large part on anecdotal pest identification from experienced agronomists, FAMV College of Agriculture, and MARNDR staff contacted during field visits to WINNER project offices and intervention areas. Several pest identification clues were found during field visits and were also extrapolated from existing pest management literature from Haiti and Dominican Republic. Some pests also lend themselves to identification more easily than others. Experience has shown that farmers and

extensionists alike often have a biased focus on the larger and more visible pests that are easier to identify, such as stink bugs, rats, caterpillars, etc. This bias should also be considered as potentially relevant to the findings presented here.

The recommended controls are based on both local agronomist's, MARNDR, and other local expert knowledge, as well as international crop research centers, USDA, and University of California, Davis, Michigan, and Florida agricultural extension and agronomist experience, research study findings, and the considerable collection of IPM databases available online. Many controls are not currently, or only recently available, to Haitian farmers. Their lack of familiarity with these novel products should not be underappreciated. Many of these control techniques and products have not been tested under local conditions in Haiti and their efficacy cannot be assured until they have been. WINNER should set up testing stations, as is possible within their programmatic priorities, in order to familiarize farmers with the use of these control options. Demonstration plots presenting these control options and products should only be established once smaller scale experimentation has produced favorable results under local conditions and given farmer capacities. The PERSUAP analysis is not a guarantee of the efficacy of the recommended pest management options under local conditions in Haiti. The PERSUAP is instead quite simply a comparative analysis and compilation of the control options, both non-chemical and chemical, that can be anticipated as safely implemented given the level of knowledge of target WINNER farmers.

III. Pesticide Evaluation Report Elements A-I

A. Acaricides

Three additional miticides (Envidor, Oberon and Dicofol) are recommended by this amendment, in addition to the controls currently recommended in the Mission-Wide PERSUAP (MWP). These controls can be used in the management of mites in bean, eggplant, tomato, pepper and fruit tree crops (mango, avocado and citrus). The following acaricides were recommended in the MWP: refined paraffinic oil (Omni Oil 6E), potassium salts (M-pede), and dimethoate products. The additional controls proposed by WINENR for inclusion in the amendment are Dicofol (dicofol) and Dursban (chlorpyrifos) to address the low availability of dimethoate products.

Chlorpyrifos (Dursban or Nuphos 4E) is not recommended as an acaricide due to the fact that it is a restricted use pesticide and because there are less toxic controls, as listed above

1. Dicofol 42% EC formulation; common trade name: Dicofol 4E EC
a. US EPA registration status: ACTIVE- EPA REG. NO. 66222-56; for beans, pepper, tomatoes, squash, grapes and citrus.

<p>b. Basis for selection of the pesticide: Dicofol is an organochlorine miticide that is currently available and in use in several parts of the WINNER program target area. Dicofol is proposed for use for mite control in peppers, eggplant, jatropha and cherry crops. These proposed uses correspond closely with the EPA registered uses for dicofol on beans, pepper, tomatoes, squash, grapes and citrus crops in the United States. Dicofol provides activity on several different species of mites including: Twospotted, Pacific, Tomato Russet, Tropical, and Citrus mite species.</p> <p>Dicofol is not a restricted use pesticide and has been classified as a Toxicity Category III product by the EPA. This product is an alternative to dimethoate which is not commonly available in the Haitian market.</p>
<p>c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: Currently in the MWP the following general approach is recommended for mite control in eggplant, tomatoes, peppers and other vegetables.</p> <ul style="list-style-type: none"> • Reduce dust around field; • Good weed management; • Remove all excess plant debris; • Avoid rotating, or planting near, plots with other host crops such as banana, plantain, cassava, cocoa, avocado;
<p>d. Proposed method or methods of application, including the availability of application and safety equipment: Dicofol is available in Haiti in an emulsified concentrate formulation that can be diluted with water and mixed according to the label recommended dosage for target crops and pests. It is registered for application with a backpack sprayer which is the application equipment most commonly employed by Haitian pesticide users.</p> <p>The PPE required for use of dicofol products is as follows:-Coveralls over long sleeve shirt and pants, waterproof gloves, rubber boots plus socks, waterproof headgear if overhead exposure is expected, waterproof apron when cleaning equipment, mixing or loading, or applying as a dip.</p> <p>-For exposure in enclosed areas, use a respirator with either an organic vapor removing cartridge with a pre-filter approved for indoor use, for exposure outdoors, use a dust/mist filtering respirator</p>
<p>e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Dicofol is banned in</p>

the EU, Japan, Romania, Netherlands and Switzerland for toxicity concerns related to user hazards and non-target organism exposure risks because it is an organochlorine.⁴⁹

Dicofol, according to EPA registration documents, received toxicity category III classification for acute oral and dermal toxicity and was shown to be moderately irritating when exposed to the skin or eyes. It has category IV acute inhalation toxicity and it is not a concern for skin sensitization based on lab testing.⁵⁰ Dicofol is an organochlorine relative of DDT that has been put through extensive comparative analysis by manufacturers and the EPA. Dicofol is eliminated from the systems of test animals more quickly than DDT. Dicofol has been classified as a Class C, possible carcinogen. Dicofol is listed by the EPA as having potential for endocrine disruption and other neurotoxic effects based on studies with male rats. Reproductive toxicity was also shown as a relevant concern for exposure to dicofol. Chronic dietary exposure is also a potential concern as dicofol does bio-accumulate overtime in fat and adrenal cells.⁵¹ According to EPA risk analysis, the bio-accumulation and toxicity concerns for dicofol and its derivative substances are nowhere near as great as for the related organochlorines, DDT and DDE.⁵²

Mitigation 1: Spray dosage and frequency should always be made according to the label.⁵³

To minimize exposure to dicofol, non-chemical (sulfur, horticultural/paraffinic oils, and or neem), reduced risk products containing spiromesifen or spiroticlofen, and reduced or lower concentrations of spray solutions of dicofol, should be favored for control of less severe mite pest infestations.

Mitigation 2: WINNER will ensure that beneficiaries are aware of the potential negative developmental, carcinogenic, and neurotoxic effects of exposure to dicofol, and particularly how these effects can affect women of child bearing age and young children. Women of child bearing age should not apply nor enter or work in areas recently (within Restricted Entry Interval (REI)) treated with dicofol products.

Mitigation 3: WINNER will promote the use of integrated non-chemical controls and lower toxicity chemical miticides prior to recommending dicofol products as is relevant to the IPM training activities in target intervention areas.

Eco-toxicity concerns for dicofol are as follows: Dicofol is very highly toxic to fish, crustacean, mollusks and aquatic invertebrates (insects).

⁴⁹ "The Rotterdam Convention: Notice of Final Regulatory Action Database." UNEP, FAO. Accessed 6/15/2012, <http://www.pic.int/Default.aspx?tabid=1368>

⁵⁰ "Registration Eligibility Decision: Dicofol." EPA, 11-20.

⁵¹ Ibid.

⁵² "Registration Eligibility Decision: Dicofol." EPA, 74.

Mitigation 4: Dicofol should never be applied directly to surface or coastal waterways or on fields nearby surface waters that contain fish without measures to limit spray drift and runoff. Implement run-off and spray drift mitigation measures such as vegetative barriers and bunds along field adjacent to waterways, spray when conditions do not favor spray drift (i.e. early morning or other low wind periods), and do not wash sprayers or throw rinseate near bodies of water.

Dicofol is slightly toxic to honeybees and moderately toxic to birds.

Mitigation 5: WINNER will not apply dicofol to crops post flower bloom or when bees are actively foraging. Apply late in the afternoon.

- f. Effectiveness of the requested pesticide for the proposed use:** Dicofol is a widely used miticide in the US for control of mite infestation on several vegetable and fruit crops.

Dicofol resistant mites are a potential concern as resistance development in mite populations is a known issue. Dicofol's mode of action is listed as Unknown by IRAC.

Other acceptable pesticides that can be used to combat similar pests include Sulfur WP, Omni oil 6E/Refined paraffin oils (paraffinic acid), Oberon, Envidor, and Dimethoate. These should be rotated with other miticides of different resistance classification (modes of action) in order to slow resistance development.

Note: The above recommended alternatives have the following resistance classifications: Sulfur, neem, narrow range oils Oberon and Envidor-23, Dicofol-UN (unknown), Dimethoate-1B.⁵⁴

- g. Compatibility of the proposed pesticide use with target and non-target ecosystems:** Dicofol should never be applied directly to surface or coastal waterways or on fields nearby surface waters without measure to limit spray drift and runoff.

- h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils:** Dicofol has a variable half-life depending on local conditions. In testing, half of dicofol residues degraded within 7-57 days, in California studies, and after 113 days in Florida.⁵⁵ Dicofol has shown low mobility and leaching in soil leaching studies and is determined by the EPA to have a low potential risk for leaching into groundwater.⁵⁶

Availability of other pesticides or non-chemical control methods: See element C, for other non-chemical mite control methods. Chemical control products should be recommended from lowest to highest toxicity as is appropriate to provide effective control given the intensity of

⁵⁴ See Mission Wide PERSUAP for pesticide evaluation information for Lorsban and Dimethoate.

⁵⁵ "Registration Eligibility Decision: Dicofol." EPA, 77.

⁵⁶ "Registration Eligibility Decision: Dicofol." EPA, 76.

infestation:

- Sulfur;
- Refined paraffin oils/Omni Oil 6E
- Insecticidal soaps, potassium salts (Zohar, M-pede)
- Envidor
- Dicofol
- Dimethoate 2.6

2. Petroleum oils, paraffin based (petroleum oil 98%) EC formulations- common trade names: Bonide Horticultural and Dormant Spray oils, Omni oil 6E, Safe-t-cide

a. US EPA Registration Status: ACTIVE- EPA REG. NO. 4-80; for control of mites in beans, corn, peppers, tomato, cucurbits and fruit trees.

b. Basis for Selection of proposed pesticide: Paraffin based oils are EPA registered for mite control in beans, corn, peppers, tomato, cucurbits, and fruit tree crops (mango, citrus, avocado), all relevant crops for the WINNER program. Unrefined and mildly refined paraffinic oils are not recommended (such as untreated mineral oil and petroleum extract) because they are Group 1, probable carcinogens, as found by EPA. Refined oils such as those contained in Safe-t-cide/Omni oil 6E, have undergone EPA registration review testing and have been found to be unclassifiable as carcinogens. For this reason refined paraffin oil products are recommended in the AMWP.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: Currently in the MWP the following general approach is recommended to mite control in eggplant, tomatoes, peppers and other vegetables.

- Reduce dust around field;
- Good weed management;
- Remove all excess plant debris;
- Avoid rotating, or planting near, plots with other host crops such as banana, plantain, cassava, cocoa, avocado;

d. Proposed method or methods of application, including the availability of application and safety equipment: Refined paraffin oils are available in soluble and emulsifiable concentrates (SC and EC). They are compatible for application using a backpack sprayer. The dosage should be verified for the target crop and pests according to the label information.

PPE required for use of Omni Oil 6E:

-Waterproof gloves

-Long sleeve shirt and pants

-Shoes plus socks

<p>Users should also: Wash hands before eating, drinking, chewing gum, smoking or using the toilet; Remove clothing immediately if pesticide gets inside, wash thoroughly and put on clean cloths; Remove PPE immediately after use; Wash gloves before removing them; Wash thoroughly and change into clean clothing as soon after use as possible.⁵⁷</p> <p>REI for Omni Oil: 4 hours, PPE, as listed above, is required for early re-entry into treated areas.</p>
<p>e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Paraffin oils have low acute toxicities via all routes of exposure, EPA toxicity class IV for acute oral and inhalation toxicities and class III for acute dermal toxicity and primary eye irritation.</p> <p>No chronic toxicities are of concern for the use of refined paraffin oils.</p> <p>Paraffin oils are potentially harmful to fish and aquatic organisms.</p> <p>Mitigation 1: Paraffin oil based products, or rinseate, should not be disposed of directly into surface waters, intertidal or coastal areas that hold fish.</p> <p>There are no additional eco-toxicity concerns related to the agricultural uses of paraffin oils.</p>
<p>f. Effectiveness of the requested pesticide for the proposed use: Paraffin oils have been found to be effective in suppression of mites, aphids, whiteflies, leafrollers, web worms and other pests in a wide range of crops. Paraffin oils act on contact by forming a coating over insect breathing openings leading to suffocation. Oils can deter insects from feeding and egg-laying on crops.</p>
<p>g. Compatibility of the proposed pesticide use with target and non-target ecosystems: See elements E and H for mitigation to reduce impacts to non-target species and ecosystems.</p>
<p>h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Paraffin oils are potentially harmful to fish and aquatic organisms.</p> <p>Mitigation 1: Paraffin oil based products, or rinseate, should not be disposed of directly into surface waters, intertidal or coastal areas.</p>
<p>Availability of other pesticides or non-chemical control methods: See element C, above for reduced risk and other non-chemical mite control methods. Chemical control products should be recommended from lowest to highest toxicity, as is appropriate, to provide effective control given the intensity of infestation:</p>

⁵⁷ This user note, although not mentioned for every pesticide is standard language included on almost all pesticide labels and, practically speaking, is a good idea to follow whenever working with pesticides.

- Sulfur;
- Refined paraffin oils/Omni Oil 6E
- Insecticidal soaps, potassium salts (Zohar, M-pede)
- Envidor
- Dicofol
- Dimethoate 2.6

3. Spirodiclofen 22.3% SC formulation; common trade name: Envidor 2SC

4. Spiromesifen 23.1% SC formulation; common trade name: Oberon 2 SC

- a. US EPA registration status: ACTIVE, Envidor EPA REG. NO. 264-831 / Oberon EPA REG. NO. 264-719; for mite control of mites and whiteflies in citrus, avocado, mango and vegetables (spinach, lettuce, broccoli, peppers, cantaloupe and cucumbers).**

Basis for selection of the pesticide: Envidor and Oberon are recommended as reduced risk alternative miticides to Dicofol, and Dimethoate.

Envidor is EPA registered and labeled for activity against several important citrus, avocado and mango mite pest species, (i.e. two spotted spider mite, citrus mite, perseia mite and avocado mites). Oberon is intended for mite control in vegetable crops relevant to WINNER's program, such as, bean, tomato, pepper and eggplant crops. Spirodiclofen and spiromesifen are both tetrionic acid derivatives active on contact against mite eggs, all nymphal development stages and adult females. These products have novel modes of action and are particularly appropriate for managing mite resistance. Their activity on various development mite stages also makes them particularly useful in integrated pest management planning for mites.

These products are not widely available nor are farmers accustomed to their use in Haiti. WINNER should, as is feasible based on cost and current mandate, promote these products as important alternatives to organochlorine miticides, such as Dicofol.

- **Extent to which the proposed pesticide use is, or could be, part of an IPM program:** Currently in the MWP the following general approach is recommended for mite control in beans, eggplant, tomatoes, peppers and fruit tree crops (mango, citrus and avocados):
- Reduce dust around field;
- Good weed management;
- Remove all excess plant debris;
- Avoid rotating, or planting near, plots with other host crops such as banana, plantain, cassava, cocoa, avocado;
- Sulfur;
- Refined paraffin oils/Omni Oil 6E
- Insecticidal soaps, potassium salts (Zohar, M-pede)

- Envidor
- Dicofof
- Dimethoate 2.6

d. Proposed method or methods of application, including the availability of application and safety equipment: Envidor and Oberon are both available in soluble and emulsifiable concentrates (SC and EC). They are compatible for application using a backpack sprayer. The dosage applied should be verified for the target crop and pests according to the label information.

PPE required for use of Envidor and Oberon: Waterproof gloves, long sleeve shirt and pants, shoes plus socks.

Users should also: Wash hands before eating, drinking, chewing gum, smoking or using the toilet; Remove clothing immediately if pesticide gets inside, wash thoroughly and put on clean cloths; Remove PPE immediately after use; Wash gloves before removing them; Wash thoroughly and change into clean clothing as soon after use as possible.

REI for Envidor and Oberon: 12 hours, PPE as listed above is required for early re-entry into treated areas.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Spirodiclofen and spiromesifen⁵⁸ have slight acute toxicities through the oral and dermal routes (EPA toxicity class III) as well as slight acute inhalation and eye irritation toxicities (toxicity class IV).⁵⁹

Spirodiclofen has been determined by the EPA to be a likely carcinogen based upon cancerous growths found in male and female test rabbits.⁶⁰

Mitigation 1: WINNER shall make community stakeholders aware of the potential carcinogenic impacts of exposure to Spirodiclofen. Use of all required PPE as listed in element D, above will reduce the exposure risks to levels considered acceptable by the EPA, provided use of labeled doses.

Spirodiclofen is moderately toxic and spiromesifen is slightly toxic to, freshwater fish and aquatic insects. The following mitigations for potential eco-toxicity hazards should be promoted by WINNER:

Mitigation 2: Spirodiclofen and spiromesifen should never be applied directly to surface or coastal

⁵⁸ "Public Report: Spiromesifen." California Department of Pesticide Regulation, 2005. 5.

⁵⁹ EPA Pesticide Factsheet: Spirodiclofen." US EPA, 2005. 4.

⁶⁰ "EPA Pesticide Factsheet: Spirodiclofen." US EPA, 2005. 4-5.

waterways or on fields nearby surface waters where contamination from spray drift is a concern. Promote use of run-off and spray drift mitigation measures such as vegetative barriers and bunds and spraying when conditions do not favor spray drift (i.e. early morning or other low wind periods).

Spirodiclofen and spiromesifen based on their mode of action and storage in fat cells has the potential to be chronically toxic to honey bees.

Mitigation 3: Spirodiclofen and spiromesifen products should not be applied to crops during periods post flower bloom or when bees are actively foraging.

f. Effectiveness of the requested pesticide for the proposed use: The EPA has found the efficacy data for Envidor to be sufficient to support their use in control of mite species in citrus, avocado, mango. Oberon field test data also shows it to be an effective control for mites and whiteflies on ornamental plants, flowers, foliage plants, field corn, cotton, cucurbit vegetables, fruiting vegetables, leafy vegetables, tuber vegetables and strawberries.

Resistance development in mite populations has been documented in several cases around the world and in the US. Resistance development is a potential concern in Haiti. Oberon and Envidor are in IRAC Group 23. These products should be rotated with other mite controls currently in use in Haiti including.

- Sulfur WP, Safe-t-Cide/Omni oil 6E (refined paraffinic oil), and Dimethoate.

Note: The above recommended alternatives have the following resistance classifications: Sulfur, refined paraffinic oils -na Dicofol-UN (unclassified), Dimethoate-**1B**.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: See elements E and H for mitigation to reduce impacts to non-target species and ecosystems.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Spirodiclofen and spiromesifen have the potential to contaminate surface water through runoff or through drift of spray in wind. Poorly draining, sandy and silty, soils with shallow water tables are more prone to have runoff containing this chemical and its major transformation products.⁶¹

Mitigation 1: If spirodiclofen and spiromesifen products are to be used in areas where surface or groundwater contamination risks are a concern WINNER should promote the use of runoff reducing mitigation (such as, well maintained vegetative buffer strips between areas to be sprayed and surface water, favoring use when rainfall is not likely within 48.)

⁶¹ “EPA Pesticide Factsheet: Spirodiclofen.” US EPA, 2005. 29.

- i. **Availability of other pesticides or non-chemical control methods:** See **element C**, above for reduced risk and other non-chemical mite control methods.

B. Bactericides

5. 2,4 xylenol 0.463% + meta cresol 0.466% flowable formulation; common trade name: Gallex

a. **US EPA Registration Status: ACTIVE, EPA REG. NO. 40230-2;** as curative for crown gall disease in roses, chrysanthemums and other ornamentals.

b. **Basis for selection of proposed pesticide:** Gallex controls existing crown gall disease and is composed of 2,4 xylenol and meta-cresol as a ready-to-use paint that is labelled as curative and EPA registered for use on floriculture crops, in particular, roses and chrysanthemums.

c. **Extent to which the proposed pesticide use is, or could be, part of an IPM program:** Few other chemical controls are effective against crown gall disease and the majority of alternatives are non-chemical cultural methods for suppressing the disease. These include:

- Disease free planting stock from reliable nursery sources, and inspect plant roots and crowns for galls prior to planting.
- Sanitation of nursery planting equipment, tools and shoes with a bleach solution can also disinfect and prevent disease spread;
- To prevent the spread of crown gall the infected plants, surrounding soil and as much of the roots possible should be removed from the nursery area;
- In areas with infested soils, rotation to a non-susceptible plant, such as grasses, can provide good control. Solarization (with a double insulation layer) of soils is also an acceptable control option.⁶²

d. **Proposed method or methods of application, including the availability of application and safety equipment:** The product is applied as a painted gall or tumor treatment for control of the bacterial diseases crown gall. The gall and cut surfaces plus 1-2 cm of the surrounding healthy bark should be painted with the product. Treated areas below ground level are allowed to dry one or more days before the soil is replaced. Treatment may be repeated after 4 to 6 months, if live galls are found upon examination. Pesticide applications should be made prior to budding.

PPE required for use of Gallex: Waterproof gloves; long sleeved shirt and long pants; hoes plus socks, protective eyewear.

⁶² “University of California (UC) Pest Management Guidelines: Floriculture and Ornamental Nurseries Crown Gall.” Statewide Integrated Pest Management Program Online. Updated March 2009, Accessed 5/31/2012. <http://www.ipm.ucdavis.edu/PMG/r280101311.html>

Users should also:

- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should also wash the outside of gloves before removing PPE.

REI for Gallex: 24 hours. Early re-entry requires the use of PPE, as listed above.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards

Meta (m)-Cresol is in EPA acute toxicity class I for severe skin and eye irritation, in class II for oral toxicity and class III for acute dermal toxicity. M-cresol end use products have also been found to be skin sensitizers. Some studies have shown that chronic m-cresol exposure can cause the growth or tumors but the EPA has not found sufficient evidence to support this finding.

Mitigation 1: WINNER should promote awareness of the potential carcinogenic effects of Gallex and ensure use of proper PPE as described in element C, above, to reduce user exposures.

Xylenol is also in EPA toxicity class I for skin and eye irritation class III for acute oral toxicity and class II for acute dermal toxicity. Xylenol is a skin sensitizer.⁶³

As Gallex is intended for greenhouse, containerized outdoor shade house and nursery uses, these enclosed areas are not likely to impact non-targets in a significant way when treated with Gallex.

f. Effectiveness of the requested pesticide for the proposed use: Xylenol and m-cresol are effective for control of crown gall at very low concentrations according to the label information.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: As Gallex is intended only for greenhouse, containerized outdoor shade house and nursery uses the EPA did not require eco-toxicity testing and exposure risk to non-target organisms should be low.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Based on the limited outdoor use sites for Gallex the exposure risk to waterways and groundwater from run-off is estimated to be low.

i. Availability of other pesticides and non-chemical controls: Upon infection the plant cells are stimulated into unregulated growth which results in the formation of galls which can interfere with water transport and lead to nutrient deficiencies. Once a plant is infected there are limited additional options for control other than removal from the planting area to prevent spread of infection to other healthy plants. See **element C**, above, for a list of other non-chemical controls for crown gall.

⁶³ "Registration Eligibility Decision: M-cresol and xylenol." US EPA, September 1994. 7-8.

6. *Agro-bacterium radiobacter* (Strain K84) 99 %; common trade name: Galltrol-A
7. *Agro-bacterium radiobacter* (Strain K1026) 0.25 %) common trade name: Nogall
a. USEPA Registration Status: ACTIVE, GALLTROL-A EPA REG. NO. 40230-1 / NOGALL EPA REG. NO. 62388-1; for Crown gall on roses and ornamental plant stock.

b. Basis for selection of the pesticide: Galltrol-A ® is a biological fungicide that is used as a bacterial inoculant for the prevention of crown gall disease in fruits and ornamental nursery plant stock (i.e. bare root seedlings, liners, and plant stock). It was first registered in 1979 and has since been classified as a microbial biopesticide by the EPA. ⁶⁴

Biopesticides are a class of pesticides derived from naturally occurring substances (biochemical pesticides), micro-organisms (microbial pesticides), and, or, substances from plants with added genetic material (plant incorporated protectants) that protect against pests. *Agrobacterium radiobacter* is a soil bacteria that competes with gall forming inoculum (*Agrobacterium tumefaciens*) present in the soil. Biopesticides are generally highly specific to a given pest species and as result are highly variable in their efficacy depending on the particular strains of *Agrobacterium* present. ⁶⁵

Galltrol-A is recommended by the label for use on roses and other ornamental nursery stock as described above.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: Few other chemical controls are effective against crown gall disease and the majority of alternatives are non-chemical cultural methods for suppressing the disease. These include:

- Disease free planting stock from reliable nursery sources, and inspect plant roots and crowns for galls prior to planting.
- Sanitation of nursery planting equipment, tools and shoes with a bleach solution can also disinfect and prevent disease spread;
- To prevent the spread of crown gall the infected plants, surrounding soil and as much of the roots possible should be removed from the nursery area;
- In areas with infested soils, rotation to a non-susceptible plant, such as grasses, can provide good control.

Solarization (with a double insulation layer) of soils is also an acceptable control option. ⁶⁶

d. Proposed method or methods of application, including the availability of application and safety

⁶⁴ "Regulating biopesticides." EPA. Last updated May 22, 2012. Accessed 5/31/2012.

<http://www.epa.gov/opp00001/biopesticides/>.

⁶⁵ "Pesticide Registration Manual: Chapter 3- Additional Considerations for Biopesticide Products." EPA. July 2010, Accessed 5/31/2012. <http://www.epa.gov/pesticides/bluebook/chapter3.html>

⁶⁶ "University of California (UC) Pest Management Guidelines: Floriculture and Ornamental Nurseries Crown Gall." Statewide Integrated Pest Management Program Online. Updated March 2009, Accessed 5/31/2012. <http://www.ipm.ucdavis.edu/PMG/r280101311.html>

equipment: Galltrol-A is sold in an agar formulation that preserves the bacterial active ingredient, *Agrobacterium radiobacter*, and should be kept refrigerated (per the label, at 35-40 degrees Fahrenheit). This refrigerated storage is required to prolong the bacteria's activity; however, it may not be feasible in all WINNER target areas of intervention. The selection process of locations where *A. radiobacter* products are to be stored and used, must consider this criteria for refrigerated storage.

A. radiobacter products are registered for use through hand operated spray, drench and dip treatment equipment.

PPE required for use of Galltrol-A : Long sleeve shirt and pants, protective eye wear, shoes and socks.

Users should also:

- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should also wash the outside of gloves before removing PPE.

REI: 12 hours; early re-entry requires use of the PPE, as listed above.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Galltrol-A , *Agrobacterium radiobacter* (*A. radiobacter*), has very low human and mammalian toxicity. According to EPA registration assessments, *A. radiobacter*, is Toxicity Category IV for acute oral and dermal toxicity. Information requirements for human and animal pathogenicity through inhalation and intravenous exposure routes were waived by the EPA on the grounds that *A. radiobacter* is a naturally occurring substance with low acute mammalian toxicity (oral, dermal, and ocular), that does not appear to be pathogenic to humans and or animals. Galltrol-A and *A. radiobacter* are potential eye irritants due to the adjuvants contained in the formulated end use product. As result been Galltrol-A is in toxicity category III for slight primary eye irritation.⁶⁷

The mode of action through which *A. radiobacter* prevents infestation of the target pathogen, *Agrobacterium tumefaciens*, and causal agent of crown gall, is well understood as it occurs through direct competition which is enhanced by *A. radiobacter*'s production of bacteriocin. For this reason, and given the lack of any cases to the knowledge of the EPA where related bacteria have caused bird, fish, insect or other non-target species disease or death, the EPA requires no ecological toxicity data for *A. radiobacter*. This decision is also made due to the indoor and otherwise contained nursery application registered uses of *A. radiobacter*.

Mitigation 2: As per the label requirements, *A. radiobacter* products or equipment rinseate (wash water) must not be applied directly to surface waters, intertidal areas below the high water mark or to any other water sources.⁶⁸

⁶⁷ "EPA Registration Eligibility Decision (RED) *Agrobacterium radiobacter*." EPA. June 1995. 6-7.

⁶⁸ "Galltrol-A Biological Prevention of Crown Gall Disease Label." AgBioChem, Inc. 2

f. Effectiveness of the requested pesticide for the proposed use: The mode of action by which *A. radiobacter* suppresses *A. tumefaciens*, the causal agent of crown gall disease, is through direct competition with the *A. tumefaciens*. The efficacy of *A. radiobacter* is highly dependant on the specific strains of *agrobacterium* present.

Since Galltrol-A must be refrigerated (35-40° F) when stored the sustainability of widespread use in rural Haiti is questionable. WINNER must investigate the initial feasibility and long-term viability of Galltrol-A in areas and among rural farmer populations where it is to be introduced. Refrigerated storage maybe unrealistic in several of the more rural areas of the WINNER project area that have consistent issues with access to reliable electricity and refrigeration storage equipment.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: The EPA has waived the ecological toxicity and risk assessments due to the low potential for *A. radiobacter* to impact non-target species and ecosystems. (See **element E** for more information on *A. radiobacter's* human and ecological toxicity).

Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: No data for *A. radiobacter's* potential for water source contamination is available. (See **element E** for more information on *A. radiobacter's* ecological toxicity).

j. Availability of other pesticides or non-chemical control methods: : Upon infection the plant cells are stimulated into unregulated growth which results in the formation of galls which can interfere with water transport and lead to nutrient deficiencies. Once a plant is infected there are limited additional options for control other than removal from the planting area to prevent spread of infection to other healthy plants.⁶⁹ The following controls can also be used to prevent and control the spread of crown gall disease:

- Use disease free planting stock from reliable nursery sources, and inspect plant roots and crowns for galls prior to planting.
- Sanitation of nursery planting equipment, tools and shoes with a bleach solution can also disinfect and prevent disease spread;
- To prevent the spread of crown gall the infected plants, surrounding soil and as much of the roots possible should be removed from the nursery area;
- *A. radiobacter*, a close relative of the crown gall organism, containing products are the only biological control currently effective. These products in general provide excellent control for most strains of crown gall.⁷⁰

⁶⁹Joy and Brian Hudelson. "University of Wisconsin Garden Facts: Crown Gall." The University of Wisconsin Extension. May 2005. Accessed 5/31/2012.

<http://www.plantpath.wisc.edu/pddc/factsheets/Low%20Color%20PDF%20Format/Crown%20Gall.pdf>. 1

⁷⁰ "Report on Plant Diseases No. 1006- Crown gall." University of Illinois IPM. September 1999. Accessed 5/31/2012. <http://ipm.illinois.edu/diseases/series1000/rpd1006/index.html>

- In areas with infested soils, rotation to a non-susceptible plant, such as grasses, can provide good control.
- Solarization (with a double insulation layer) of soils is also an acceptable control option.⁷¹

C. Bird repellent

Currently the only non-chemical control measure that is practiced for the protection of corn and rice seed from birds are the use of scare crows in fields. This control technique is not able to provide effective control in all cases and for this reason WINNER and target beneficiary farmers are interested in exploring the potential viability of a chemical bird repellent. There are few such products on the market but one, methyl anthranilate (MA) is a naturally occurring compound, which repels birds by triggering a pain response in one of the nerves of birds' heads. MA is widely used for flavoring in the US food industry. This product is not reported as typically available in Haitian supply markets currently. Before promoting this product WINNER should experiment with test plots and later demonstration plots to further investigate the efficacy in control of bird pest species under local conditions and the expected level of acceptance by target farmers.

8. Methyl anthranilate 20-28%, liquid formulation; common trade names: Rejex-it and Avian Control.

a. US EPA regulation status of pesticide: ACTIVE, Rejex-It EPA REG. NO. 58035-9 / Avian Control EPA REG. NO. 33162-1; for all agricultural sites including corn and rice.

b. Basis for selection of the pesticide: Field studies with MA have shown that aerial application of MA to corn and sunflower can discourage depredations by flocks of blackbirds, also, application to grass, turf, and winter wheat reduced grazing by geese and other species at golf courses, parks, and crop fields.⁷² Theoretically, given the mode of action, MA should repel a wide range of bird species including the crows and *Tisserin* spp. which can lead to significant losses of corn and rice just prior to harvest, according to Haitian farmers and WINNER agronomists. The non-toxic mode of action with which MA repels birds leads to few health and ecological concerns.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: Methyl anthranilate will not eliminate the depredation of crops by any bird species but will lead the bird to

⁷¹ "University of California (UC) Pest Management Guidelines: Floriculture and Ornamental Nurseries Crown Gall." Statewide Integrated Pest Management Program Online. Updated March 2009, Accessed 5/31/2012. <http://www.ipm.ucdavis.edu/PMG/r280101311.html>

⁷² Avery, Michael L., "AVIAN REPELLENTS" (2002). *USDA National Wildlife Research Center - Staff Publications*. Paper 462. http://digitalcommons.unl.edu/icwdm_usdanwrc/462

favor untreated food sources over those treated with MA. If there are no readily available alternatives to MA treated crops than lab studies have shown that birds will forego the discomfort caused by MA and eat the treated food. For this reason USDA studies suggest that provision of an alternate food source along with the use of a chemical repellent will improve outcomes.⁷³

Additional non-chemical control strategies to reduce crop losses, include:

- Coating rice seed with clay to make more difficult for birds to handle once planted and seed is muddled;
- Seed treated with fungicide can also repel birds;
- Provision of alternative food sources during times of particularly high bird crop damage;
- Scare crows;
- Sprays of insecticide to reduce insect populations that attract birds;
- Diluted sprays of copper fungicides that lead to detectible copper residues that birds associate with physiological effects from copper toxicity;

d. Proposed method or methods of application, including the availability of application and safety equipment: MA is applied as a foliar spray or by fogging. MA has minimal residual action so treatment should be withheld until crop is at risk of bird depredation.

PPE recommended for use of Methyl anthranilate: Eye protection, long sleeved shirt and long pants.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:

Acute and chronic toxicity: MA is a slight to moderate eye irritant and has slight acute toxicity (EPA toxicity class III) via the oral, dermal and inhalation routes of exposure. MA is not a dermal sensitizer or irritant.

Ecological toxicity: Due to the repelling effects of MA and its not toxic mode of action it is not expected to negatively affect birds. MA is moderately toxic to freshwater fish. **Mitigation: MA must not be applied directly to fish bearing waters.** MA is practically non-toxic to mammals, birds, honey bees and is slightly toxic to freshwater insects.

f. Effectiveness of the requested pesticide for the proposed use: The efficacy of MA is not well tested in fruiting crops, but studies and experience in corn and sunflower fields in the US have demonstrated its effectiveness. MA is widely used in California for protection of cherries, corn, and sunflowers.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems:

See **element e** for information about impacts to non-target organisms and environmental fate of the active ingredients.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils:

See **element e** for information about impacts to non-target organisms and environmental fate of the active ingredients.

⁷³ Avery, Michael L., "AVIAN REPELLENTS" (2002). *USDA National Wildlife Research Center - Staff Publications*. Paper 462. http://digitalcommons.unl.edu/icwdm_usdanwrc/462

i. Availability of other pesticides or non-chemical control methods:

Other chemical alternatives such as methiocarb, are too toxic for use by farmers, and anthraquinone is specific to bird species such as black birds not identified as problematic in Haiti. MA provides the most reliable means of control when used in concert with non-chemical control methods listed above in element b.

D. Fumigants

Currently there are no fumigants approved for use by the Mission-Wide PERSUAP in the protection of stored grain crops. WINNER proposes the use of aluminum phosphine fumigants for use in protection of stored grains from general storage pests (weevils, moths and borers). WINNER staff or farmer stakeholders should not apply these products themselves but should hire professional fumigators with appropriate equipment, safety procedures and training.

Common stored product pests of rice, maize, sorghum, beans, pigeon pea, potato, sweet potato and cassava are rice weevil *Sitophilus oryzae*, granary weevil *S. granarius*, and maize weevil *S. zeamais*, cowpea weevil *Callosobruchus maculatus*, Angoumois grain moth *Sitotroga cerealella*, tropical warehouse moth *Ephestia cautella*, Mediterranean flour moth *Ephestia kuehniella*, rice moth *Corcyra cephalonica*, red flour beetle *Tribolium castaneum*, potato tuber moth *Phthorimaea operculella*, sweet potato weevil *Cylas formicarius*.

The USEPA considers aluminum and magnesium phosphide fumigant products to “have significant benefits (protection of stored products and public health use) and there are few if any viable alternatives.”⁷⁴ However, all fumigant RUPs must only be applied by government licensed or otherwise certified fumigation services that have technical expertise and extensive training in fumigation practices and appropriate personal protective equipment. Phosphine gases are highly volatile and extremely toxic and without qualified applicators unintended human health impacts are likely. **As certified professional services are not in place, according to WINNER reports, no fumigation can be authorized to take place.**

E. Fungicides

The fungicides proposed for inclusion in the amendment include Topsin (Thiophanate-methyl), Aliette (fosetyl aluminum), and Cuprosan (Copper oxychloride). These products are locally available alternatives to the Mission-wide PERSUAP fungicides recommended for prevention and suppression of rust, *Phytophthora spp*, *Pythium* rots, anthracnose, yellow/black sigatoka, rusts and powdery mildew for plantains, beans, corn, leeks, tomato, peppers and fruit tree crops (mango, citrus, avocado). The

⁷⁴“R.E.D. Facts: Aluminum and Magnesium Phosphide,” 5.

Mission-wide PERSUAP recommended copper based fungicides (Kocide and Phyton, copper hydroxide and sulfate) are reported as not reliably available in local markets of the WINNER intervention areas.

Pyraclostrobin is proposed by the amendment team for use in the suppression of bean diseases including anthracnose, powdery mildew, rusts and alternaria leaf spot.

The Mission-wide PERSUAP recommended copper based fungicides (Kocide and Phyton, copper hydroxide and sulfate) are not reliably available in local markets of the WINNER intervention areas.

Aliette (fosetyl-al), Cuprosan (mancozeb+copper oxychloride) and Topsin (thiophanate methyl) are recommended here, and Quadris (azoxystrobin), Dithane (mancozeb), and Ridomil (mefenoxam), are recommended in the Mission-wide PERSUAP. All of these products can play a role in the effective management of the fungal disease issues considered here. Their application should be as preventatives, applications after an epidemic is established is wasteful and will only accelerate resistance issues.

**7. Copper oxychloride <17.6% + mancozeb 30% SC⁷⁵ / copper oxychloride 74% WDG and WP formulations – US trade name: ‘Badge SC’ / ‘C-O-C-S WDG’
Haitian trade name: Cuprosan**

Copper oxychloride is available in products of EPA Toxicity Class II and III. Those products that are less concentrated, water dispersed granule formulations less likely to contact eyes and all products in toxicity Class III should be favored.

a. US EPA registration status: ACTIVE, ‘Badge SC’ EPA REG. NO. 80289-3 / C-O-C-S WDG EPA REG. NO. 34704-326

b. Basis for selection of the pesticide: Cuprosan WP, copper oxychloride, is one copper chemical compound of the Group II copper compounds. Also included in this group is copper hydroxide (Kocide), a fungicide currently recommended for use by the Haiti Mission-Wide PERSUAP⁷⁶. The copper compounds represent a widely used broad spectrum of agrochemicals including fungicide, algicide, herbicides, insecticides, etc.⁷⁷ Copper oxychloride is registered for use by the EPA on a broad range of food and non-food crops and sites, including on beans, corn, and plantain among other crops relevant to the WINNER program.

Copper based fungicides are most efficacious against the oomycetes group of fungus-like pathogens and can be used for suppression of foliar diseases including: *Phytophthora spp.*, anthracnose (*Colletotrichum lindemuthianum*), powdery mildew (*Erysiphe polygoni*) etc.) Several important fruit, vegetable, nut and staple crops in Haiti can be affected by these diseases, including; avocado, banana, beans, corn, eggplant, pepper, tomatoes, mangoes, rice and others. Coppers are less effective for management of soilborne pathogens, such as *Fusarium spp.*

⁷⁵ See appropriate sections of the original USAID/Haiti Mission-Wide PERSUAP for relevant pesticide evaluation information beginning on page, 46.

⁷⁶ See page 43 of the USAID/Haiti Mission-Wide PERSUAP for relevant pesticide evaluation information on copper oxide and copper sulfate products.

⁷⁷ “EPA Registration Eligibility Decision for Coppers.” US EPA, .16

Mancozeb, is a second active ingredient included in some formulations of Cuprosan. Mancozeb is a broader spectrum fungicide with activity against a wider array of fungal disease than copper compounds. Mancozeb has activity against, anthracnose, powder mildew, rusts, *Phytophthora* spp. and *Pythium* spp. and is approved for use in the same crops as listed above.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program:

Cultural controls	Chemical controls
<ul style="list-style-type: none"> ▪ Crop rotation with non-host crops; ▪ Use of resistant varieties and non-damaged, non-infested seed; ▪ Planting schedules according to crop forecasts (delaying if conditions are optimum for fungal disease development); ▪ Good drainage and air circulation of greenhouses, fields, and storage facilities; ▪ Maintenance of plant vigor through appropriate and consistent irrigation and fertilization; ▪ Post-harvest removal, use for animal feed or burial of all crop residues. 	<ul style="list-style-type: none"> ▪ Sulfur ▪ Seeds treated with Thiram and/or Maxim with proper handling precautions.⁷⁸ ▪ Azoxystrobin ▪ Pyraclostrobin ▪ Fosetyl-al (for phytophthora) ▪ Mancozeb ▪ Thiophanate-methyl

d. Proposed method or methods of application, including the availability of application and safety equipment: The following are acceptable labeled uses: soil, foliar, greenhouse/nursery, post- and pre- fruit set sprays, tree trunk applications and seed treatments at various times throughout growing seasons. Cuprosan should be applied as a preventative treatment. Dosage rates must be respected as too much copper can be toxic to plants. Spray tank mixes of Cu fungicides with organosilicone surfactants should be avoided because these surfactants have been shown to increase the risks of phytotoxicity.⁷⁹

All copper compounds require the following PPE: **Eye goggles or full face shield, long-sleeve shirt and long pants, chemical resistant footwear (rubber boots) and socks, chemical resistant headgear (waterproof hat).**

REI: 48 hours; early re-entry to treated areas requires the use of waterproof gloves, coveralls, over long sleeve shirt and long pants, shoes plus socks.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Copper oxychloride is classified in the EPA toxicity category I for primary eye irritation, is corrosive to the eyes and can cause corneal opacity, redness and vascularization. Copper oxychloride has slight to moderate acute toxicity

⁷⁸ Table inserted from: Solberg, Scott, Eysenbach, Hans, et. al. "USAID, Haiti Mission-Wide PERSUAP." USAID, USAID partners and SMTN, Dec. 2012. 49.

⁷⁹ Vladimir Orbovic, Diann Achor, and James P. Syvertsen "Adjuvants affect penetration of coppers through isolated cuticles of citrus leaves and fruits." HORTSCIENCE Vol. 42(6) October 2007.

via the oral, dermal and inhalation routes (Class II (dermal)-III). Copper oxychloride has been shown to be a non-irritant via skin exposure testing. **Copper oxychloride is available in products of EPA Toxicity Class II and III. Products in toxicity Class III should be favored.**

The users of copper oxychloride products should always wear the PPE as listed, above, in **Element C**.

Although copper is a vital micronutrient for life at higher dosages it becomes toxic as do other heavy metals. It will not degrade and hence will build up in concentration over time. Coppers have been shown to be highly toxic to most aquatic species including fish and algae, but no concerns for toxicity to marine and estuarine plant species has been found.

Mitigation 1: Copper oxychloride products should never be applied directly to surface waters, estuaries or coastal areas, and maximum dosage must be respected to avoid over build-up of copper in soils and waterways.

Mitigation 2: Minimize drift by applying copper oxychloride products only when wind conditions are light. Minimized copper oxychloride run-off through the use of control barriers and soakways in all areas where surface water contamination from run-off is a potential concern.

Copper is also practically non-toxic to honeybees. Copper does bio-accumulate in soils and in concentrations 80ppm have deleterious effects on soil invertebrates important for soil fertility, such as earthworms. Copper in high enough concentrations can also overwhelm the ability of birds and other mammals to cope with the excess they are exposed to.⁸⁰

Mitigation 3: Non-chemical alternatives to copper compounds (listed in Element B) for fungal disease control should always be given preference over application of copper compounds.

Mancozeb:

Acute and chronic toxicity: Mancozeb has slight acute toxicity through the oral, dermal and inhalation routes (EPA toxicity class III-IV) and is not a dermal sensitizer or irritant, however mancozeb is slightly irritating to eyes. **Mitigation: Proper eye protection (goggles, or face shield) should be worn when mixing, loading or handling Maxim.**

A breakdown product of mancozeb, ethylenethiourea (ETU), is a potential carcinogen and has been found to cause reproductive/developmental toxicity effects in laboratory test animals.

Mitigation : All handlers should be informed of the potential carcinogenicity of mancozeb and encouraged to reduce their exposure through the use of the required PPE.

Mitigation: Women of child bearing age and young children should be made aware of the potential for development or reproductive toxicity effects resulting from mancozeb exposure and discouraged

⁸⁰ “Registration Eligibility Decision for Coppers,” United States Environmental Protection Agency. Revised May 2009, 8-9.

from handling mancozeb or entering areas where mancozeb is applied.

Ecological toxicity: Mancozeb is highly toxic to aquatic invertebrates and fish. **Mitigation: Mancozeb uses do not pose significant risk to aquatic organisms so long as spray drift and runoff is minimized in treatment areas nearby fish holding waters.**

Mancozeb is not persistent in soils (field half-life 3 days in soil). It is practically insoluble in water and thus is unlikely to be carried down by rains to groundwater. However a breakdown product of mancozeb is of concern, ETU is predicted to be susceptible to leaching and highly soluble and mobile. However, once introduced into the soil ETU lacks stability which limits its leaching. **Mitigation: Mancozeb does not pose significant risk of ground water contamination so long as it is not applied in ways that directly contaminate surface waters or shallow water tables.**

f. Effectiveness of the requested pesticide for the proposed use: While there are some non-target impacts that can result from overuse and bio-accumulations, with proper management copper can be used in an integrated management strategy of cultural, non-chemical and reduced risk chemical controls to effectively manage potentially damaging fungal diseases.

Copper oxychloride have fungicide resistance classification of M1. Copper hydroxide should be rotated with similar products of different resistance classification in order to prevent pest tolerance although cases of resistance have not been widely reported.

Note: The following fungicide alternatives are classified by FRAC in these mode of action groups: Azoxystrobin and pyraclostrobin **11**, Fosetyl-al **33**, Copper compounds **M1**, mancozeb and thiram **M3**, mefenoxam and metalaxyl **4**, thiophanate-methyl **1**, fludioxonil **12**.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: Cuprosan should never be applied directly to any surface waters. Please see **element E** for additional effects on non-target organisms.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Spray drift of copper oxychloride should be minimized by applying it only when wind conditions are light. Copper oxychloride run-off control barriers and soakways should be implemented in all areas where surface water contamination from run-off is a potential concern.

Copper oxychloride is naturally occurring in nature and is found in water. Copper products applied to the soil surface are not expected to leach copper into groundwater as copper is readily absorbed by soils where it remains.

i. Availability of other pesticides or non-chemical control methods:
Alternatives to copper based fungicides should be promoted due to impacts on non-target organisms.

See **element B**, above, for other non-chemical control methods.

Control Options to be recommended in the order listed base on relative toxicities:

- Prune out dead limbs/leaves; avoid over-irrigation; increase air flow to facilitate drying

- Sulfur
- Seeds treated with Thiram and/or Maxim with proper handling precautions.⁸¹
- Azoxystrobin
- Pyraclostrobin
- Fosetyl-al (for phytophthora)
- Mancozeb
- Thiophanate-methyl

12. Fosetyl aluminum 80% WDG formulation; common trade name: Aliette.

Fosetyl-Al is available in products of EPA Toxicity Class I and II which should be avoided. These higher risk formulations are the technical grade (100% concentrated) and emulsifiable concentrate/liquid formulations that have higher risk of splashing in eyes. The WDG formulated products in toxicity Class III should be favored.

a. US EPA registration status: ACTIVE, EPA REG. NO. 264-467; for suppression of *Pythium* and *Phytophthora* spp.

b. Basis for selection of the pesticide: Fosetyl-Al (chemical name: aluminum tris (o-ethylphosphonate)) is a systemic fungicide that suppresses *Phytophthora* spp., in citrus, avocado, pineapple, and melons, as well as, late blight and damping off (*Pythium* spp.) in tomato, downey mildew (*Peronospora* spp.) in cabbage and melons, and broccoli.⁸²

a. Extent to which the proposed pesticide use is, or could be, part of an IPM program: See Haiti Mission-Wide PERSUAP (MWP) for more details on IPM plans, non-chemical and other controls for soil fungi, *Phytophthora* spp., *Pythium* spp, etc. damping-off and root rot.

Cultural controls	Reduced-risk controls
<ul style="list-style-type: none"> ▪ Crop rotation with non-host crops; ▪ Use of resistant varieties and non-damaged, non-infested seed; ▪ Planting schedules according to crop forecasts (delaying if conditions are optimum for fungal disease development); ▪ Good drainage and air circulation of greenhouses, fields, and storage facilities; ▪ Maintenance of plant vigor through appropriate and consistent irrigation and fertilization; 	<ul style="list-style-type: none"> ▪ Sulfur ▪ Seeds treated with Thiram and/or Maxim with proper handling precautions.⁸³ ▪ Azoxystrobin ▪ Pyraclostrobin ▪ Fosetyl-al (for phytophthora) ▪ Mancozeb ▪ Thiophanate-methyl⁸⁴

⁸¹ Table inserted from: Solberg, Scott, Eysenbach, Hans, et. al. "USAID, Haiti Mission-Wide PERSUAP." USAID, USAID partners and SMTN, Dec. 2012. 49.

⁸² "EPA RED Facts: Fosetyl-Al (Aliette)." USEPA, January 1991. 1.

⁸³ Table inserted from: Solberg, Scott, Eysenbach, Hans, et. al. "USAID, Haiti Mission-Wide PERSUAP." USAID, USAID partners and SMTN, Dec. 2012. 49.

⁸⁴ Table inserted from: Solberg, Scott, Eysenbach, Hans, et. al. "USAID, Haiti Mission-Wide PERSUAP." USAID, USAID partners and SMTN, Dec. 2012. 49.

<ul style="list-style-type: none"> ▪ Post-harvest removal, use for animal feed or burial of all crop residues. 		
<p>b. Proposed method or methods of application, including the availability of application and safety equipment: Aliette is a water soluble granular formulation in Haiti that should be diluted in water and applied with a backpack sprayer at the recommended dosage and rates on the label.</p> <p>PPE required for use of Aliette:</p> <ul style="list-style-type: none"> - Full face shield or goggles - Chemical resistant/waterproof gloves - Long pants and shirt (or coveralls) - Shoes plus socks <p>Restricted entry interval (REI) for Aliette: 24 hours; early re-entry into treated areas requires the use of the PPE as listed above.</p> <p>Pre-harvest interval (PHI) for Aliette: Variable depending on the crop and product. Low-end: 12 hours for cucurbits (melon, cucumber, etc.); 3 days for brassica crops (cabbage, broccoli, spinach, etc.); High-end: 110 days for asparagus).</p>		
<p>c. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Formulated fosetyl-Al is classed as an EPA toxicity category III for acute oral toxicity and primary dermal irritation, it poses low acute inhalation toxicity⁸⁵. However, technical (100%) fosetyl-Al is in EPA toxicity category I, severe eye irritant and for this reason products containing fosetyl-Al carry the signal word Caution on the label. The EPA has classified fosetyl-Al as a category C carcinogen, a ‘possible human carcinogen’, based on study results showing oncogenic effects in rats fed the highest doses of fosetyl-al in the study. These doses are far bigger than the amounts of aluminum-fosetyl humans would typically be exposed to through its registered uses. Fosetyl-Al is not a mutagen and it does not pose developmental or reproductive effects of concern.⁸⁶</p> <p>Fosetyl-Al is available in products of EPA Toxicity Class I and II which should be avoided. These higher risk formulations are the technical grade (100% concentrated) and emulsifiable concentrate/liquid formulations that have higher risk of splashing in eyes. The WDG formulated products in toxicity Class III should be favored.</p> <p>No additional mitigation measures, apart from ensuring the use of proper PPE, consistent with label’s directions, are required for use of fosetyl-Al products. (see Element C above for detailed PPE requirements.)</p>		

⁸⁵ “EPA RED Facts: Fosetyl-Al (Aliette).” USEPA, January 1991. 1.

⁸⁶ “EPA Registration Eligibility Document: Aluminum Tris (Referred to as Fosetyl-Al).” USEPA, Dec. 1990. 5-8.

EPA studies have shown that fosetyl-Al does not pose a risk to birds or fish, and is practically non-toxic to these non-target species. Fosetyl-Al is practically non-toxic to honey bees, and does not adversely affect aquatic plants.⁸⁷

d. Effectiveness of the requested pesticide for the proposed use: Fosetyl-Al is in the mode of action group name #33. Fosetyl-Al should be rotated with products that suppress or have activity against similar fungal pests and have different resistance classifications in order to reduce the risk of developing pest tolerances.

Note: The following fungicide alternatives are classified by FRAC in these mode of action groups: Azoxystrobin and pyraclostrobin **11**, Fosetyl-al **33**, Copper compounds **M1**, mancozeb and thiram **M3**, mefenoxam and metalaxyl **4**, thiophanate-methyl **1**, fludioxonil **12**.

e. Compatibility of the proposed pesticide use with target and non-target ecosystems: See element e, above, for specific non-target organism and ecosystem effects. In general, fosetyl-al poses very low risks to non-target organisms and ecosystems when used according to the label's direction.

f. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Fosetyl-Al degrades rapidly in soil to non-toxic components. When it is applied to plant foliage, it can be washed off by heavy rainfall. Since it is soluble in water, susceptible to leaching, and stable to decomposition by water, fosetyl-Al may leach to ground water in cases where unexpected heavy rainfall closely follows foliar application of the pesticide.⁸⁸ The risk of groundwater contamination is considered to be very low by the EPA.

Mitigation 1: The use of Fosetyl-Al products used in areas with extremely shallow, unconfined aquifers or where drinking water contamination risks are elevated (areas with porous, sandy soils favorable to leaching, surface waters used for drinking water, etc.) should put in place run-off and spray drift control measures (such as, soil bunds, vegetative borders around fields, no application prior to heavy rains).⁸⁹

i. Availability of other pesticides or non-chemical control methods: Other acceptable fungicides with activity against *Phytophthora spp.* and other similar fungal diseases include: azoxystrobin, copper compounds (copper sulfate, copper oxchloride, etc.), mancozeb, mefenoxam, sulfur, thiram and fludioxonil treated seeds. These should be promoted in the following order, as appropriate, based on relative toxicities, user and ecological risks:

1. sulfur,
2. thiram and fludioxonil treated seeds,
3. azoxystrobin,
4. copper compounds (copper sulfate, copper oxychloride, etc.),

⁸⁷ "USAID-ADP/Fintrac Environmental Assessment and PERSUAP." USAID, Fintrac and Sun Mountain International, June 19, 2007. 21

⁸⁸ "USAID-ADP/Fintrac Environmental Assessment and PERSUAP." USAID, Fintrac and Sun Mountain International, June 19, 2007. 21

⁸⁹ "EPA Registration Eligibility Document: Aluminum Tris (Referred to as Fosetyl-Al)." USEPA, Dec. 1990. 13.

6. fosetyl-al
7. mefenoxam.
8. mancozeb,
9. thiophante-methyl

13. Pyraclostrobin 20%; flowable formulation; common trade name Cabrio EG

a. US EPA registration status: ACTIVE, EPA REG. NO. 7969-187; for proposed use in prevention and suppression of *Anthraco* *colletotrichum* spp. and rust (*Uromyces appendiculatus*) in common beans and corn and alternaria leaf spot, powdery mildew (*Erysiphe polygoni*), downy mildew (*Phytophthora nicotianae* and *P. phaseoli* in beans only.

b. Basis for selection of the pesticide: Improving bean and corn production is a major pillar of the WINNER's agricultural development program and requires a wide range of management strategies to address challenges with potentially serious fungal diseases such as anthracnose. *Anthraco* *colletotrichum* spp. is one of the most significant fungal diseases for WINNER target farmers of both bean and corn in the Bas Boen-Cul de Sac and Lower Artibonite.⁹⁰ Other potentially economically important fungal diseases, i.e. powdery mildew, for both bean and corn, and alternaria leaf spot and downy mildew in bean can also be suppressed by pyraclostrobin. Pyraclostrobin has low acute toxicity, minimal long term human health impacts and ecological toxicity to non-target species.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program:

Effective management of *anthracnose* spp. requires an integrated approach. As anthracnose in beans is seed born, and can also be seed borne in corn, one important factor in reducing the chances for infestation is the use of quality seed. As the limited availability of high quality seed and lack of seed certification program in Haiti, are widely recognized constraints to agriculture in Haiti, other alternative methods must also be implemented by Haitian farmers. The following are some examples of non-chemical control techniques available to WINNER and target farmers:

- Fields should not be entered for cultivation or pesticide applications when the plants are wet from rains or early morning dew. Avoiding unnecessary movement in infested fields will minimize the spread of the disease;
- Tools and equipment used in infested fields should be sterilized;
- Fields with infestations should be cultivated, harvested and sprayed last.⁹¹
- Seed treatments with mancozeb and fludioxinil + mefenoxam are options for limiting seed to seed transfer of anthracnose.

d. Proposed method or methods of application, including the availability of application and safety equipment:

Foliar sprays of pyraclostrobin are most effective as preventative treatments. Recent publications from the North Dakota State University extension suggest two preventative sprays, one early and one late in

⁹⁰Fiona LittleJohn-Carillo and Brittany Smith. "Notes from field interviews with WINNER agronomist and farmers." August 2012.

⁹¹ "Anthracnose of dry beans." North Dakota State University (NDSU) Plant Disease Management Extension, January 2012. 4.

bloom provide the most consistent results in reducing anthracnose in beans.⁹²

PPE: Waterproof gloves, eye protection (goggles, face shield or safety glasses), coveralls over short sleeved shirt and shorts, rubber boots plus socks, waterproof hat if overhead exposure is expected and a waterproof apron for use when mixing and loading.

REI: 12 hours; early re-entry requires the use of the following PPE: waterproof gloves, coveralls and shoes and socks.

PHI: Dry beans- 21 days, succulent beans and corn – 7 days

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:

Pyraclostrobin has slight acute toxicity, EPA toxicity class III through the oral and dermal routes. Acute inhalation toxicity is moderate, and classified as toxicity class II for technical grade pyraclostrobin (98% concentration) but formulated pyraclostrobin (38% concentration) has low acute inhalation toxicity (class IV). Pyraclostrobin is not a skin or eye irritant and is classified in EPA toxicity class IV for these effects. No additional mitigation other than the label required PPE is needed to safeguard users.

Pyraclostrobin is very highly toxic to fish, aquatic insects and crustaceans.

Mitigation: Pyraclostrobin should not be applied near fish bearing surface or coastal waterways. When application near these areas is required, mitigations to limit spray drift and run-off must be implemented (i.e. application in early mornings when wind speeds are low, berms, planting of vegetation along field's edges and avoiding applications when rain is eminent within 48 hours).

Pyraclostrobin has also been found to be moderately toxic to birds but its application to beans and corns is not expected to have a significant negative impact on birds

f. Effectiveness of the requested pesticide for the proposed use: Pyraclostrobin does not provide complete control or act as a curative for elimination of anthracnose infestations. However, foliar sprays can best be used as preventatives and also serve to reduce the transmission and spread of the disease.

Pyraclostrobin and azoxystrobin are at high risk of having target plant pathogens develop resistance. According to experiences in the US and Europe documented by FRAC. In cereals and bananas, use of group 11 fungicides should always be used in formulated mixtures with non-cross-resistant fungicides (non-strobins, and other fungicides not in FRAC group 11). In particular, accounts of resistance developemtn in black sigatoka (*Mycosphaerella fijiensis*) have been documented in Central and South America. Rotation, mixed formulation or an acceptable tank mix with other non-group 11 fungicides are important for effective pest management with pyraclostrobin products if resistance development is to be delayed or avoided.⁹³

Note: The following fungicide alternatives are classified by FRAC in these mode of action groups: Azoxystrobin and pyraclostrobin **11**, Fosetyl-al **33**, Copper compounds **M1**, mancozeb and thiram **M3**, mefenoxam and metalaxyl **4**, thiophanate-methyl **1**, fludioxonil **12**.

⁹² "Anthracnose of dry beans." NDSU Extension, January 2012. 3.

⁹³ Keith Brent and Derek W. Holloman. Fungicide Resistance in Crop Pathogens: How Can it Be Managed 2nd Revised Edition. Crop Life and the Fungicide Resistance Action Committee, 2007. P42.

<p>g. Compatibility of the proposed pesticide use with target and non-target ecosystems: For additional details on potential impacts on non-target species see element e, above.</p>
<p>h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils:</p> <p>Pyraclostrobin is a potential groundwater and surface water contaminant, as this pesticide can persist in run-off for several months after application. The risks are acceptably low, according to the EPA, under most conditions, these risks are elevated in areas with sandy and loamy soils and shallow water tables. Mitigation: Pyraclostrobin should not be applied in areas with shallow water tables and porous sandy soils without proper mitigations to limit spray drift and run-off (i.e. application when wind speeds are low, berms, planting of vegetation along field's edges and avoiding applications when rain is eminent within 48 hours)</p>
<p>i. Availability of other pesticides or non-chemical control methods: Alternatives to pyraclostrobin include the following fungicides recommended in the MWP, or, here in the AMWP. The below fungicides are in order from least toxic to more toxic, the less toxic products should be promoted first when possible.</p> <p>Seeds pre-treated with thiram, fludioxonil, metalaxyl, mancozeb, treated seeds Copper Oxychloride, copper hydroxide Azoxystrobin Fosetyl-Al Mancozeb Thiophanate-methyl</p>
<p>8. thiophanate-methyl 70% WP, common trade names: Topsin WP and Systec</p> <p>Thiophanate-methyl is available in products of EPA Toxicity Class II and III. Those products in toxicity Class III should be favored.</p> <p>a. US EPA registration status: ACTIVE, Topsin WP EPA REG. NO. 73545-11 / Systec EPA. REG. NO. 48234-12, for use in management of anthracnose, <i>Botrytis</i> spp. and <i>Sclerotinia</i> spp. in beans, melons and onions, and can be use as a potato seed pieces treatment.</p>
<p>a. Basis for selection of the pesticide: Thiophanate-methyl (TM) products such as Topsin are systemic fungicides for activity against <i>Collectotricum</i> spp. causal agent of anthracnose, <i>Botrytis</i> and <i>Sclerotinia</i> spp. leaf and stem spots, molds and rots, powdery mildew and gummy stem blight in beans, citrus and melons in particular. TM is also registered by the EPA for use on the following food/feed crops such as, almonds, beans, apples, apricots, canola, garlic, grapes, cantaloupes, cherries, cucumbers, garlic, melons, nectarines, onions, peaches, peanuts, pears, pecans, pistachios, plums, potatoes, pumpkins, soybeans, squash, strawberries, sugar beets, watermelons, and wheat. A tolerance for residues on bananas treated with TM has also been established.</p> <p>Bananas/plantains are not labeled crops in the US under TM registrations; this is likely due to the limited US production of these crops and the expense of obtaining EPA label registrations for minor crops. The use profile on a wide range of fruiting tree crops in the US is similar enough to the proposed use in plantain that TM's use on plantains can be expected, based on the analysis of the amendment team, to represent no greater risk than if its use were restricted to the US labeled crops. TM has activity against <i>Mycosphaerella fijiensis</i>, the causal fungal pathogen of black sigatoka, a major fungal</p>

disease of Haitian banana, and is proposed for this use here.

TM products are available and currently in use in areas WINNER is working. TM products are, reportedly, more accessible to target farmers than the products, copper hydroxide, copper sulfate, mancozeb and mefenoxam that are currently recommended in the USAID, Haiti Mission-Wide PERSUAP.⁹⁴ TM also has been reported and shown to have greater activity in suppression of powdery mildew, *Phytophthora* spp. and *Pythium* spp. when compared with other recommended alternatives (copper compounds and fosetyl-al) However, due to the increased chronic toxicity risks TM use should be minimized to the extent possible through rotation and partnered use with these other less toxic alternatives.

b. Extent to which the proposed pesticide use is, or could be, part of an IPM program: There are several relevant non-chemical, preventative and disease suppressing control measures, including, cultural, mechanical, as well as reduced risk controls (copper compound containing fungicides).

Pre-planting: -Select fields with lowest or no recent incidence of anthracnose;

-Anthracnose is seed borne and the most effective preventative is using anthracnose free seed;

Planting and growth:

- Prune out dead limbs/leaves and those with visible infections;
- Avoid over-irrigation during growth;
- As anthracnose is water borne, avoid entering and moving around in wet fields;
- Prune low branches 60 cm off the ground to reduce humidity.
- Prune and harvest preferably during dry conditions
- Inter-crop with fruit-bearing shrubs and annual vegetables to help conserve biodiversity and reduce pest populations.

Crop Rotation:

- Avoid rotation of host crops in areas with repeated severe anthracnose infestation such as banana, plantains, beans and coffee.

c. Proposed method or methods of application, including the availability of application and safety equipment: Thiophanate-methyl can be applied through use of a, backpack or hand-held sprayer, broadcast spray, seedling drench, and seed piece treatment. Dosage varies by crop type and pest, refer to the label dosage rates for more detailed information.

PPE required for use of Topsin®: Long sleeve shirt and pants, waterproof gloves, rubber boots and socks.

The **REIs** for Topsin are listed according to crop type are: **12 hours for ornamentals; 24 hours for bean, cucurbits, wheat, and other field crops; and 2 days for citrus and other fruit tree crops.**⁹⁵

The **PHIs** for Topsin according to crop type are: **None listed for flowers and ornamentals; 1 day for cucurbits; 14 days for succulent beans, 28 days for dry beans**⁹⁶; **21 days for soybean.**⁹⁷

⁹⁴ “WINNER Bas Boen agronomists PERSUAP amendment field survey response.” Sun Mountain International. June, 2012.

⁹⁵ “EPA RED Facts Thiophanate-methyl.” US EPA, November 2004. 4.

For this product the REI and PHI vary depending on the crop type. Use the above rates or those on the label for those crops missing from the above.

d. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Thiophanate-methyl lab testing results for acute toxicity showed low acute oral toxicity, EPA toxicity category IV and category III for acute dermal and inhalation toxicity. TM WP products are classified overall to be in EPA toxicity category IV. Product labels are legally required to appear with the signal word Caution. Discomfort, tearing and blurred vision may result if thiophanate-methyl gets into the eyes. Exposure if prolonged or in high doses by inhalation may cause irritation and coughing. TM is also a skin sensitizer.⁹⁸

Mitigation 1: Proper PPE should always be worn when handling, mixing, loading or applying Thiophanate-methyl products

Thiophanate-methyl, according to the US EPA lab results and Pesticides Information Network, show TM probable developmental reproductive, thyroid and liver toxicity effects. The EPA has classified this chemical as a probable carcinogen.

The liver and thyroid are the primary target organs of TM and MBC (a breakdown product) in several species following subchronic or chronic dietary exposure. The testes are also a known target organ of MBC. **TM** is classified as “**likely to be carcinogenic**” to humans based on dose-dependent increases in liver tumors in male and female mice. MBC is classified as a possible human carcinogen based on hepatocellular tumors in female mice. Developmental toxicity based on decreased fetal body weight and increases in skeletal variations was observed in the fetuses of rabbits exposed to TM. **MBC** was associated with **adverse reproductive effects in rats**. PAN lists it as such also.

Mitigation 2: Lower risk alternatives should be employed in preventative approaches to suppressing fungal disease and preventing disease damage prior to use of thiophanate-methyl.

Mitigation 3: WINNER stakeholders should promote awareness among users about thiophanate-methyl’s potential carcinogenicity. Women and men of child bearing age and young children should, in particular, be advised of the developmental, reproductive risks that have been shown to be associated with overexposure to thiophanate-methyl products. Entry into treated areas should be restricted until after REIs have elapsed. Women of child bearing age and children should be prohibited from handling TM products or seed treated with TM.

Mitigation 4: Handlers mixers and applicators of TM products should be rotated so the same person is not repeatedly applying TM products all the time, and to reduce the risks of chronic exposure for the users.

Thiophanate-methyl is practically non-toxic to birds and terrestrial mammals, and honey bees but is

⁹⁶ “Topsin® M 70WP Product Label.” Cerexagri-Nisso LLC. 3.

⁹⁷ “EPA Registration Eligibility Decision: Thiophanate-methyl.” US EPA, December 2005. 104-105.

⁹⁸ “EPA Registration Eligibility Decision: Thiophanate-methyl.” US EPA, December 2005. 11.

very highly toxic to earthworms.

TM build up in soils overtime can negatively affect earthworm populations.

Mitigation 1: TM products should only be applied within the recommended dosages and maximum application rates on the label must be respected.

Mitigation 2: Lower risk alternatives should be employed in preventative approaches to suppressing fungal disease and preventing damage prior to use of Thiophanate-methyl.

Thiophanate-methyl is slightly to moderately toxic to fish aquatic invertebrate insects.⁹⁹ It does not appear to bioaccumulate in fish. Thiophanate-methyl is not toxic to plants when used at recommended application levels.¹⁰⁰

Mitigation 2: TM product should never be applied directly to surface waters, coastal or estuarine areas, nor should it be applied in areas of fields directly adjacent to surface waters (where spray drift may contaminate the water) or when conditions favor spray drift.

e. Effectiveness of the requested pesticide for the proposed use: Thiophanate-methyl is registered by the EPA for all the following use sites, relevant to the WINNER program and target fungal pest species. **Use Sites** food/feed crops, nut and fruit trees, beans, green beans, cantaloupes, cucurbits, garlic, onions, peanuts, potatoes, and ornaments, and tree nurseries.¹⁰¹

Target species include: *Botryosphaeria*, *Botrytis*, *Cercospora*, *Cladosporium*, *Coccomyces*, *Colletotrichum*, *Corynespora*, *Cristulariella*, *Dendrophoma*, *Diaporthe*, *Dibotryon*, *Didymella*, *Diplodia*, *Fusicladium*, *Gloeodes*, *Gnomonia*, *Erysiphe*, *Fusarium*, *Monilinia*, *Mycosphaerella*, *Phaenocryptopus*, *Phomopsis*, *Podosphaera*, *Pseudocercospora*, *Puccinia*, *Rhizoctonia*, *Scirrhia*, *Sclerotium*, *Septoria*, *Sphaerotheca*, *Venturia*, and *Zygophiala*.¹⁰²

Resistance management in the use of TM is essential as Group 1 fungicides are at a high risk of resistance development by target pathogens. According to experiences in the US and Europe documented by FRAC rotation and, or, formulations with a mix of other non-group 1 fungicides are important criterion for effective pest management with TM products.¹⁰³

Note: The following fungicide alternatives are classified by FRAC in these mode of action groups: Azoxystrobin and pyraclostrobin **11**, Fosetyl-al **33**, Copper compounds **M1**, mancozeb and thiram **M3**, mefenoxam and metalaxyl **4**, thiophanate-methyl **1**, fludioxonil **12**.

f. Compatibility of the proposed pesticide use with target and non-target ecosystems: See element e above for use restriction/mitigations for reduction of risks of surface water contamination and impacts to beneficial earthworm populations.

g. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography,

⁹⁹ EPA Registration Eligibility Decision: Thiophanate-methyl. US EPA, December 2005. 63.

¹⁰¹ EPA Registration Eligibility Decision: Thiophanate-methyl. US EPA, December 2005. 6.

¹⁰² EPA Registration Eligibility Decision: Thiophanate-methyl. US EPA, December 2005. 6.

¹⁰³ Keith Brent and Derek W. Holloman. Fungicide Resistance in Crop Pathogens: How Can it Be Managed 2nd Revised Edition. Crop Life and the Fungicide Resistance Action Committee, 2007. p36.

hydrology, and soils: Thiophanate-methyl degrades rapidly in soil and has little effect on soil bacteria. The compound is absorbed by soil particles and is not very mobile. Thiophanate-methyl remains unchanged in the soil for varying lengths of time, with a faster rate of degradation in alkaline and silty loam soils, than in sandy loam soils. The half-life of thiophanate-methyl is about 7 days. Thiophanate-methyl is very insoluble in water. The potential for leaching is low, since both thiophanate-methyl and its breakdown product MBC are adsorbed by soil particles.¹⁰⁴

j. Availability of other pesticides or non-chemical control methods:

See **element B**, above, for other non-chemical control methods.

Control Options (to be recommended in the order listed; follow the label directions):

- Prune out dead limbs and avoid over-irrigation;
- Use pre-treated seeds (thiram and fludioxonil, metalaxyl, mancozeb);
- azoxystrobin (Quadris (F)) and pyraclostrobin (Headline)
- copper hydroxide (Kocide 4.5 If (F))
- mancozeb (Dithane);¹⁰⁵
- thiophanate-methyl.

¹⁰⁴ Wagner, Dez, et.al. "USAID-ADP/Fintrac Environmental Assessment and PERSUAP." USAID, FINTRAC, SMTN, June 19, 2007. 25-26

¹⁰⁵ Solberg, Scott, Eysenbach, Hans, et. al. "USAID/Haiti Mission-Wide PERSUAP." USAID and partner organization, SMTN. December 2, 2010. 117.

1. Seed piece treatment fungicide

There are currently two recommended seed treatment products in the MWP. Fludioxonil 21% + metalaxyl-M 8.4% is used as a seed treatment, for the hybrid corn promoted by WINNER. The common trade name of this product is Maxim XL and is formulated as an emulsifiable concentrate. Also thiram 75% is recommended in the MWP for similar uses on vegetable seeds. A similar product is now proposed in the AMWP for use as a potato seed piece treatment. Fludioxonil 0.05% + Mancozeb 5.7%, commonly found sold under the trade name Maxim MZ, is proposed as a seed treatment for potato soil borne fungal pests (such as *pythium*, *rhizoctonia*, *fusarium spp.* and silver scurf for cut seed potatoes).

14. Fludioxonil 0.5% + Mancozeb 5.7% EC formulation – common trade name: Maxim MZ

a. US EPA registration status: ACTIVE, EPA REG. NO. 100-1158

b. Basis for selection of the pesticide: Maxim MZ, fludioxonil + mancozeb, is a seed treatment specifically designed to be applied to potato seed pieces for the suppression of several economically important fungal diseases. Fludioxonil and mancozeb both have low acute toxicities that pose little acute human and ecological risks when used for seed treatment purposes. Both these active ingredients are currently recommended in the MWP. Treatment of potato planting material provides preventative fungal control that reduces farmer's and non-target species' exposures and also limits the need for foliar spray applications of fungicides. Maxim MZ is classified as an EPA toxicity class III product which is indicative of its low acute toxicity.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: The following non-chemical controls are all parts of a good integrated management strategy for the suppression of soil borne disease in potato:

- Use of resistant varieties and non-damaged, non-infested seed;
- Planting schedules according to crop forecasts (delaying if conditions are optimum for fungal disease development);
- Good drainage and air circulation of greenhouses, fields, and storage facilities;
- Maintenance of plant vigor through appropriate and consistent irrigation and fertilization;
- Post-harvest removal, use for animal feed or burial of all crop residues.

d. Proposed method or methods of application, including the availability of application and safety equipment: Maxim MZ is formulated as a dust and should be diluted with water to make a liquid slurry then applied to seeds. Application should only be done by applicators trained in pesticide safety and the use of proper PPE.

PPE required for use of Maxim MZ: Waterproof gloves, respirator with dust/mist filter with MSHA/NIOSH approval number prefix TC-21 or any N, R, P, or HE filter, long sleeved shirt and long pants, protective eye wear and waterproof apron, shoes plus socks.

REI: 24 hours; early re-entry into treated areas requires use of the following PPE: waterproof gloves, coveralls, shoes plus socks.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:

Mancozeb:

Acute and chronic toxicity: Mancozeb has slight acute toxicity through the oral, dermal and inhalation routes (EPA toxicity class III-IV) and is not a dermal sensitizer or irritant, however mancozeb is slightly irritating to eyes. **Mitigation: Proper eye protection (goggles, or face shield) should be worn when mixing, loading or handling Maxim.**

A breakdown product of mancozeb, ethylenethiourea (ETU), is a potential carcinogen and has been found to cause reproductive/developmental toxicity effects in laboratory test animals.

Mitigation : All handlers should be informed of the potential carcinogenicity of mancozeb and encouraged to reduce their exposure through the use of the required PPE.

Mitigation: Women of child bearing age and young children should be made aware of the potential for development or reproductive toxicity effects resulting from mancozeb exposure and discouraged from handling mancozeb or entering areas where mancozeb is applied.

Ecological toxicity: Mancozeb is highly toxic to aquatic invertebrates and fish. **Mitigation: Potato seed treatments with mancozeb do not pose significant risk to aquatic organisms so long as treated potato seeds are not disposed of, or stored in ways that directly contaminate fish holding waters.**

Mancozeb is not persistent in soils (field half-life 3 days in soil). It is practically insoluble in water and thus is unlikely to be carried down by rains to groundwater. However a breakdown product of mancozeb is of concern, ETU is predicted to be susceptible to leaching and highly soluble and mobile. However, when applied as a seed treatment and introduced into the soil ETU lacks stability which limits its leaching. **Mitigation: Potato seed treatments with mancozeb do not pose significant risk of ground water contamination so long as treated potato seeds are not disposed of, or stored in ways that directly contaminate surface waters or shallow water tables.**

Fludioxonil:

Acute and chronic toxicity: Fludioxonil has slight acute toxicity (EPA toxicity Class III-IV) for all pathways of exposure, including oral, dermal and inhalation. Fludioxonil is a slight eye irritant.. Maternal toxicity in pregnant rats was observed in EPA cited development and reproductive toxicity studies however no increased susceptibility of offspring was found. Fludioxonil is not a carcinogen and is a Group D chemical – not classifiable as to human carcinogenicity, evidence of non-carcinogenicity in humans.

Ecological toxicity: Fludioxonil is moderately persistent in soils (half-lives ranging from 143 to 495 days) however it is not expected to volatilize from the soils, also it has low solubility in water. For these reasons fludioxonil is mostly a concern for surface water contamination but is not expected to leach into groundwaters. Some of its degradates are mobile and could potentially leach into groundwater

<p>but these are not of toxicological concern. Fludioxonil is categorized as highly toxic to freshwater fish and invertebrates. Mitigation: Potato seed treatments with fludioxonil does not pose significant risk to aquatic organisms so long as treated potato seeds are not treated, disposed of, or stored in ways that directly contaminate fish holding waters. Fludioxonil is practically non-toxic to birds and honeybees.</p>
<p>f. Effectiveness of the requested pesticide for the proposed use: Maxim MZ has been show by manufacturer research data, validated by the EPA registration process, to be an effective tool in suppression of potato soil-borne fungal diseases and in particular to reduce loses from fusarium dry rot and silver scurf.</p> <p>Mancozeb has been classified by FRAC to be in group M3. Fludioxonil is in the FRAC group 12. Thiophanate-mehtyl, an alternative potato seed treatment is in FRAC MOA group 1.</p>
<p>g. Compatibility of the proposed pesticide use with target and non-target ecosystems: See element e for information about impacts to non-target organisms and environmental fate of the active ingredients.</p>
<p>h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Treated seeds will not be disposed of or used in areas where they could directly contaminate surface or groundwater.</p>
<p>i. Availability of other pesticides or non-chemical control methods: Non-chemical controls that could form the basis of an IPM plan for potato fungal diseases can be found in element b, above. Soil borne fungal diseases in potato are most effectively suppressed with disease free planting materials, as well as non-chemical cultural controls and seed treatments.</p>

F. Herbicides

1. Corn and bean herbicides

The recommended herbicides in the MWP are not sufficient for weed management in corn and bean production. To this end the SMTN technical assistance team is coming up with a host of additional herbicides with different modes of action as well as levels of residual and contact effects. The herbicides recommended here, all provide good alternatives to the two currently recommended products (glyphosate and fusillade). The following herbicides have been screened and recommended for use on corn and beans for varying weed species: **bentazon (corn, beans and rice), carfentrazone-ethyl (corn and rice), sethoxydim (beans and corn), halosulfuron-methyl and pendimethalin (corn).**

15. bentazon 44%; soluble concentrate formulation; common trade name: Basagran, EPA REG. NO. 7969-45

16. carfentrazone-ethyl 50% emulsifiable concentrate; common trade name: Aim 50 DF, EPA REG. NO.

279-3182

17. halosulfuron-methyl 75%; flowable formulation; common trade names: Sandea, EPA REG. NO. 81880-18

18. pendimethalin 33-40%; liquid, EC, SC, and granular formulations, common trade names: Pendimax 3.3 and Prowl 3.3 EC EPA REG. NO. 68156-6 and 241-337.

19. sethoxydim 13%; emulsifiable concentrate formulation; common trade name: Segment, EPA REG. NO. 7969-88

a. US EPA registration status: All products are ACTIVE and are recommended for use in beans and or corn to control common grasses and broad leaf weed species

These products are registered for use in the production of the following crops:

Corn:

bentazon (for post-emergence broadleaves i.e. nutsedge, cleavers and stork's bill. *It can also be used on beans and rice)

carfentrazone-ethyl (for post-emergence control of broad-leaf weeds, i.e. morning glory, lambs quarters, cheese weed. *It can also be used on beans and rice)

halosulfuron-methyl (effective both pre- and post-emergence for control of broad leaf weeds and yellow nutsedge. *It can also be used on beans and rice)

pendimethalin (for pre-emergence control of grasses. *It can also be used on rice)

Beans:

bentazon (for post-emergence broadleaves i.e. nutsedge, cleavers and stork's bill. *It can also be used on corn and rice)

carfentrazone-ethyl (for post-emergence broad-leaf weeds, i.e. morning glory, lambs quarters, cheese weed. *It can also be used on corn and rice)

sethoxydim (for post-emergence control of annual grasses, i.e. barnyard, itch, signal and crab grasses, etc. and perennial grassy weeds, i.e. Bermuda, Johnson, guinea grasses, etc.)

halosulfuron-methyl (effective both pre- and post-emergence for control of broad leaf weeds and yellow nutsedge. *It can also be used in corn and rice)

b. Basis for selection of the pesticides: In order to address the full spectrum of weed issues for the current areas of WINNER's implementation and more effectively provide options for managing the development of resistant biotypes, additional herbicides approved for use in corn and beans have been recommended. In intensive agricultural systems such as Haiti's bean and corn growing regions where these crops are often grown with minimal crop rotation, fallow, or cover cropping to replenish soil nutrients, natural enemy populations, etc., the use of selective herbicides with little residual action, such as these, can improve the sustainability of production and reduce the impacts on non-target species. The minimal human health and ecological impacts expected from the use of these products were the basis for selecting these particular herbicides.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program:

Weed control is a challenging and economically important issue for Haitian cash crop farmers of beans and corn. While some farmers' fields are small enough in scale that manual weeding remains a viable option, many farmers have a large enough crop that herbicide use is an economically

attractive alternative to hiring additional workers for weeding. Herbicides are an expensive investment and in order to ensure favourable weed management outcomes in the long term, alternative non-chemical controls such as crop rotation, the use of stale seed beds, solarisation, crop spacing to increase shading, use of mechanical weeding tools (i.e. hula-hoe), and even flame-weeding should be tested locally and offered up to farmers as important alternatives to explore. These alternatives are especially important given the long term economic and environmental costs of solely relying on chemical herbicides.

d. Proposed method or methods of application, including the availability of application and safety equipment:

The recommended herbicides are available in a range of liquid formulations that should be applied with the appropriate applicator equipment such as a backpack sprayer.

PPE required for use of recommended herbicides:

Bentazon: Waterproof gloves, long sleeve shirt and pants and shoes plus socks.

REI – 48 hours; early re-entry requires use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI – Follow label instructions

Carfentrazone-ethyl: waterproof gloves, long sleeve shirt and pants and shoes plus socks.

REI – 12 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI - Follow label instructions

Halosulfuron-methyl: long sleeve pants, shoes plus socks.

REI 12 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI – Beans and corn = 30 days

Pendimethalin: Waterproof gloves, long sleeve shirt and long pants, shoes plus socks.

REI – 24 hours; early re-entry requires the use of the following PPE Coveralls, waterproof gloves, and socks plus shoes.

PHI – Follow label instructions

Sethoxydim: waterproof gloves, long sleeve shirt and pants and shoes plus socks.

REI – 12 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI – Dry beans = 30 days and for succulent beans = 15 days

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:

Bentazon

Acute and chronic toxicity: Bentazon is classified by the EPA in toxicity class III for acute oral, dermal and inhalation toxicity. Bentazon has been found in testing to be slightly irritating to the skin and eyes. Reproductive and maternal toxicity testing have revealed some toxicity effects, however the exposure risks for workers and consumers are evaluated by the EPA as being very low given the activity of the product at low dosages. The maximum application rate in rice is 2.24 kg/ha per year. This rate should be adhered to by WINNER and partner stakeholders. **Mitigation: Promote awareness of the potential reproductive and development risks, although slight. Women of child bearing age and children, in particular, should as a precaution, be prevented from being exposed to bentazon.**

Ecological toxicity risks: Bentazon is a known groundwater contaminant **Mitigation: Promote EPA required maximum application dose of 1.12 kg of a.i./ha at a rate of no more than twice per year.** There are few expected negative effects for non-target organisms associated with the use of bentazon on rice, corn and beans. Bentazon is not acutely toxic to fish or plankton and practically non-toxic to aquatic invertebrates and slightly toxic to birds and bees. Bentazon may be harmful to non-target terrestrial, aquatic and semi-aquatic plants. **Mitigation: Impacts on non-target should be minimized by implementing run-off and spray drift control measures (spraying in the early morning when winds are low, no application when rainfall is eminent).**

Carfentrazone-ethyl

Acute and chronic toxicity: Carfentrazone-ethyl is classified in EPA toxicity class III for acute oral, dermal and inhalation toxicities, and in toxicity class IV for primary eye and skin irritation. There are no test data that indicate concern for any chronic toxicity as result of carfentrazone-ethyl exposures.

Ecological toxicity risks: Carfentrazone-ethyl has been shown in EPA test data to be slightly toxic to fish and bees and moderately toxic to some types of plankton. **Mitigation: Impacts on non-targets should be minimized by implementing run-off and spray drift control measures (spraying in the early morning when winds are low, no application when rainfall is eminent).**

Halosulfuron-methyl

Acute and chronic toxicity: Halosulfuron-methyl has been classified in EPA toxicity class III for acute oral, dermal and inhalation toxicities. Halosulfuron-methyl is neither a significant eye nor skin irritant and is placed in EPA toxicity class III for these routes of exposure. In some EPA test data slight development toxicity effects were observed.¹⁰⁶ **Mitigation: As EPA development toxicity test data are suggestive of potential impacts to pregnant mother's and child's health, women of child bearing age and children should be made aware of the risks from exposure to these products and should be encouraged to minimize the risks of their exposure.**

Ecological toxicity: Halosulfuron-methyl is practically non-toxic to fish and aquatic invertebrates and slightly toxic to birds. This herbicide has the potential to contaminate surface and ground waters. **Mitigation: Impacts on non-target should be minimized by implementing run-off and spray drift control measures (spraying in the early morning when winds are low, no application when rainfall is eminent).**

¹⁰⁶ "Halosulfuron-methyl: pesticide tolerances." The Federal Register Vol. 75, No. 45, August 2010. P 46849.

Pendimethalin

Acute and chronic toxicity

Pendimethalin generally is of low acute toxicity through all pathways of exposure, EPA toxicity class III through oral and eye exposure and class IV through dermal and inhalation. Pendimethalin exposure in laboratory testing caused thyroid follicular cell adenomas in male and female rats and has been classified as a Group C, possible human carcinogen. **Mitigation: Use of non-chemical weed management controls, rotation with other less toxic herbicides and use of required PPE will limit the exposure risks.**

Ecological toxicity risks: Pendimethalin dissipates by binding to soil and is essentially immobile once bound to soil. Although pendimethalin can contaminate surface water from spray drift, runoff or from rainfall events its high affinity to bind to soil and sediment will likely limit concentrations of pendimethalin in surface waters. The risk of groundwater contamination is low.

Pendimethalin doesn't represent a high acute or chronic risk to birds or to mammals. Fish may be negatively affected by exposure to pendimethalin. **Mitigation: Pendimethalin should not be applied in a way that contaminates, surface, estuarine or marine fish holding water.**

Sethoxydim

Acute and chronic toxicity: Sethoxydim has been classified in EPA toxicity class III for acute oral, dermal and inhalation toxicities. Sethoxydim is neither a significant eye nor skin irritant and is placed in EPA toxicity class IV for these effects. According to the EPA test results have shown sethoxydim is toxic to the liver.

Ecological toxicity: Sethoxydim is slightly toxic to aquatic insects and fish, as well to some types of plankton but moderately toxic to amphibians. **Mitigation: In fields bordering surface, estuary or coastal waters, wetlands or other habitats containing sensitive or endangered species, measures to reduce run-off and spray drift (soil bunding, vegetative borders, application when wind speeds are typically reduced (in the early morning), no application when rainfall is eminent) should be implemented.** Sethoxydim is practically non-toxic to bees and birds. Sethoxydim has the potential to contaminate surface and groundwater however, the estimated levels of contamination from the labeled uses are below the EPA level of concern.¹⁰⁷

Effectiveness of the requested pesticide for the proposed use:

Herbicide resistance management is an important part of any IPM program. The following are the HRAC herbicide mode of action classifications for the recommended herbicides for bean and corn:

bentazon is in **group C3.**

carfentrazone-ethyl is **group E.**

halosulfuron-methyl is in **group B.**

pendimethalin is in **group K1.**

sethoxydim is in **group A.**

Herbicides should be rotated, to the extent possible, so as to target similar pest species with a variety of

¹⁰⁷ "RED for Sethoxydim." USEPA, October, 2005. 7

different modes of action, thereby reducing the exposure to particular action pathways and making resistance development less likely.	
f. Compatibility of the proposed pesticide use with target and non-target ecosystems	All the recommended herbicides, have the potential to contaminate surface and groundwater or harm non-target plants and organisms if label instructions are not followed. No direct application of these products to surface waterways is permitted. These risks are estimated by the EPA as acceptably low assuming the label dosage, application frequency and other use requirements are followed. See element e , above for more specific eco-toxicity information.
g. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils:	There are no additional conditions for the use of the recommended herbicides other than those mitigation measure stipulated in element e .
h. Availability of other pesticides or non-chemical control methods:	Corn: Of the herbicides recommended for corn and beans, carfentrazone-ethyl poses the lowest human health and ecological toxicity risks.

2. Rice herbicides

The WINNER program promotes a System of Rice Intensification with transplanted rice. Due to the scale of farmer's growing operations and expense of labor, Haitian rice production uses chemical herbicides for broadleaf and grassy weeds.

The use of herbicides for weed management in rice production is particularly necessary in, the traditional Haitian method of planting direct seeded rice. In this type of planting weeds and the rice are on the same growth timeline (rice is not transplanted) and weeds offer far greater competition for water and nutrients. However, the increased yield of direct seeding from water induced stress through a calculated irrigation regime is highly desirable and provides the rationale for experimenting with this approach. The following herbicides were screened and recommended according to the PERSUAP methodology: **2, 4-D acids and salts, bentazon, bispyribac-sodium, carfentrazone-ethyl, cyhaliofop-butyl, fenoxaprop-p-ethyl, halosulfuron-methyl, pendimethalin, propanil, thiobencarb, triclopyr and sodium chlorate.**

Other herbicides were proposed or found available as alternatives but these were not recommended based upon the following rationales:

<u>Active ingredient:</u>	<u>Rationale for Not recommending:</u>

1. Butachlor	Butachlor is not EPA registered and has been shown to be a likely carcinogen. Additionally, a chemical compound in the same chloroacetamide family, alachlor, has a similar mode of toxicity and is registered as an RUP by the EPA for its carcinogenicity and groundwater contamination concerns. ¹⁰⁸
2. MCPA	The EPA in their most recent registration of MCPA cancelled its rice uses due to unacceptable occupational and ecological risks. ¹⁰⁹
3. Molinate	Not recommended because EPA registration cancelled and due to findings of exposure related reproductive neurotoxicity, cholinesterase inhibition, suggestive evidence of carcinogenicity and persistence in surface waters and risks of contaminating groundwater. ¹¹⁰
4. Oxadiargyl	Oxadiargyl is not EPA registered and is in the oxadiazole chemical family that contains another active ingredient (oxadiazon) that poses reproductive toxicity, carcinogenic risks, and can bio-accumulate in surface waters. Given the lack of certainty that oxadiargyl does not share these same toxicity risks, and the availability of alternatives, oxadiargyl is not recommended. ¹¹¹
5. Pretilachlor	Pretilachlor is also not EPA registered and is in the chloroacetamide family that contains several active ingredients (propachlor, acetochlor, alachlor) that pose reproductive toxicity, carcinogenic and groundwater contamination risks. Given the lack of certainty that pretilachlor does not share these same toxicities and pose a threat to groundwater, as well as the availability of alternatives, pretilachlor is not recommended. ¹¹²

¹⁰⁸ “Registration Eligibility Decision for Alachlor.” US EPA, November 1998.

¹⁰⁹ “Registration Eligibility Decision for MCPA.” US EPA, December, 2004. p. V.

¹¹⁰ Dobozy, Virginia A. “Human Health Risk Assessment: Molinate.” US EPA, November 2002.

¹¹¹ “Registration Eligibility Decision for Oxadiazon.” US EPA, September 2003.

¹¹² “Registration Eligibility Decision for Propachlor.” US EPA, November 1998.

Recommended herbicide active ingredients for use on rice:

20. 2, 4-D acids and salts (NOT Esters) 46-47%; liquid, emulsifiable concentrate (EC) formulations, common trade names: 2-4, D Amine 4, EPA REG. NO. 62575-1

21. bentazon 44%; soluble concentrate (SC) formulation; common trade name Basagran, EPA REG. NO. 7969-45

22. bispyribac-sodium 80%; soluble concentrate formulation, common trade name Regiment, EPA REG. NO. 59639-105

23. carfentrazone-ethyl 50% EC formulation; common trade name Aim 50 DF, EPA REG. NO. 279-3182

24. cyhaliofop-butyl 18.2%; SC formulation; common trade name Clincher EZ, EPA REG. NO. 62719-605

25. fenoxaprop-p-ethyl 6.7%; SC formulation; common trade name Ricestar, EPA REG. NO. 264-682

26. halosulfuron-methyl 75%; flowable formulation; common trade names Halosulfuron 75 WDG, EPA REG. NO. 2749-528

27. pendimethalin 0.7-60%; liquid, EC, SC, and granular formulations, common trade names: Pendimax 3.3 and Prowl 3.3 EC EPA REG. NO. 68156-6 and 241-337.

28. propanil 16.6-41.4%; flowable, water dispersed granules, EC formulations; common trade names: Stam 4 SC EPA REG. NO. 70506-167

29. thiobencarb 15%; granular formulation; common trade name: Bolero 15G, EPA REG. NO. 63588-14

***The granular formulation of thiobencarb is recommended over liquid formulations which require engineering controls during application that are likely not widely available to target Haitian farmers.**

30. triclopyr triethylamine salt (TEA) 44.4%; granular, liquid and EC formulations, common trade name: Grandstand R, EPA REG. NO. 62719-215

31. sodium chlorate 52%; soluble concentrate formulation; common trade name: Drexel defol 750 , EPA REG. NO. 19713-486

Of the above herbicides, **bispyribac-sodium, carfentrazone-ethyl sodium chlorate, propanil, fenoxaprop-p-ethyl and cyhaliofop-butyl** are the least toxic and should be favored when they provide effective control for target weed species.

a. US EPA registration status: All products are ACTIVE and are recommended for use in rice to control common grasses and broad leaf weed species both before and after their emergence.

These herbicides are proposed by WINNER as part of SRI they are promoting in Haiti. Direct seeding of rice is also reported as a traditional practice in Haiti. WINNER will work with target farmers to demonstrate the benefits of effective herbicide use for increasing yields from SRI. Because the proposed use of these products is for weed control in rice production, and the risks associated with there uses are similar, these products will be considered together

b. Basis for selection of the pesticides: Weed species if un-controlled in rice can reduce yields significantly¹¹³, according to the International Rice Research Institute's (IRRI) weed control handbook.

¹¹³ Ampony-Nyarko, Kwesi and De Data, S.K. "A Handbook for weed control in rice." International Rice Research Institute (IRRI)." 1991. 76

Weeds are the most serious pest in rice as if they are not controlled they will suffocate the entire crop each season. The range of herbicides that can be used safely in rice is limited and a mix of both pre- and post-emergence products is desirable.

The herbicide chemicals selected here all fall within the EPA toxicity classifications III and IV. For some of these chemicals there are chronic exposure toxicities (neurotoxic, endocrine disruption or possible carcinogenic effects) that increase the potential risks associated with the use of some products. In all cases these chemicals have relatively low toxicities, user and ecological hazards when compared with the alternatives also screened.

All these products are recommended by the EPA and, or, the IRRI weed management handbook for use as either pre- or post-emergent weed control in transplanted and direct seeded rice.

Pre-emergence herbicides:

halosulfuron-methyl (for control of broad leaf weeds and yellow nutsedge, can also be used in beans and corn)

thiobencarb (for grasses and broadleaves with some activity on sedges)

pendimethalin (for grasses)

Post-emergence herbicides:

2, 4-D acids and salts (for sedges, broad leaf and aquatic weed species)

bentazon (for broadleaves i.e. nutsedge, cleavers and stork's bill, can also be used on corn and beans)

bispyribac-sodium (for grasses i.e. johnson and barnyard grasses; broad leaf weeds (dayflower, gooseweed, etc., non-residual)

carfentrazone-ethyl (for broad-leaf weeds, i.e. morning glory, lambs quarters, cheese weed, can also be used on corn and beans)

cyhaliofop-butyl (for annual and perennial grasses)

fenoxaprop-p-ethyl (for annual and perennial grasses)

halosulfuron-methyl (for control of broad leaf weeds and yellow nutsedge, can also be used in beans and corn)

propanil (for broad leaf weed species)

thiobencarb (for grasses and broadleaves with some activity on sedges)

triclopyr (for broad leaf and sedges resistant to phenoxy acid herbicides (such as 2, 4-D)

Sodium chlorate is used as a general non-selective contact herbicides and demonstrates phytotoxic and desiccation effects that lead to defoliation and death of plant species.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program:

These herbicides are all commonly used for weed control in US rice production as well as in rice growing regions all over the world. There are several integrated chemical controls aside from the use of herbicides, including the following:

Stale seed bed techniques should be promoted as a way to prevent weed establishment and reduce the need for chemical weed controls. Intermittent flooding and drainage of paddies rice can also minimize aquatic and semi-aquatic weed species if done at appropriate weed growth stages.

- 1) Maintain flood water in the field for the first month to delay weed emergence
- 2) Ensure plots are as level as possible, any exposed soil surface area will provide ideal conditions for weed germination.
- 3) Use a stale seedbed technique. Following land preparation weeds are allowed to emerge with rainfall or irrigation and allowed to reach 2-5 leaf stage before they are destroyed with shallow cultivation or use of a non-residual contact herbicide (i.e. sodium chlorate, glyphosate).
- 4) Reduce spacing of rice so as to reduce the available soil area for competition by weeds. Planting at 100 kg/ha or higher has been observed to reduce competition from weeds.
- 5) Hand weeding is critical during the first 6 weeks after seeding to increase the likelihood of effective weed management. If seedlings are planted densely mechanical weeding is difficult, especially. Two to three hand weedings at this stage are recommended to prevent yield losses.

d. Proposed method or methods of application, including the availability of application and safety equipment:

Labels for rice herbicides require the use of appropriate herbicide application equipment such as backpack sprayer and, or, granular shakers.

All products are available in a range of formulations and are proposed for use by knowledgeable rice farmers and association members that have received training in proper rice herbicide application techniques, equipment and personal protective equipment use in accordance with the products' labels. This is of increased importance in rice as the aquatic nature of rice culture increases the risks of run-off in irrigation waters that can lead to surface and groundwater contamination.

PPE required for handling recommended herbicides:

2, 4-D acids and salts: Eye protection goggles, water-proof gloves, waterproof hat, coveralls over short sleeves and short pants, rubber boots.

REI – 48 hours; early re-entry requires the same PPE as listed above.

PHI – 60 days: only one pre-plant application and only one post-emergence application.

Bentazon: Waterproof gloves, long sleeve shirt and pants and shoes plus socks.

REI – 48 hours; early re-entry requires use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI – Follow label instructions

Bispyribac-sodium: Waterproof gloves, long sleeve shirt and pants and shoes plus socks.

REI – 12 hours; early re-entry requires use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI – Follow label instructions

Carfentrazone-ethyl: waterproof gloves, long sleeve shirt and pants and shoes plus socks.

REI – 12 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI - Follow label instructions

Cyhaliofop-butyl: Long-sleeved shirt and long pants, protective eyewear, shoes and socks.

REI – 12 hours; early re-entry requires use of the following PPE: Coveralls over long sleeve shirt and pants, waterproof gloves, rubber boots and socks, eye goggles or face-shield.

PHI - Follow label instructions

Fenoxaprop-p-ethyl: Long-sleeved shirt and long pants, protective eyewear, shoes and socks.

REI – 24 hours; early re-entry requires the following PPE: waterproof gloves, coveralls/long sleeved shirt and long pants, shoes plus socks.

PHI – 65 days

Halosulfuron-methyl: long sleeve pants, shoes plus socks.

REI 12 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes and socks.

PHI – Follow label instructions

Pendimethalin: Waterproof gloves, long sleeve shirt and long pants, shoes plus socks.

REI – 24 hours; early re-entry requires the use of the following PPE Coveralls, waterproof gloves, and socks plus shoes.

PHI – Follow label instructions

Propanil: Eye protection goggles, water-proof gloves, waterproof hat (if overhead exposure expected), coveralls over long sleeve shirt and long pants, rubber boots, and a waterproof apron for mixing and loading.

REI – 24 hours; early re-entry requires the following PPE: Coveralls over long-sleeve shirt and long pants; waterproof gloves; rubber boots plus socks; protective eyewear.

PHI – Follow label instructions

Thiobencarb: **The granular formulation of thiobencarb is recommended over liquid formulations which require engineering controls during application that are likely not widely available to target Haitian farmers.*

PPE For granular formulations: chemical-resistant apron, chemical-resistant gloves, long-sleeve shirt, long pants, shoes, and socks.

REI – 24 hours; early re-entry requires the use of the following PPE Coveralls, waterproof gloves, and socks plus shoes.

PHI - Follow label instructions

Triclopyr: protective eyewear (goggles), waterproof gloves, long sleeve shirt and pants, shoes plus socks.

REI – 48 hours; early re-entry requires use of the following PPE: protective eyewear (goggles), coveralls, waterproof gloves, and shoes plus socks.

PHI - Follow label instructions

Sodium chlorate: long sleeve shirt and pants, shoes plus socks.

REI – 12 hours; for early re-entry wear above PPE plus chemical resistant gloves.

PHI – 7-10-days.

Do not graze field within 14 days of treatment with sodium chlorate.

- e. **Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:**

2, 4-D acids and salts

Acute and chronic toxicity risks – Formulated 2, 4-D acid or salt, at the concentrations contained in end use products has low acute toxicity risks (toxicity class III-IV). Acute oral, dermal and inhalation toxicities are categorized as class III. 2, 4-D in its acid and salt forms are highly toxic (class I) and corrosive to eyes. **As mitigation: PPE worn when handling, mixing or using 2, 4-D should include appropriate eye protection in the form of a full face shield or goggles.**

2, 4-D is not classifiable as a carcinogen, nor has it been shown in EPA studies to have developmental toxicity or neurotoxicity effects of concern. The potential for endocrine disruption effects from repeated exposure to 2, 4-D has been identified as a concern by the EPA. No complete set of testing results for these effects have been developed so the risks are uncertain at this point.¹¹⁴ **As mitigation full use of required PPE should be worn by handlers, mixers and sprayers of 2, 4-D and these sprayers should be varied so as to reduce the repeat exposure experienced by any one person.**

2, 4-D ecological toxicity risks are summarized here: Acid and amine salts of 2, 4-D are practically non-toxic to freshwater and marine fish as well as to amphibians. These formulations of 2, 4-D range from slightly toxic to practically non-toxic to freshwater invertebrates.¹¹⁵ 2, 4-D esters can be highly toxic to freshwater fish and invertebrates and this contributes to the rationale for the EPA's lack of registration of these esters for use on rice. **Mitigation: Only 2, 4-D acid and amine salt form should be used on rice. 2, 4-D esters are not to be used on rice.**

2, 4-D is moderately to practically non-toxic to birds. The toxicity of 2, 4-D for vascular plants is two orders greater than that for non-vascular plants. **Mitigation: Impacts on non-target plant and aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Bentazon

Acute and chronic toxicity: Bentazon is classified by the EPA in toxicity class III for acute oral, dermal and inhalation toxicity. Bentazon has been found in testing to be slightly irritating to the skin and eyes. Reproductive and maternal toxicity testing has revealed some toxicity effects however, the exposure risks for workers and consumers are evaluated by the EPA as being very low given the activity of the product at low dosages. Further reducing any cause for concern is low maximum application rate, 2.24 kg/ha per year. **Mitigation: Promote awareness of the potential reproductive and development**

¹¹⁴ "EPA RED for 2, 4-D." US EPA, June 2005, 21.

¹¹⁵ "EPA RED for 2, 4-D." US EPA, June 2005, 59-60.

risks, particularly to women of child bearing age and children, and discourage any potential exposure to women or children.

Ecological toxicity risks: Bentazon is a known groundwater contaminant **Mitigation: Promote EPA required maximum application rate of 1.12 kg/ha no more than twice per year.** There are little expected negative effects for non-target organisms associated with the use of bentazon on rice, corn and beans. Bentazon is not acutely toxic to fish or plankton and practically non-toxic to aquatic invertebrates and slightly toxic to birds bees. Bentazon may be harmful to non-target terrestrial, aquatic and semi-aquatic plants. **Mitigation: Impacts on non-target plant and aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, application frequency and any post-application irrigation water holding periods.**

Bispyribac-sodium

Acute and chronic toxicity: Bispyribac-sodium (BS) is not expected to be harmful for humans, if ingested this chemical is not metabolized by humans rather it is secreted intact. The only registered product for use on rice is EPA toxicity class III, the WHO toxicity class is II. Bispyribac-sodium has been shown in manufacturer testing to be non-carcinogenic, not mutagenic and not to have any development or reproductive toxicities.

Ecological toxicity: BS has the potential to leach into ground and surface waters but the low maximum application rate (0.053 lbs/acre) 59 g/ha per season reduces the risk of significant contamination. BS is practically non-toxic to fish, aquatic insects, crustaceans and bees. BS may be harmful to non-target terrestrial, aquatic and semi-aquatic plants. **Mitigation: Impacts on non-target plant and aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Carfentrazone-ethyl

Acute and chronic toxicity: Carfentrazone-ethyl is classified in EPA toxicity class III for acute oral, dermal and inhalation toxicities, and in toxicity class IV for primary eye and skin irritation. There are no test data that indicate concern for any chronic toxicity as result of repeated carfentrazone-ethyl exposure.

Ecological toxicity risks: Carfentrazone-ethyl has been shown in EPA test data to be slightly toxic to fish and bees and moderately toxic to some types of plankton. **Mitigation: Impacts on non-target plant and, or other aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Cyhaliofop-butyl and fenoxaprop-p-ethyl

Acute and chronic toxicity: Cyhaliofop-butyl and fenoxaprop-p-ethyl (FPE) are both aryloxyphenoxy propionic acids that have similar modes of action and human acute and chronic toxicity risks.

Cyhaliofop-butyl is EPA toxicity class III for acute oral, dermal and inhalation toxicities as well as for eye and skin irritation. EPA registration data do not have a full set of specific human acute toxicity data however, all FPE end use products are classified as EPA toxicity class III (indicating a similarly low range of acute toxicities as cyhaliofop-butyl products). There are no chronic toxicity, carcinogenic or neurotoxic effects associated with exposure to cyhaliofop-butyl or fenoxapropo-p-ethyl products.

Ecological toxicity risks: As these two active ingredients share a similar mode of action, their toxicities to non-target organisms are comparable. Both cyhaliofop-butyl and FPE are highly toxic to freshwater fish, and are moderately to highly toxic to freshwater insects and marine/estuarine crustaceans. Cyhaliofop-butyl and FPE are slightly to non-toxic to bees. Cyhaliofop is practically non-toxic to birds and there is no acute toxicity data of FPE for birds. **Mitigation: Impacts on non-target plant and aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Halosulfuron-methyl

Acute and chronic toxicity: Halosulfuron-methyl has been classified in EPA toxicity class III for acute oral, dermal and inhalation toxicities. Halosulfuron-methyl is neither a significant eye nor skin irritant and is placed in EPA toxicity class III for these effects as well. In some EPA referenced test data slight development toxicity effects were observed.¹¹⁶ **Mitigation: As EPA development toxicity test data suggests potential impacts to pregnant mother and child's health, women of child bearing age and children should be made aware of the risks from exposure to these products and should be encouraged to minimize the risks of their exposure.**

Ecological toxicity: Halosulfuron-methyl is practically non-toxic to fish and aquatic invertebrates and slightly toxic to birds. This herbicide has the potential to contaminate surface and ground waters, particularly when used in rice or on other areas with basic soils with high clay contents. **Mitigation: Impacts on non-target plant and, or other aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Pendimethalin

Acute and chronic toxicity

Pendimethalin generally is of low acute toxicity through all pathways of exposure, EPA toxicity class III through oral and eye exposure and class IV through dermal and inhalation. Pendimethalin exposure in laboratory testing caused thyroid follicular cell adenomas in male and female rats and has been classified as a Group C, possible human carcinogen. **Mitigation: Use of non-chemical weed management controls, rotation with other less toxic herbicides and use of required PPE will limit the exposure risks.**

Ecological toxicity risks: Pendimethalin dissipates by binding to soil and is essentially immobile once bound to soil. Although pendimethalin can contaminate surface water from spray drift, runoff or from

¹¹⁶ "Halosulfuron-methyl: pesticide tolerances." The Federal Register Vol. 75, No. 45, August 2010. P 46849.

heavy rainfall events and irrigation water discharge, its high affinity to bind to soil and sediment will likely limit concentrations of pendimethalin in surface waters. The risk of groundwater contamination is low.

Pendimethalin doesn't represent a high acute or chronic risk to birds or to mammals. Fish may be negatively affected by exposure to pendimethalin. **Mitigation: Pendimethalin should not be applied in a way that contaminates, estuarine or marine fish holding waters.**

Propanil

Acute and chronic toxicity: Propanil has slight acute toxicity and is in EPA toxicity class III for acute dermal toxicity and eye irritation and toxicity class IV for acute oral and inhalation toxicities and skin irritation. This active ingredient has also tested negative for carcinogenic and mutagenic effects.

Ecological toxicity risks: Propanil poses a moderate acute toxicity risk to fish, for all other non-targets, bees, crustaceans and amphibians, there is a range of toxicity from practically non-toxic to slight acute toxicity. **Mitigation: Impacts on non-target plant and aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Thiobencarb

Acute and chronic toxicity risks: Thiobencarb poses only slight acute toxicity; it is classified as EPA toxicity class III for acute oral and dermal toxicity and eye irritation and in toxicity class IV for acute inhalation toxicity. Thiobencarb is a cholinesterase inhibitor and repeated exposure can affect brain and nervous system function. **Mitigation: Full use of required PPE should be worn by handlers, mixers and sprayers of thiobencarb. Herbicide sprayers should be varied so as to reduce the repeat exposures experienced by any one person.**

Ecological toxicity risks: Thiobencarb is moderately to highly toxic to freshwater fish and marine/estuarine crustaceans, as well as highly toxic to freshwater insects, moderately toxic to amphibians and practically non-toxic to birds. **Mitigation: The EPA mandates a 30-day water holding restriction for permanent flood waters after treatment with granular thiobencarb. Thiobencarb should also not be applied if rain is eminent within 24 hours.**

Triclopyr

Acute and chronic toxicity risks: Triclopyr in the triethylamine salt (TEA) and butoxyethyl ester (BEE) forms have low acute toxicities, triclopyr TEA and BEE are toxicity class III for acute oral and dermal toxicity and class IV for acute inhalation toxicity. Triclopyr TEA is in EPA toxicity class I for severe eye irritation and is corrosive to eyes, triclopyr BEE conversely is only a slight eye irritant (EPA toxicity class III). **Mitigation: For triclopyr TEA products PPE should include appropriate eye protection in the form of a full face shield or goggles.**

Triclopyr has been linked to potential reproductive toxicity effects in testing in rats and mice.

Exposure poses potential risks especially to pregnant women and women of child bearing age.

Mitigation: Women of child bearing age and children should be made aware of the developmental toxicity risks and discouraged from handling triclopyr products.

Ecological toxicity risks:

Triclopyr TEA and BEE have variable toxicities for non-target aquatic organisms: BEE is highly toxic to fish while TEA is only slight toxic to fish, BEE is also moderately toxic to freshwater insects while TEA is practically non-toxic. As triclopyr is an herbicide impacts on non-target plant species is also of potential concern. **Mitigation: Impacts on non-target plant and aquatic organisms from irrigation water discharge and run off should be minimized by following label requirements for maximum dosage, frequency and any post-application irrigation water holding periods.**

Triclopyr TEA and BEE are practically non-toxic and non-toxic to bees, amphibians and plankton. TEA and BEE are slightly toxic to birds.

Sodium chlorate

Acute and chronic toxicity risks: Sodium chlorate has very low acute toxicity risks and is in toxicity class III for acute dermal toxicity, skin and eye irritation and class IV for acute oral and inhalation toxicities. Sodium chlorate has shown toxic effects to the thyroid of rats in lab testing. Due to the increased sensitivities of rat thyroids these toxic effects are not expected to be as severe in humans. The PPE required above will keep risks at an acceptable level. Sodium chlorate is classified as not carcinogenic at doses less than those that cause thyroid toxicity.

Ecological toxicity risks: Sodium chlorate is not a naturally occurring compound. However, testing for acute risks to non-target organisms show that this active ingredient is not an acute risk to freshwater fish or invertebrates, and is not acutely toxic to crustaceans or birds. Exposure risks for non-target plant species is also below the EPA's threshold for concern. No additional mitigations are required to protect non-target organisms.

f. Effectiveness of the requested pesticide for the proposed use:

Herbicide resistance management is an important part of any IPM program. The following are the herbicide resistance classifications for the recommended herbicides for rice:

cyhaliofop-butyl and **fenoxaprop-p-ethyl** are in the Herbicide Resistance Action Committee's (HRAC) **group A**.

bispyribac-sodium and **halosulfuron-methyl** are in **group B**.

propanil is in **group C2**.

bentazon is in **group C3**.

carfentrazone-ehtyl is **group E**.

pendimethalin is **group K1**.

thiobencarb is in **group N**.

2, 4-D acids and salts, and **triclopyr TEA/BEE** are in **group O**

Herbicides should be rotated, to the extent possible, so as to target similar pest species with herbicides that act through a variety of different modes of action, thereby reducing the exposure to

particular action pathways and making resistance development less likely.
<p>g. Compatibility of the proposed pesticide use with target and non-target ecosystems All the recommended herbicides, with the exception of sodium chlorate, have the potential to contaminate surface and groundwater or harm non-target plants and organisms if label instructions are not followed. These risks are estimated by the EPA as acceptably low assuming the label dosage, application frequency and other use requirements are followed. See element e, above for more specific eco-toxicity information and use requirement mitigations.</p>
<p>h. Conditions under which the pesticides are to be used, including climate, flora, fauna, geography, hydrology, and soils: These herbicides are approved for use in rice so, they can be used in flooded paddies, although their effectiveness may be increased with applications to drained rice plots, this is particularly true for contact foliar herbicides. Post application irrigation water holding periods are applicable to many of these herbicides and should be referenced on the labels.</p>
<p>i. Availability of other pesticides or non-chemical control methods:</p> <p>For Pre-emergence herbicide control halosulfuron-methyl has lower human health and ecological toxicities and should be favored as the lower risk alternative to thiobencarb and pendimethalin. It should be noted that both thiobencarb and pendimethalin have possible chronic exposure toxicities for humans.</p> <ul style="list-style-type: none"> - halosulfuron-methyl (for broadleaves and sedges) - thiobencarb (for grasses and broadleaves with some activity on sedges) -pendimethalin (for grasses) <p>For post-emergence herbicides: Bispyribac-sodium, carfentrazone-ethyl, propanil, fenoxaprop-p-ethyl and cyhaliofop-butyl should be favored as lower risk options compared to the remaining alternatives.</p> <ul style="list-style-type: none"> bispyribac-sodium (for grasses i.e. johnson grass, barnyard grass; broad leaf weeds (dayflower, gooseweed, etc., non-residual) carfentrazone-ethyl (for broad-leaf weeds, i.e. morning glory, lambs quarters, cheese weed) halosulfuron-methyl (for broadleaves and sedges) propanil (for broad leaf weed species) fenoxaprop-p-ethyl (for annual and perennial grasses) cyhaliofop-butyl (for annual and perennial grasses) 2, 4-D acids and salts(for sedges, broad leaf and aquatic weed species) bentazon (for broadleaves i.e. nutsedge, cleavers and stork's bill, can also be used on corn and beans) thiobencarb (for grasses and broadleaves with some activity on sedges) triclopyr (for broad leaf and sedges resistant to phenoxy acid herbicides (such as 2, 4-D))

G. Insecticides

1. Cockroach controls: This PERSUAP Amendment also considers the use of cockroach control products for use in food processing and storage facilities supported by the WINNER program. The WINNER program identified this shortcoming in the current PERSUAP and proposed the amendment team investigate acceptable control options, both chemical and non-chemical.

The following products were screened and not recommended due to high acute toxicities, EPA cancelled registration, or not approved for use in food processing areas: Temprid SC (imidacloprid + cyfluthrin), Maxforce Granular Bait (hydamethylnon), Suspend SC (deltamethrin), Dragon/Baygon (pyrethrins, propoxur, chlorpyrifos and piperonal butoxyl), flufenoxuron, cyphenothrin, and lodfenphos/jodfenphos. **The following products were recommended: Advantage 1000/Advance Liquid (boric acid), Max Force Roach Killer (fipronil) and Avert Prescription Treatment (avermectin / abamectin).**

32. Avermectin 0.05% gel bait formulation; common trade name: Avert Prescription Treatment, EPA REG. NO. 499-406

33. Boric acid 54.2%; gel bait formulation; common trade names: Advantage 1000 EPA REG. NO. 68592-1 / Advance Liquid (Haitian Product)

34. Fipronil 0.001 – 0.05% gel bait formulation; common trade name: Max Force FC Roach Killer Bait Gel, EPA REG. NO. 432-1460.

Of these three cockroach controls boric acid is the less toxic and should be favored when it provides effective control. Liquid gel bait solutions of boric acid are safer for use in food processing facilities than dust formulations which should not be used around surfaces used for food.

a. US EPA registration status: All products are ACTIVE for cockroach control in food processing facilities.

The above are products used by a Haitian pest management service provider contracted by WINNER for pest control of cockroaches in food processing facilities. Because the proposed use of all these products is for cockroach control in food processing facilities, the same usage as considered in the US EPA registered equivalent products, these products will be considered together.

b. Basis for selection of the pesticide: Cockroaches are considered a public health threat in food processing and restaurant facilities as they can be vectors of many human diseases. Cockroaches are generally associated with unsanitary conditions and can prove difficult to control with sanitation controls alone in buildings where water or food sources (leaking pipes, food storage/handling areas) and hiding places (cracks, crevices, etc.) abound. The Haitian company employed by the WINNER program, Boucard Pest Control, uses a range of different insecticides for control of cockroaches. The least toxic of these products are those recommended here on the basis of their reduced acute and chronic toxicities. The chemical active ingredients, boric acid, avermectin and fipronil are all EPA registered for uses in cockroach control in food processing facilities as well as in other domestic and industrial use sites. These end use products are also all classified as EPA toxicity class III. There are specific use restrictions for each of the particular products considered here as well as different modes of action so as to help manage cockroach resistance. These products kill several non-resistant cockroach species including: the American cockroach, *Periplaneta Americana*, German cockroach, *Blattella germanica*, and the Asian and Oriental cockroaches, *Blattella asahinai*, *orientalis*.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: Sanitation of food processing and storage areas, elimination of water and food sources, along with

mechanical controls (sticky traps) provide reliable means for suppressing and monitoring cockroach pests so as to know when chemical control measures are justified. These control measures should be used prior to the use of chemical insecticides.

d. Proposed method or methods of application, including the availability of application and safety equipment: Labels for cockroach baits require specific spot treatment applications in cracks and crevices, in burrows or placement of baits in protective housing (i.e. housed in a center of a length of PVC tubing or other bait box/station) so as to prevent access or feeding by non-target organisms. All cockroach baits should be applied on non-food surfaces (i.e. the floor, not countertops)

All products are gel baits and, with the exception of boric acid products which can be used by lay persons, must only be used by the professional pest control service applicators that are properly trained in safe application practices and label directions.

PPE required for handling cockroach gel baits (Advantage, Avert, and Max Force roach killer products): Eye protection goggles, water-proof gloves, long sleeve shirt and long pants, shoes plus socks

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: All end use products considered here are EPA Toxicity Category III (slightly toxic). Boric acid containing products are acceptable for use by lay people (non-professional applicators).

The acute toxicities of technical grade and some agricultural use products containing avermectin and fipronil are EPA toxicity class I and some are restricted use products for aquatic and other high acute eco-toxicities. However, the gel bait formulations proposed here contain such low concentrations of these active ingredients that the toxicity classification is greatly reduced. Furthermore their indoor use profile make the risk to aquatic organisms minimal. ¹¹⁷

Mitigation 1: WINNER will promote the application of all cockroach products in accordance with label restrictions. Only professional applicators will apply Avert and Max Force roach killer products.

EPA test results have shown that avermectin and boric acid have reproductive and developmental toxicities in lab studies with pregnant mice.¹¹⁸ **Mitigation 2: Avermectin and boric acid are reproductive toxins and human exposures pose potential risks, especially to pregnant and women of child bearing age and children. Women of child bearing age and children should be made aware of the developmental toxicity risks and discouraged from handling avermectin and boric acid products.**

Fipronil has been shown in EPA testing to be a possible carcinogen. **Mitigation 3: Exposure risks to fipronil should be reduced through the use of appropriate personal protective equipment.**

As there are no outdoor uses of cockroach products proposed by WINNER there is little expected risk of exposure to non-target organisms.

f. Effectiveness of the requested pesticide for the proposed use: These control measures are effective in control of common cockroach pests and can help overcome strains resistant to organophosphate, organochlorine, pyrethroid, and carbamate products. All recommended products can be rotated to help manage and reduce the development of insect resistance.

Advantage 1000 (boric acid) is unclassified by IRAC

Max Force roach killer (fipronil) is in the IRAC group 2B

Avert Prescription treatment (avermectin) is in IRAC group 6

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: No outdoor uses of cockroach controls are proposed so no significant risks to non-target species and

¹¹⁷ “EPA RED acute toxicology testing data: Abamectin technical products.” US EPA, July 1998. 4

¹¹⁸ “Avermectin EPA RED factsheet.” US EPA. 1989.

ecosystems are expected as result of the proposed uses of cockroach gel baits.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: No outdoor uses of cockroach controls are proposed so no significant risks to non-target species and ecosystems are expected as result of the proposed uses of cockroach gel baits.

i. Availability of other pesticides or non-chemical control methods: The cockroach control active ingredients fipronil and avermectin have high acute toxicities. These products should be used only when cultural (improved sanitation) and less toxic boric acid products fail to provide effective control. The controls should be used in the following order (from least (1) to most toxic (4)):

1. Improved sanitation practices (i.e. removal of potential cockroach food attractants and water sources, and hiding places) and monitoring through sticky traps
2. Advantage 1000 (boric acid)* Least toxic option in terms of acute toxicity
3. Max Force roach killer (fipronil)
4. Avert Prescription treatment (avermectin)

3. Post-harvest controls- The WINNER program as part of their continued effort to help Haitian farmers fight post-harvest storage losses has requested additional guidance on acceptable controls for the protection of stored grains. The product **Actellic 5E (pirimiphos methyl)** is currently recommended for protection of stored grain in the MWP. The PERSUAP amendment team is including this small reference here to further emphasize that for the purposes of small farmers grain protection, Actellic **must only be used for direct treatments on grains that are for use as seed**. Actellic also can be used for the treatment of empty grain storage facilities, storage areas and the inside of storage bins. This recommendation is made in light of the risks for unsafe residues on grain resulting from direct application of an insecticide to grains intended for human consumption.

4. Rice insect controls: The stink bug (*Solubea ornata*) and rice stem stink bug (*Tibraca limbativentris*), leafminers (*Hydrellia griseola* or *H. wirthi*) as well as the rice planthopper (*Tagosodes orizicolus*) are pests of rice that can require chemical control. Of several potential insecticides available the amendment team recommends the use of **buprofezin** for planthoppers and stink bugs and **thiamethoxam** and **buprofezin** for the rice stem and common stink bugs. **Spinetoram/spinosad** are recommended for control of leafminers.

Other alternatives for control of these pests such as **carbaryl (trade name Sevin)** or **methyl parathion** or **malathion** have the potential, to contaminate groundwater and cause serious negative human health (cholinesterase disruption, cancer, reproductive and developmental toxicities) and ecological effects. Given the Haitian context and general level of farmer capacity in pesticide use, the likelihood that the usage of these products will be sufficiently circumscribed to mitigate such risks is not very likely, for this reason the lower risks alternatives listed above are recommended.

36. Buprofezin 70%, wettable powder formulation; common trade name: Applaud 70 WP
37. Thiamethoxam 25%, emulsifiable concentrate; common trade name: Actara
38. Spinetoram *Saccharopolyspora spinosa* 25%, wettable formulation; common trade name: Delegate and Spinosad, *Saccharopolyspora spinosa* 80%, water dispersed granule form: Entrust

a. US EPA registration status: ACTIVE for thiamethoxam for use on rice. Spinetoram and buprofezin are not commonly used in rice production in the US but are registered for use in a range of fruit and vegetable crops (i.e. registered for control of whiteflies, scale insects, mealybugs, leafminers, leaf rollers, planthoppers, and leafhoppers on cucurbits, grapes, lettuce, and tomatoes, and citrus, and spinetoram is also used on cranberries). Buprofezin is registered for use in India, Phillipines and other rice growing countries and has been promoted in China for its role in the management of brown planthopper resistance to conventional pesticides¹¹⁹.

b. Basis for selection of the pesticides: These pesticides all show low acute toxicities (EPA toxicity class III or IV) and are selective in their activity against homoptera, sucking pests, such as those listed above for rice. Buprofezin is an Insect Growth Regulator (IGR) that has very low human and ecological toxicities. Spinetoram is a spinosyn insecticide that is registered by the EPA as a reduced risk pesticide and toxicologically analogous to spinosad, a first generation spinosyn product, already recommended in the MWP. Thiamethoxam, a neonicotinoid insecticide is particularly effective for control of planthoppers and stink bugs. Planthoppers in the Caribbean are vectors for the disease hoja blanca, an economically important disease.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program:
 These products represent an array of modes of action and varying levels of toxicity that are well suited for different levels of infestation. Also the variability of their modes of action, limits the need for repeated applications of a single pesticide or group of pesticides with the same action pathway. Stink bugs and planthoppers in rice should also be managed with non-chemical control measures including the following.

Planthoppers/leafhoppers:

- The use of planthopper resistant varieties, as they become available, is the most effective control.
- Avoid long maturing rice varieties.
- Plant early in the growing season to escape pest buildup.
- Coordinated planting of neighboring farmers within three weeks of each other.
- Use selective insecticides against other pests so as to conserve natural enemies.
- Practice good weed management, leafhoppers infestations have been correlated to weedy fields.
- Use buprofezin or thiamethoxam

¹¹⁹ Wang, Yanhua, et. al. "Buprofezin susceptibility survey, resistance selection and preliminary determination of the resistance mechanism in *Nilaparvata lugens*." Pest Management Science, 64:1050–1056 (2008).

Leaf miners/leaf rollers:

- Providing adequate nutrition to the crop will increase its tolerance of the pest damage.
- Infestations must be quite severe to necessitate use of controls, as the damage to plants is quite minimal due to the small size of the leafminer.
- When damage to plants requires, spray spinosad or spinetoram

Stink bug:

- Removing grasses will lower the population of stink bugs in the area so maintain a weed free crop.
- Use thiamethoxam

Rice stem stink bug:

- Plow the field after harvest to kill lingering bugs.
- Flood to 15 cm to drown eggs
- Space rows of rice wide apart to allow more sunlight to penetrate to base of plant
- Use buprofezin

d. Proposed method or methods of application, including the availability of application and safety equipment: For planthopper control buprofezin or thiamethoxam sprays have to be directed at the base of plants so a motorized sprayer gives best results. Thiamethoxam can also be applied to rice as a seed treatment for control of certain pests. The growing stage of the planthopper is important to know. If the population is mostly adults, control will be low as the eggs escape contact with insecticides. If the population is mostly young nymphs, most of the time natural enemies will contain them. For stink bugs, rice stem stink bugs and leafminers insecticides should be sprayed as foliar treatments. Insecticide applications to rice should be made after fields have been drained to ensure best coverage and control.

PPE required for buprofezin: waterproof gloves, long shirt and pants, shoes plus socks.

REI: 12 hours; early re-entry requires the use of the following PPE: coveralls over long sleeve shirt and pants, rubber boots plus socks.

PHI: follow label indications.

PPE required for spinetoram and spinosad: Long sleeved shirt and long pants, shoes plus socks.

REI: 4 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes plus socks.

PHI: follow label indications.

PPE required for thiamethoxam: waterproof gloves, long shirt and pants, shoes plus socks.

REI: 12 hours; early re-entry requires the use of the following PPE: coveralls over long sleeve shirt and pants, rubber boots plus socks.

PHI: follow label indications.

e. **Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:**

Buprofezin

Acute and chronic toxicity: According to the NY state EPA registration information, neither technical grade buprofezin (98% concentration) nor the formulated end use product Applaud (70% concentration) were found to be very acutely toxic via the oral, dermal or inhalation routes, neither form of buprofezin was found to be irritating to the eyes or skin. Some 'weak' carcinogenic potential was revealed in testing on laboratory animals although this evidence has been deemed by the EPA as suggestive, not indicative of buprofezin's carcinogenicity.¹²⁰ **Mitigation: Ensure PPE as required on the product label is worn to reduce exposure.**

Ecological toxicity:

Buprofezin is practically non-toxic to bees but has been found to be moderately-to-highly toxic to fish and aquatic insects. **Mitigation: buprofezin is not to be applied in a manner that could lead to runoff or spray drift into fish holding waters. Rice paddies nearby fish holding water should be drained prior to application, no applications should be made when rain is eminent within 48 hours.**

Spinetoram and spinosad

Acute and chronic toxicity: Spinetoram and spinosad have very low acute toxicity, EPA toxicity class III-IV, via the oral, dermal and inhalation routes. It has been shown to be a dermal sensitizer but is not a dermal or an eye irritant. Spinetoram has been shown to have reproductive toxicity in maternal rats but no increased susceptibility resulted in exposed offspring. Neither spinosad nor spinetoram produced any mutagenic or carcinogenic effects.

Ecological toxicity: Spinetoram/spinosad is practically non-toxic to mammals and bird species according to EPA test data. Spinetoram/spinosad has also been shown to dissipate rapidly, its half-life is less than a day under most field conditions. However, spinetoram and spinosad have been found to be moderately toxic to highly toxic for fish, crustaceans and aquatic insects, and also to bio-accumulate in fish over time leading to reproductive and growth issues. **Mitigation: Spinetoram and spinosad are not to be applied in a manner that could lead to runoff or spray drift into fish holding waters. Rice paddies nearby fish holding water should be drained prior to application, no applications should be made when rain is eminent within 48 hours.** Spinetoram and spinosade are highly toxic to bees, although as rice is self-pollinated the use of spinetoram/spinosad in rice is not

¹²⁰ "Buprofezin - Registration of Applaud® 70 WP Insect Growth Regulator 5/03." NY State Department of Environmental Conservation: Division of Solid and Hazardous Materials, May, 2003.

expected to pose significant adverse effects to bees.

Thiamethoxam

Acute and chronic toxicity: Thiamethoxam has slight acute toxicity via the oral, dermal and inhalation routes, and is classified in EPA toxicity category III-IV. Thiamethoxam is not a dermal sensitizer or irritant and is also not irritating to eyes. Although test data has previously shown thiamethoxam exposure in rats and mice to lead to the development of tumors, the Cancer Assessment Review Committee has determined that humans are not likely to be at risk of developing tumors following exposure to thiamethoxam.¹²¹

Ecological toxicity: Thiamethoxam is highly toxic to bees although as rice is self-pollinated the use of spinetoram in rice is not expected to pose significant adverse effects to bees. Thiamethoxam is highly toxic to aquatic invertebrates. Thiamethoxam is also moderately persistent in soil (half-life 54 days in sandy loam soil) however its half life is reduced under aquatic field conditions (such as rice paddies) to around 13 days. None the less, thiamethoxam has a high potential for mobility in some soil types where it may lead to groundwater contamination; however, when applied as a foliar spray, the product is absorbed into plant foliage, thus reducing the risk for groundwater contamination. EPA modeling for contamination to surface and groundwater from use of thiamethoxam in rice paddies confirms that when applied at label rates, levels of thiamethoxam in surface and ground water are likely to be below the levels of concern for drinking water quality standards. **Mitigation: Despite the estimated low risk of high levels of thiamethoxam contaminating ground water, measures to reduce runoff and drift should be put in place when thiamethoxam is applied nearby surface waters or areas with a shallow water table.**

f. Effectiveness of the requested pesticides for the proposed uses: Buprofezin is most effective against the nymphal stages of target pests and inhibits the formation of the exoskeleton causing death after several days, and reducing feeding almost immediately. Buprofezin also inhibits oviposition in adults and reduces viability of eggs.

Spinetoram and spinosade are active on target pests through ingestion or direct contact after which it interferes with the insect's nervous system causing loss of muscle control and eventual death.

Thiamethoxam is systemic and taken up by plant tissue, plant matter or sap must be consumed for the pesticide to be effective, which makes it well-suited to combat sucking insects. Thiamethoxam has long residual effects, greatly reducing the number of applications needed per season. It is registered by the EPA for use as a foliar treatment against whiteflies, aphids, stink bugs, weevils and grasshoppers.

¹²¹ "Thiamethoxam: Human Health Risk Assessment Scoping Document in Support of Registration Review." USEPA, Dec, 2011. p. 2

To avoid resistance development in target pests these pesticides should be rotated with products that also target the same pests but with different modes of action as classified by IRAC groups.

Thiamethoxam is in IRAC group 4.

Spinosad and spinetoram are in IRAC group 5.

Buprofezin is in IRAC group 16.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: See element e, above, for more information on impacts to non-target species. No significant impacts to non-target species are expected.

h. Conditions under which the pesticides are to be used, including climate, flora, fauna, geography, hydrology, and soils:

As these products are recommended for application in rice fields, the presence of surface waters nearby and shallow water tables will necessitate mitigation to avoid excessive spray drift, run-off and leaching of these pesticides products. See **element e**, above for more specific mitigation requirements and information.

i. Availability of other pesticides or non-chemical control methods:

Other alternatives for control of these pests such as **carbaryl (trade name Sevin)** or **methyl parathion** and **malathion** have increased potential for serious negative human health (cholinesterase disruption, cancer, reproductive and developmental toxicities) and ecological effects, as result of drift, run-off or leaching in rice growing areas with shallow water tables. Given the Haitian context and general level of farmer capacity in pesticide use, the likelihood that the usage of these products will be sufficiently circumscribed to mitigate such risks is not very likely, for this reason the lower risks alternatives listed above are recommended.

H. Molluscicides

Slugs and snails are economically significant pest for the vegetable production in hillside growing regions, such as Kenscoff and Duvier, where rains can be more severe and frequent. In the MWP it was concluded that the most effective means of control for these pests were non-chemical cultural and mechanical control techniques such as use of obstructions (broken egg and sea shells, coffee grounds) baiting, trapping and manual removal. These options were considered to be more appropriate than the use of a Restricted Use Pesticide (RUP) known as Mesurol (methiocarb) which is no longer registered by the EPA for use on food crops (only ornamental and turf usages are currently EPA registered). Methiocarb is also carcinogenic and has several chronic human health risks for users and consumers as well as ecological toxicity concerns associated with its use. Metaldehyde was the standard molluscicides for many years in the US but has been withdrawn due to toxicity to pests and livestock that consume the

bait. This amendment has allowed for additional consideration of an alternative that is less widely used by Haitian farmers in these regions but still available on the market, Sluggo (iron phosphide). These granular pellet products pose reduced risks to users, vegetable consumers and the environment. The AMWP is recommending the use of iron phosphate containing products as reduced risk alternative controls for use in slug control. Methiocarb and metaldehyde containing products are not recommended.

39. Iron phosphate 1%, granular formulation: common trade name: Sluggo-Snail

a. US EPA Registration: ACTIVE, Sluggo EPA REG. NO. 67702-3

b. Basis for selection of the pesticide: Sluggo is a biochemical molluscicide/fungicide that is used as bait for control of slugs and snails in the production of vegetables, fruit and ornamental crops. Iron phosphate is an organic compound found readily in nature and has a history of minimal toxicity from human and environmental exposures.¹²²

According to label information Sluggo is approved for use in organic agriculture for slug control by the National Organic Program (NOP) of the U.S. Department of Agriculture (USDA). The NOP recommend the use of other preventative and non-chemical slug/snail controls, including, mechanical, physical obstruction, baiting and trapping pest management techniques.¹²³

Sluggo is recommended by the label for control of a wide range of slug and snail species, including but not limited to the following: *Deroceras spp.*, *Arion spp.*, *Limax spp.*, *Helicella spp.*, *Helix spp.*, *Helicella spp.* and *Cepaea spp.*¹²⁴

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: Sluggo is considered a reduced risk naturally occurring chemical that can be coupled effectively with several other non-chemical controls such as:

- Habitat removal to create bare ground around fields discourages snails to cross
- Planting of repellent and trap crops
- Physical barriers (copper mesh wire fencing, abrasives (coffee grounds, sand, wood shavings, ash, egg shells)
- Trapping with the use of attractants (i.e. scraps of papaya/plantain)¹²⁵;
- Physical removal in periods of high snail and slug activity (i.e. early morning)
- When handling snails latex gloves must be used, as this animal is a vector of the

¹²² "Pesticide Registration Manual: Chapter 3- Additional Considerations for Biopesticide Products." EPA. July 2010, Accessed 5/31/2012. <http://www.epa.gov/pesticides/bluebook/chapter3.html>

¹²³ "OMRI Certificate: Sluggo Snail and Slug Bait," Certis USA LLC. Accessed 6/4/2012, http://www.certisusa.com/pest_management_products/insecticidal_bait/sluggo.htm

¹²⁴ "Sluggo-AG Label." Lawn and Garden Products, Inc. 1

¹²⁵ For relevant findings on from studies on the effectiveness of trapping for Giant African Snail control see the "PRODEL Ecuador PERSUAP." USAID, ACIDI-VOCA and Sun Mountain International. October 2010. 46.

nematode parasite *Angiostrongylus cantonensis*, which produces eosinophilic meningitis, *Angiostrongylus costarricensis*, which mainly affects children and can cause intestinal problems and death¹²⁶.

WINNER will promote the use of preventative non-chemical controls, as feasible, in target areas.

d. Proposed method or methods of application, including the availability of application and safety equipment: Sluggo is sold in a granular formulation and should be applied directly onto the ground around target field area and throughout plant rows. Evening is the best time to apply the bait, as slugs travel and feed predominantly at night and in the early morning. According to the label¹²⁷, bait should be applied as it dissolves or is consumed, approximately every two weeks at rates of 22kg/ha – 44 kg/ha of vegetable or field crop plantings (or 2.2g – 4.4g per sq. meter). The higher application rate should be favored during severe infestation, heavily watered areas or during extended periods of heavy rain.¹²⁸

Care must always be taken during applications to ensure no granules become lodged in the foliage or fruit of any food crops that could be harvested. This product is poisonous if swallowed. Users should take precautions to prevent ingestion by young children or pets of the granular bait once applied to fields.

Iron phosphate products require the use of PPE as follows: Long sleeve shirt and pants, shoes and socks.

Users should also:

Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

For Sluggo-A there is no required REI for treated areas. This product has no required tolerance or pre-harvest intervals (PHIs) and can be used up to and on the day of harvest.¹²⁹

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: According to the EPA, no unreasonable adverse effects on human health are expected from the registered uses of iron phosphate in slug control. Iron phosphate has very low human and mammalian toxicity, specifically, it is a toxicity category IV for acute oral and dermal toxicity, dermal irritation. Iron phosphate is a slight eye irritant, toxicity category III. EPA registration eligibility information requirements for acute inhalation toxicity,

¹²⁶ Ibid.

¹²⁷ It should be noted that the labels that accompany products sold in Haiti are from sources all over the world (Israel, Brazil, China, US, DR, Mexico, France) and are not likely to include the complete set of the precautionary, user safety, dosage or restrictions language that is legally required by the US EPA to appear on all U.S. pesticide labels. In the rare case that all this information is present it is seldom in a locally understood language (French, or Creole).

¹²⁸ Ibid.

¹²⁹ “Sluggo Snail and Slug Bait Label.” Certis USA LLC. 1.

dermal sensitization, genotoxicity, immunotoxicity, developmental toxicity and subchronic (90 day) oral toxicity testing were waived for iron phosphate as it is generally regarded to be safe by the EPA, has low toxicity, is used in low doses as a nutritional supplement, is abundant in nature and has low water solubility.¹³⁰

Personal protective equipment should be worn when applying Sluggo. (see **Section D** above for more detailed information on label required PPE).¹³¹

The ecological risk assessment information requirements were waived by the EPA because of iron phosphate's lack of toxicity to non-target bird, fish and insect species. This risk to beneficials such as honey bees is considered to be non-existent as the granular formulation precludes honey bee exposure. The risks to earthworms, beetle and other beneficials is also expected to be minimal as testing showed no effects on these species at up to two (2) times the maximum application rate.¹³²

f. Effectiveness of the requested pesticide for the proposed use: Iron phosphate acts as a stomach contact poison and is formulated as a granular bait that contains slug attractants to lure snails and slugs. Upon ingestion, even in small amounts, snails/slugs will stop feeding, become less mobile and die within 3-6 days. The labels of iron phosphate products note that dead slugs may not always be visible as they often crawl off to secluded places to die. Iron phosphate baits not eaten by snails will degrade and be absorbed into soils. Iron phosphate is commonly used as an ingredient in fertilizers.¹³³

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: The EPA has waived the ecological toxicity and risk assessments due to the low potential for iron phosphate slug control products, used according to label directions, to impact non-target species and ecosystems. (See **Section E** for more information on iron phosphate's human and ecological toxicity).

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: The EPA only requires environmental fate assessments, including those covering groundwater contamination risks, for biochemical pesticides that have identified issues in regard to their human or eco-toxicity effects. Iron phosphate, having no such toxicity effects, was not required to have environmental fate data provided by the registrant. In addition iron phosphate has low water solubility and is even more water insoluble once dissolved in soils.¹³⁴

i. Availability of other pesticides or non-chemical control methods: Slugs are an economically

¹³⁰ "Iron (Ferric) Phosphate Technical Document." EPA. October 1998. Accessed 6/4/2012, http://www.epa.gov/opp00001/biopesticides/ingredients/tech_docs/tech_034903.htm

¹³¹ "Sluggo Snail and Slug Bait Label." Certis USA LLC. 1..

¹³² Iron (Ferric) Phosphate Technical Document." EPA. October 1998. Accessed 6/4/2012, http://www.epa.gov/opp00001/biopesticides/ingredients/tech_docs/tech_034903.htm

¹³³ "Sluggo-AG Label." Lawn and Garden Products, Inc. 1

¹³⁴ Iron (Ferric) Phosphate Technical Document." EPA. October 1998. Accessed 6/4/2012, http://www.epa.gov/opp00001/biopesticides/ingredients/tech_docs/tech_034903.htm

significant pest in vegetable production, particularly for WINNER's program activities in Kenscoff. There are several proven non-chemical control techniques that can be used to reduce crop damage from slugs and snails in small scale agriculture and garden settings, including:

- Habitat removal to create a perimeter 1.5 m wide around the field
- Planting of repellent and trap crops
- Physical barriers (copper wire mesh screen fencing, abrasives (coffee grounds, sand, wood shavings, ash, egg shells)
- Trapping with the use of attractants (i.e. scraps of papaya/plantain)¹³⁵;
- Physical removal in periods of high snail and slug activity (i.e. early morning)
 - When handling snails latex gloves should be used. Snails are vectors of a form of meningitis, *Angiostrongylus costarricensis*, which mainly affects children and can cause intestinal problems and death¹³⁶.

¹³⁵ For relevant findings on from studies on the effectiveness of trapping for Giant African Snail control see the "PRODEL Ecuador PERSUAP." USAID, ACDI-VOCA and Sun Mountain International. October 2010. 46.

¹³⁶ Ibid.

I. Nematicides:

As found in the Mission-Wide PERSUAP the use of non-fumigant nematicides, as witnessed and reportedly in practice in parts of Haiti, are expected to carry health and environmental risks that could, without further analysis and mitigation jeopardize the livelihoods of the applicators of these products, their families' and community's health. These products contain active ingredients with both high acute and chronic toxicities. Active ingredients considered in the Mission-Wide PERSUAP for nematicide products included oxamyl (Vydate), ethoprop (Mocap), diazinon (Diazinon), deltamethrin (Decis). Additional active ingredients considered in this amendment include: cadusafos (Rugby), fosthiazate (Nemthorin), carbofuran (Furadan) and dazomat (Basamid). Commercial names for products containing these chemicals include, Nemathorin, Vydate and Mocap, respectively. These products also pose significant chronic toxicities (i.e. reproductive and development toxicity affects). For these reasons, the US EPA has classified all such products as Restricted Use Pesticides (RUPs).

As recommended in the Mission-Wide PERSUAP, and continued to be recommended here: "EPA toxicity Class I and II, RUP nematicides should not be recommended for purchase, promotion or use through the WINNER program. This is based on the target beneficiary population's lack of access to sufficient technical information, extension resources and equipment to be able to use RUPs within the acceptable levels of human and ecological risks. Any Restricted Use Pesticides promoted by USAID funded programs requires a further environmental assessment, specifically concerning the environmental costs and the social and economic benefits related to their use, before they can be approved for use by USAID funded projects."¹³⁷ This level of assessment falls beyond the scope of this targeted PERSUAP amendment proposed on behalf of the WINNER program.

Alternative Controls:

1. Crop rotation

2. Solarization: is a way of using the sun's heat to sterilize soil as deep as 8 inches and will kill nematodes. Use a clear (not white or black), UV-stabilized plastic (polyethylene or polyvinyl chloride) tarp or sheeting 0.5 to 4 mils thick. The tarp material must be flexible enough to stretch across the soil surface. Using two layers of thin plastic sheeting, separated by a thin insulating layer of air increases soil temperatures and the overall effectiveness of solarization treatments. The edges of the sheets must be buried to a depth of 5 or 6 inches in the soil to prevent blowing or tearing of the tarp by the wind. The plastic sheets should be maintained for 4-6 weeks during the dry season. It will also control weeds and soil pathogens and soil insects.

3. Chancellor (*bacillus firmus*)¹³⁸

¹³⁷ "USAID Haiti Mission-Wide PERSUAP." USAID and partner organizations, SMTN, December 2010. 1.

¹³⁸ Recommended in the MWP, see p. 74.

J. Plant Growth Regulators:

Plant growth regulators (PGRs) are proposed for use in the WINNER program's flower production activities. These activities were not considered in the Mission-Wide PERSUAP (MWP). PGRs are active in very low concentrations and achieve results that are difficult, economically prohibitive or nearly impossible to achieve with the use of other techniques. PGRs should not be considered substitutes for good cultural practices that promote healthy and strong flowers (i.e. proper water and nutrient management, pest and weed control). A chemical plant growth regulator (PGR) is a natural or synthetic substance that, in very small quantities, regulates or controls some aspects of plant growth (i.e. stem length, rooting, flowering, leaf abscission, fruiting, and winter hardiness). Regulators can promote or retard plant growth and development, depending on the PGR chosen and the concentration used.¹³⁹

40. Cycocel (Chlormequat chloride 11.8%) L / SC formulations – common trade name: Cycocel

a. US EPA registration status: ACTIVE Use only in floriculture, EPA REG. NO. 241-74

b. Basis for selection of the pesticide:

Cycocel is a plant growth regulator (PGR) classified as a quaternary ammonium compound and is used in flower production to reduce stem elongation, growth rate and generally improve flower color and toughness. (VT and VSU Cooperative Extension. Selecting and Using Plant Growth Regulators on Floricultural Crops. P.1) It is also used to promote lateral branching and flowering in floriculture.

Cycocel is specialized for use on bedding plants and ornamentals in greenhouse production and for containerized ornamentals in outdoor shade houses and nurseries. Specifically Cycocel is recommended for use on *camellia spp.*, carnations and chrysanthemums, Easter lilies (*Zantedeschia aethiopica*) as well as several other ornamental flowering and bedding plants.

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: PGRs are not substitutes for good cultural floriculture practices. In order to maximize the effectiveness of PGRs plants must be in good health, unstressed and supported through an integrated nutrient and water management system that is targeted to the flower species and the producer's goals.

d. Proposed method or methods of application, including the availability of application and safety equipment: PGRs such as Cycocel can be applied as a foliar spray, drench to root substrates, or dip for bulbs.

Cycocel is a liquid formulation of chlormequat chloride at a concentration of 11.8%. It should be

¹³⁹ "2012 Cornell Guide to the Integrated Management of Greenhouse Floral Crops 'Chapter 10.2 Chemical Growth' Regulators." Cornell University Cooperative Extension, 2012. Accessed at <http://ipmguidelines.org/Greenhouse/Chapters/CH10/default-2.aspx>.

applied as a foliar spray or a planting material drench. See label for information on application rates for specific flower species. Application should be according to product label instructions and be made with a handheld backpack sprayer wand.

PPE required for use of Cycocel : Long sleeve shirt and pants, chemical resistant gloves (i.e. made of natural or synthetic rubber thicker than 14 mils), shoes and socks

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Chlormequat chloride has been tested by the US Environmental Protection Agency (EPA) for toxicity to human health and the environment. All studies concerning human health risks concluded that risk levels of labeled uses were below the Agency's Level of Concern (LOC). While no additional mitigation measures are deemed necessary by the EPA to protect the health of users, label instructions require the use of Personal Protective Equipment (PPE). Chlormequat chloride is registered for use only on ornamental plants grown in greenhouses, nurseries and shadehouses. As chlormequat chloride has no food/feed uses and no U.S. tolerances associated with its use, it is not subject to the Food Quality Protection Act of 1996.

Ecological toxicity: Greenhouse uses of Cycocel are not associated with any environmental toxicity risks due to the contained nature of the growing environment. However, chlormequat chloride may pose acute and sub-chronic risks to birds, reptiles, amphibians, mammals and terrestrial as well as aquatic plants. **If outdoor shadehouse uses are considered** the following mitigations should be put in place:

1. Flowers will be containerized in pots
2. Run-off control structures (i.e. grassed/vegetated drainage ways, berms, holding ponds,etc.) surrounding outside shade house and nursery plots.
3. Only hand-wand application of Cycocel are permitted by label requirements, this is primarily in an effort to reduce the amount of excess active ingredient that comes into contact with non-target species, application with tractor drawn boom sprayers is prohibited.
4. Plant containers should be placed atop dirt, gravel or plastic so as to minimize the risk of non-target plant species to come into contact with chlormequat chloride.

Chlormequat chloride is practically non-toxic to freshwater and marine fish as well as to honey bees.¹⁴⁰

f. Effectiveness of the requested pesticide for the proposed use: Plant growth regulator active ingredients are effective at extremely small concentrations and dosage. Although PGRs are not substitutes for good cultural flower production practices their well-targeted use can be highly

¹⁴⁰“EPA RED Chlormequat chloride.” US EPA, September 2007.

beneficial economically as they typically cut labor as well as production costs and yield a higher quality flower than is otherwise possible.¹⁴¹

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: There are no significant concerns for human health associated with the current labeled. For indoor/greenhouse uses of Cycocel there are no concerns with its toxicity to non-target ecosystems or species. For outdoor uses specific mitigation measures are required to prevent run-off and over-application to address potential toxicity risks for birds, reptiles, amphibians, mammals and terrestrial or aquatic plants. (See **element e**, above, for more detailed information on mitigation measures required for outdoor application of Cycocel)

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Cycocel is potentially toxic to birds, reptiles, amphibians, mammals and terrestrial or aquatic plants the WINNER program should favor its use in indoor greenhouse flower production systems.

Availability of other pesticides or non-chemical control methods: Florel, B-Nine, Bonzi and Sumagic are also PGRs that reduce stem length. They should be promoted in this order (from lowest to highest toxicity) as long as they can provide effective growth regulation effects in target flower species:

- B-Nine or Cycocel
- Florel or Bonzi, Sumagic

41. Bonzi (Paclobutrazol 0.4 %) – SC/L formulation common trade name Bonzi

a. US EPA registration status of the proposed pesticide: ACTIVE for floriculture only for use in greenhouses. EPA REG. NO. 100-1079
There is a 50%WP formulation which tox class II. Ensure use of the 0.4% concentration product as this is less toxic, class III.

b. Basis for selection of the pesticide: This product reduces internode elongation Bonzi is a plant growth regulator (PGR) used in flower production to reduce internode stem elongation and favor a more compact growth pattern in flowers. The three methods of application recommended by the product label are spray, drenches or bulb soak applications.

Bonzi is registered for use on the following flower types of the WINNER program: Carnations (Dianthus spp.)

¹⁴¹2012 Cornell Guide to the Integrated Management of Greenhouse Floral Crops 'Chapter 10.2 Chemical Growth' Regulators. Cornell University Cooperative Extension, 2012.
<http://ipmguidelines.org/Greenhouse/Chapters/CH10/default-2.aspx>

<p>c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: (See first PGRs element I or C above)</p>
<p>d. Proposed method or methods of application, including the availability of application and safety equipment: Paclobutrazol should be applied as a foliar spray, drench or bulb soak. See label instructions for particular dosage and rates recommended for target flower species.</p> <p>PPE required for use of Bonzi : Long sleeve shirt and pants, chemical resistant gloves (i.e. made of natural or synthetic rubber thicker than 14 mils), shoes and socks.</p> <p>Users should also:</p> <ul style="list-style-type: none"> - Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. - Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. <p>REI: Personal protective equipment, as described above, should be worn by all Bonzi handlers, mixers/applicators and workers entering Bonzi sprayed areas prior to the required 12 hour REI.</p>
<p>e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: The product is currently under re-registration review and acute inhalation and dermal toxicity occupational risk assessment are pending. This review is scheduled to be completed by August 2012. Existing data provides no evidence of developmental or reproductive toxicity effects of paclobutrazol. However, no testing on occupational risks of short-term inhalation toxicity, have yet been completed.¹⁴².</p> <p>The ecological risk assessments completed to date cause the EPA no reason to expect that threats associated with registered uses of Bonzi are likely to exceed the EPA's threshold level of concern (LOC) for acute toxicity to non-target species of birds, mammals, fish or amphibians. Chronic risks to mammals and aquatic invertebrates are not likely to exceed the EPA LOC. However, EPA LOCs are expected to be exceeded for chronic risks to birds, mammals, fish and amphibians as well as for non-target plant species, as result of paclobutrazol's mode of action.¹⁴³.</p> <p>Greenhouse uses of paclobutrazol are not likely to be associated with any environmental toxicity risks due to the contained nature of the growing environment. However, outdoor uses of paclobutrazol in nurseries or shade houses, may pose acute and sub-chronic risks to non-target species, organisms and ecosystems. If outdoor uses are considered the following mitigations should be put in place:</p> <ol style="list-style-type: none"> 1. Flowers will be containerized in pots

¹⁴² "Paclobutrazol Summary Document: Registration Review." EPA, March 2007, 29.

¹⁴³ "Paclobutrazol Summary Document: Registration Review." EPA, March 2007, 8.

2. Run-off control structures (i.e. grassed/vegetated drainage ways, berms, holding ponds, etc.) surrounding outside shade house and nursery plots.
3. Hand-wand application of Bonzi should be promoted as it is the most effective application method to reduce excess application of active ingredient and resulting exposure risks to non-target species. Chemigation or tractor drawn application methods should be discouraged.¹⁴⁴
4. Plant containers should be placed atop dirt, gravel or plastic so as to minimize the risk of non-target plant species to come into contact with paclobutrazol.

The WINNER program will ensure the **standard transport mitigations (see fumigation element e)** are implemented during transport of paclobutrazol to reduce the exposure risks to non-target organisms:

f. Effectiveness of the requested pesticide for the proposed use: Plant growth regulator active ingredients are effective at extremely small concentrations and dosage. Although PGRs are not substitutes for good cultural flower production practices their well-targeted use can be highly beneficial economically as they typically cut labor as well as production costs and yield a higher quality flower than is otherwise possible.¹⁴⁵

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: See **element e**, above, for more detailed information on mitigation measures required to reduce risks of Bonzi to non-target species.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Paclobutrazol has the potential for chronic risks to birds, mammals, fish and amphibians as well as for non-target plant species as result of paclobutrazol's mode of action, leaching and persistence properties in soils.¹⁴⁶ The WINNER program should favor its use in indoor greenhouse flower production systems and minimize its outdoor uses.

i. Availability of other pesticides or non-chemical control methods:

Florel, B-Nine and Cycocel and Sumagic are also PGR that reduce stem length. They should be promoted in order listed below (from lowest to highest toxicity) as long as they can provide effective growth regulation effects in target flower species:

- B-Nine or Cycocel
- Florel or Bonzi, Sumagic

42. Florel (Ethephon phosphonic acid 3.9%) SC/L and formulations – common trade name Florel

¹⁴⁵ “2012 Cornell Guide to the Integrated Management of Greenhouse Floral Crops Chapter 10.2.” Cornell University Cooperative Extension. 2012, accessed 5/14/12.

<http://ipmguidelines.org/Greenhouse/Chapters/CH10/default-2.aspx>.

¹⁴⁶ “The Pesticide Properties Database.” The European Union and University of Hertfordshire. Last update 06 May 2012, accessed 5/17/12. <http://sitem.herts.ac.uk/aeru/footprint/en/index.htm>

<p>a. USEPA registration status: ACTIVE, EPA REG. NO. 264-263, for use in floriculture to promote fruit ripening, abscission, flower induction, breaking of apical dominance and other plant responses.</p>
<p>b. Basis for selection of the pesticide: Florel is a plant growth regulator applied as a foliar spray that can be used to induce flowering in bromeliads, initiating earlier leaf drop of roses, tall hedge and apple nursery stock, and increases in lateral branching of chrysanthemums, reduction in stem length and fruit elimination in ornamentals¹⁴⁷. Florel aborts flowers, inhibits internode elongation, and promotes branching of floriculture crops.</p>
<p>c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: (See previous element c, above.)</p>
<p>d. Proposed method or methods of application, including the availability of application and safety equipment: Ethephon phosphonic acid should be applied as a foliar spray with backpack and hand wand sprayers within 4 hours of mixing. Florel should never be applied through any type of irrigation systems.</p> <p>PPE required for use of Florel : Protective eyewear (i.e. goggles), long sleeve shirt and pants, chemical resistant gloves (i.e. made of natural or synthetic rubber thicker than 14 mils), shoes and socks.</p> <p>Users should also:</p> <ul style="list-style-type: none"> - Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. - Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Wash the outside of gloves before removing. <p>REI: 48 or 72 hours is required for the labeled uses of ethephon phosphonic acid. The 72 hour REI for this product is recommended when it is used in areas experiencing less than 64 cm (25 inches) of average rainfall per year. If this REI is broken than PPE listed above is required of workers entering the sprayed area early, prior to the end of the REI.</p>
<p>e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Ethephon products are corrosive and can cause acute skin and eye irritation, for this reason the EPA classifies ethephon as a Toxicity Category I for acute skin and eye irritation.</p> <p>Florel is an EPA Toxicity Category III resulting from its moderately acute toxicity through oral, dermal and inhalation routes. Mitigation: Users should wear goggles as is required by the label listed PPE.</p>

¹⁴⁷ “Florel Brand Ethephon Growth Regulator Label.” Southern Agriculture Insecticides, Inc. 1-2

As an organophosphate pesticide, Ethephon has been tested and found to be a cholinesterase inhibitor and neurotoxin.¹⁴⁸ In addition, dermal toxicity studies in rabbits have found observed skin effects occurring at all dosage levels.

No test findings indicate sufficient evidence that ethephon is a carcinogen. The EPA has determined Florel to be a Group D carcinogen, based on insufficient weight of existing evidence supporting its cancer causing potential. The EPA RED concludes that no mutagenic, or developmental effects have been found associated with testing of mother rats.¹⁴⁹ PAN lists it as a bad actor because it is an organophosphorous chemical. But the EPA RED concluded that ethephon as currently registered will not cause unreasonable risk to humans or the environment. The PAN conclusion is viewed as a precaution but the evidence from EPA clears the use of Florel by the WINNER program, as in accordance with the PERSUAP IPM methodology of promoting the last toxic controls first.

According to EPA environmental assessments, ethephon is non-persistent in the environment and dissipated to half in 7-25 days at field test sites. Ethephon also has low soil mobility and does not present a risk for groundwater contamination.

Ethephon has been found to have slight acute toxicity to mammals based on testing with rats but has been found to be practically non-toxic to fish and bird species. Ethephon is classified as slightly-to-practically non-toxic for fish, aquatic invertebrates, mollusks and honeybees. Minimal impacts for non-target terrestrial and aquatic plants can be expected such as, reduced growth rate and plant height. These risks are minimal for the proposed indoor and outdoor nursery/shade house uses of Florel and do not require any mitigation measures other than the following:

Mitigation 2: WINNER will not apply ethephon directly to surface waters or through any type of irrigation system.¹⁵⁰

f. Effectiveness of the requested pesticide for the proposed use: (See previous PGR's element f, above)

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: No significant impacts for non-target ecosystems are expected to result from the WINNER program's uses of Florel.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: The standard 24 hour REI of Ethephon increases to 72 hours, when in use

¹⁴⁸ "The Pesticide Properties Database." The European Union and University of Hertfordshire. Last update 06 May 2012, accessed 5/22/12. <http://sitem.herts.ac.uk/aeru/footprint/en/index.htm>

¹⁴⁹ "RED Facts: Ethephon." EPA April 1995, 2.

¹⁵⁰ "RED Facts: Ethephon." EPA April 1995, 5.

in drier climates, those experiencing less than 64 cm (25inches) of rain annually.
<p>i. Availability of other pesticides or non-chemical control methods: Sumagic, B-Nine and Cycocel are also PGRs that reduce stem length. They should be promoted in the order listed below (from lowest to highest toxicity) as long as they can provide effective growth regulation effects in target flower species:</p> <ul style="list-style-type: none"> - B-Nine or Cycocel Florel or Bonzi, Sumagic
<p>43. N6-Benzyl-adenine (N-1H-purine 6-amine) 2%, common trade name, Configure EPA REG. NO. 62097-19</p> <p>44. Gibberellic acid 4% SC/L formulations – common trade name Pro Gibb Plus 2x Growth Regulator, EPA REG. NO. 73049-16</p> <p>a. USEPA registration status of the proposed pesticides: Both ACTIVE for use in floriculture in greenhouses only</p>
<p>b. Basis for selection of the pesticide: N-6 Benzyl-adenine and gibberellic acid are highly active plant growth regulators that are used to provide an additional source of natural plant hormones such as cytokinin and gibberellins. These hormones are involved in nearly every process of plant growth and are involved in promoting several desirable effects including: preventing leaf yellowing, increasing flower size, delaying flower senescence¹⁵¹ in lilies, reducing minimum temperature requirements for plant growth, and overcoming bud and seed dormancy. Label recommended uses cover leaf yellowing in lilies and promoting plant growth in bedding plants, annual and perennial potted crops, field grown ornamentals, bulbs and poinsettias.</p> <p>Gibberellic acid, one of the products' active ingredients, is a naturally occurring compound and has a non-toxic mode of action on plants. N6-Benzyl-adenine, the other product active ingredient, also closely resembles naturally occurring plant compounds, has a non-toxic mode of action It is used to promote plant growth and hasten maturity</p>
<p>c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: (See element I below).</p>
<p>d. Proposed method or methods of application, including the availability of application and safety equipment: Products are soluble concentrates that should be mixed with water at the label recommended dosage for the target crops. For foliar applications uniform sprays are important.</p>

These products should not be applied through any type of irrigation system or directly to surface waters.¹⁵²

PPE required for use: Protective eye wear, long sleeve shirt and pants, chemical resistant gloves (i.e. made of natural or synthetic rubber thicker than 14 mils), shoes and socks.

Users should also:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Wash the outside of gloves before removing.

REI Configure: 4 hours; early re-entry into treated areas requires use of the following PPE: coveralls, waterproof gloves and shoes plus socks.

REI for Gibberellic acid is 12 hours; early re-entry into treated areas requires use of the following PPE: Coveralls, chemical resistant gloves, shoes plus socks, protective eyewear.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Gibberellic acid containing products have very low acute toxicity risks. Acute oral toxicity, dermal irritation and sensitization impacts of gibberellic acid were tested to be in the EPA toxicity category IV. Gibberellic acid is in toxicity category III for acute dermal and inhalation toxicity as well as for eye irritation. No developmental toxicity or mutagenic effects of gibberellic acid exposure have been found seen in testing.¹⁵³

The EPA has found N6-Benzal-adenine to be in toxicity category III for acute oral toxicity and eye irritation, and in toxicity category IV for acute dermal and inhalation toxicities and for dermal irritation. Development toxicity was noted in testing of exposure with rats, and was manifested by significant decreases in fetal body weight and other development abnormalities. Testing for mutagenicity as result of exposure to N6-Benzal-adenine resulted in no observable effects.¹⁵⁴

Mitigation 1: WINNER will promote awareness among women of child bearing age and among children of the potential reproductive/developmental toxicities of N6-Benzal-adenine and encourage these groups to limit their exposures to this product.

According to the EPA environmental risk assessment data, the registered uses of gibberellic acid and N6-Benzal-adenine are unlikely to present any risks to non-target terrestrial, avian, aquatic or insect species. Gibberellic acid has been tested to be practically non-toxic to Bobwhite quail, cold water fish, aquatic invertebrates and relatively non-toxic to honeybees. Due to the fact that gibberellin is a naturally occurring growth stimulator with a non-toxic mode of action, risks to non-target plants are not a concern.

N6-Benzal-adenine is practically non-toxic to avian species and is slightly toxic to freshwater fish and

¹⁵² "Fascination Plant Growth Regulator Solution Label." Valent Professional Products. 2009, 1-5.

¹⁵³ "Registration Eligibility Decision: Gibberellic acid." EPA. December 1995, 11-13.

¹⁵⁴ "Registration Eligibility Decision: N6-Benzyl-adenine." EPA. 5-7.

aquatic invertebrates. N6-Benzal-adenine is also not expected to have any negative toxicity effects on non-target insects or plant species.

Mitigation 2: WINNER will not apply PGRs directly to surface waters or through any type of irrigation system.

f. Effectiveness of the requested pesticide for the proposed use: Products are extremely active plant growth regulators that promote plant growth through providing a supplementary source of naturally occurring plant hormones, cytokinin and gibberellins, involved in plant growth processes.

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: According to the EPA environmental risk assessment data, the registered uses of gibberellic acid and N6-Benzal-adenine are unlikely to present any risks to non-target terrestrial or aquatic mammal, bird, fish, plant or insect species.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: No additional conditions for this pesticides use are required. The WINNER program will follow all applicable label requirements for the use.

i. Availability of other pesticides or non-chemical control methods: Products are both recommended PGRs that promote plant growth. They are both of low acute toxicity to humans and the environment and can be used more or less interchangeably.

44. Sumagic PGR (Uniconazole-P .055%) SC/L formulations; common trade name Sumagic

a. USEPA registration status of the proposed pesticide: ACTIVE, EPA REG. NO. 59639-37, for floriculture uses only in greenhouses.

b. Basis for selection of the pesticide: Sumagic is an extremely active plant growth regulator that reduces internode elongation and leads to a more compact and desirable flower growth pattern for a wide range of ornamental plants. Sumagic can also contribute to darker coloring, more numerous and bigger flowers, as well as increased leaf thickness, water retention and chlorophyll content. Sumagic is recommended for use as a foliar spray, drench, bulb/cutting dip or as a soil surface treatment prior to planting for the following types of ornamentals: lilies, chrysanthemums, bedding plants, woody and herbaceous species, annual and perennial potted flower crops.¹⁵⁵

c. Extent to which the proposed pesticide use is, or could be, part of an IPM program: See element I, below.

d. Proposed method or methods of application, including the availability of application and safety equipment: Sumagic is a soluble concentrate that should be mixed with water and applied

¹⁵⁵ “Sumagic Plant Growth Regulator Label.” Valent Professional Products. 2010. 3-9.

with a backpack hand wand sprayer at the label recommended rates for the particular flower species in question.

PPE required for use of Sumagic :

- Long sleeve shirt and pants
- Chemical resistant gloves (i.e. made of natural or synthetic rubber thicker than 14 mils)
- Shoes and socks

Users should also:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Wash the outside of gloves before removing.

REI for Sumagic is 12 hours; early re-entry requires the use of the following PPE: coveralls, waterproof gloves, shoes plus socks

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Uniconazole-P end use products have a Toxicity Category IV for acute oral and inhalation toxicity as well as for dermal irritation. Sumagic, and related products, are in EPA toxicity category III for acute dermal and eye irritation. It has been shown in testing on rabbits and mice to developmental and oncogenic toxicities and in high enough dosage concentrations, uniconazole exposure can result in increased liver weights and abnormalities, as well as the development of both benign and malignant tumors. **Uniconazole-P in its 1991 registration review was classified as a Group C, possible human carcinogen, by the EPA.** Some developmental toxicity effects were noted in testing, however the data is considered incomplete.¹⁵⁶

Mitigation: WINNER will promote awareness among users, and women of child bearing age, children in particular, of the potential carcinogenic and reproductive/developmental toxicities of uniconazole and encourage these groups to limit their exposures to this product. Other PGRs should be rotated with uniconazole to reduce exposures to this product.

Sumagic is practically non-toxic to birds and slightly toxic to fish according to the EPA data on the environmental characteristics of uniconazole-P. The risks to the environment are estimated by the EPA to be no greater than those associated with the registered uses of other triazole products. No data on toxicity for terrestrial or aquatic plant species is available.

Uniconazole-P is persistent in soil and aqueous solutions and highly mobile, particularly in sandy soils with low organic matter content. This leads to EPA concerns with the use of uniconazole-P and its potential to contaminate surface and ground water.¹⁵⁷ To mitigate these risks WINNER will implement the following mitigations:

¹⁵⁶ "Pesticide Fact Sheet: Uniconazole." EPA. September 1991. 4-7.

¹⁵⁷ Ibid. 7-8.

<p>Mitigation: As per the label requirements, WINNER will not apply Sumagic directly to surface waters or through any type of irrigation system.</p> <p>Mitigation: As per the EPA label requirements, WINNER will not apply Sumagic directly to the soil surface, or plants and pots in contact with the soil, in areas with sand soils that have high porosity and low organic matter content.</p>
<p>f. Effectiveness of the requested pesticide for the proposed use: Sumagic is a highly active PGR that is effective at extremely low concentrations of its active ingredient.</p>
<p>g. Compatibility of the proposed pesticide use with target and non-target ecosystems: Sumagic presents minimal risks to non-target bird, fish, freshwater invertebrates and beneficial (bee) species. No data is available on uniconazole-P's effects on terrestrial and aquatic plant species.</p>
<p>h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: Uniconazole-P does present the risk of ground and surface water contamination under certain environmental conditions and should not be used in areas where the risks for water contamination are high (i.e. high water tables, nearby estuaries, rivers, lakes, sandy soils with low organic matter and high porosity). To mitigate these risks WINNER will implement the following mitigations:</p> <ul style="list-style-type: none"> - As per the label requirements, WINNER will not apply Sumagic directly to surface waters or through any type of irrigation system. - As per the EPA label requirements, WINNER will not apply Sumagic directly to the soil surface, or plants and pots in contact with the soil, in areas with sand soils that have high porosity and low organic matter content.
<p>i. Availability of other pesticides or non-chemical control methods: Florel, B-Nine and Cycocel are also PGR that reduce stem length. They should be promoted in this order (from lowest to highest toxicity) as long as they can provide effective growth regulation effects in target flower species:</p> <ul style="list-style-type: none"> - Cycocel - Florel or Bonzi, Sumagic

K. Rodenticides:

No rodenticides were recommended in the MWP. Rodents are an economically important storage pest for many stored crops in Haiti (including grains such as corn and sorghum, dry beans, etc.). The MWP recommended improved sanitation and trapping as potentially viable control options for small scale storage. WINNER is proposing additional chemical controls to deal with heavy infestations where sanitation and trapping do not provide effective control.

All proposed rodenticides are recommended based on the AMWP analysis including:

Rozol (Chlorophacinone ... 0.005%) available in pellet formulation

Kle rat (brodifacoum .005%) pellet and small wax block formulations

Maki (Bromadiolone .005%) pellet and small wax block formulations

Kaput (warfarin 0.025%) is recommended to be promoted first as it is the least toxic (both to humans and the environment) of the recommended rodent control option.

45. Warfarin 0.025%) pellet and small wax block formulations, common trade name: Kaput, EPA REG. NO. 72500-18
46. Chlorophacinone ... 0.005% pellet and small wax block formulations, common trade name Rozol, EPA REG. NO. 7173-243
47. Brodifacoum .005% pellet and small wax block formulations, common trade name: Final All-weather blox/Jaguar bait chunx, EPA REG. NO. 12455-89. Kle rat (Haitian product),
48. Bromadiolone .005% pellet and small wax block formulations common trade name: Maki, EPA REG. NO. 7173-202

Of these four rodenticides warfarin is the least toxic to non-targets and should be most emphasized. Wax blocks are the safest to use over powder and pellet formulations.

a. US EPA registration status: All products are ACTIVE

These common rodenticides', rat/mouse poison's, active ingredients are registered jointly by the US EPA in a single Registration Eligibility Decision (RED) analysis. For this reason, and the fact that the proposed use of these products around storage areas for crops is the same usage as considered in the US EPA RED, the four products will be considered together.

All products are potentially available in tracking powder formulations. Tracking powders of any of the above products are not recommended for use in the WINNER program due to their status as RUPs. Many such products have also had their registrations cancelled by the EPA as result of the unacceptable exposure risks for humans and non-target organisms associated with these forms of rodenticides.¹⁵⁸ Wax blocks are the safest to use over powder and pellet formulations and can be placed in the field inside bamboo tubes to protect them from livestock, pets, children and other non-target organisms. Farmers should be trained on how to safely use the recommended rodent poison baits. Only ready-to-use wax bait block formulations should be recommended.

b. Basis for selection of the pesticide: The chemicals from the coumarin (warfarin, bromadiolone and brodifacoum) and Indandione (chlorophacinone) chemical families have long been used for control of common rats and mice in and around households or other building as well as for field pests such as Norway rat and roof rat. These chemicals are also available are registered for use in agricultural fields (i.e. orchards), transport vehicles (ships and trains) and other outdoor areas, such as irrigation ditches, and sewer systems.¹⁵⁹ There are specific use restrictions for each of the particular products considered here as well as different modes of action (anticoagulants and non-anticoagulants).

Anticoagulant rodenticides: Are typically slower acting and require multiple feedings for the target pest to consume a lethal dose over the course of 3-5 days, most anticoagulants are only lethal provided that pests continue consuming them for periods of 5-9 days. (bromadiolone and

¹⁵⁸ Tracking powder formulation not recommended (see element D for more details)

¹⁵⁹ "R.E.D. Facts: Rodenticide Cluster." US EPA, July, 1998. 1.

brodifacoum, second generation coumarins, are exceptions to this rule and can be lethal with just a single dose).

Warfarin containing products CAN be used indoor and outdoors in non-food crop fields. This includes in and around houses, buildings and areas used for food processing and storage.¹⁶⁰

Warfarin is one of the early rodenticides, first registered by the EPA in the 1950s and is still held to be one of the least toxic rodenticide products available. There are few eco-toxicity concerns for warfarin products as compared to the alternatives.

Bromadiolone and brodifacoum products can only be used indoors and around buildings.

Bromadiolone products should be used for residential uses only NOT be used in areas used for food storage or processing**Non-anticoagulant rodenticides:** Are typically fast acting single dose poisons. To increase the effectiveness of these products **pre-baiting techniques** should be employed (see **element e**, below, for more on **pre-baiting**)

Chlorophacinone products are registered for uses indoors and around building exteriors. **These products CAN be used in food storage or processing areas, and agricultural fields used for food and non-food crops.**

c. Extent to which the proposed pesticides' use is, or could be, part of an IPM program: Sanitation of field and storage areas along with mechanical controls such as traps, provide reliable means for suppressing and controlling rodent pests. These control measures should be used prior to the use of chemical rodenticides.

d. Proposed method or methods of application, including the availability of application and safety equipment: Labels for rodenticide baits require outdoor applications, in burrows or other protective housing (i.e. housed in the center of a length of PVC tubing, bamboo, or other bait box/station) so as to prevent access or feeding by non-target organisms. **All rodenticide baits should be placed out of the reach of children.**

Chlorophacinone and Warfarin products are proposed for use by the WINNER program for control of common rat, mouse and other pests indoors and outdoors.

Chlorophacinone and Warfarin *tracking powder formulations* will NOT be used because of increased inhalation and dietary exposure risks for users and consumers of stored or processed foods.

Brodifacoum products will only be applied within or around the building exteriors of indoor food storage or processing areas for control of mouse/rat pests, as these are the only EPA registered uses relevant to and applicable for WINNER program's agricultural and food processing activities.

Brodifacoum tracking powders will NOT be used because of increased inhalation and dietary exposure risks for users and consumers of stored or processed foods.

¹⁶⁰ "Registration Eligibility Document: Warfarin and its Sodium Salt." US EPA, May 1991. 3.

Bromadiolone products will only be applied indoors for control of mouse/rat pests.

The WINNER intervention areas where these products will be applied outdoors are all non-urban, rural or peri-urban areas.

PPE required for handling rodenticide chemicals (Kaput, Rozol, Maki, Kle Rat products) not already in place packs: Dust masks/respirators, water-proof gloves, long sleeve shirt and pants, shoes and socks.

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards: Rodenticides are highly toxic to humans. Warfarin, brodifacoum, bromadiolone and chlorophacinone are all classified in the EPA Toxicity Category I (highly toxic) for acute oral, dermal and inhalation toxicities. The high toxicity of these products and their use in residential settings lead to serious concerns for accidental human exposure to these toxic chemicals. Care should be taken to follow the use requirements associated with these products. EPA studies suggest that children under the age of six are at a particularly increased risk of exposure when rodenticides are used in and around the home.¹⁶¹

Mitigation 1: WINNER will promote the application of all rodenticide products inside burrows, bait stations or boxes/tubes that reduce access for children and other non-target species to the rodenticide baits. Bait pellets are not recommended as wax blocks are safer and more easily contained in protective bamboo or plastic tubes. This will reduce access for all but target rat and mouse pests.

Mitigation 2: All rodenticide bait formulations should have an indicator dye (pellets of a bright blue, green color) that help indicate if a child has consumed the bait pellet. All rodenticide products, if available, should contain a bittering agent (i.e. Bitrex¹⁶²) to deter ingestion by humans.

Mitigation 3: Warfarin, brodifacoum and chlorophacinone tracking powders will not be used because of EPA actions to restrict usage and cancel these products due to increased inhalation and dietary exposure risks for users of these products.¹⁶³

None of these chemical pose any chronic, neurological, or development health risks except for **warfarin** which is a proven teratogen (developmental toxin that disrupts the development of the fetus). Birth defects and still births have been observed as result of accidental exposure to coumarin during pregnancy.¹⁶⁴

Mitigation 4: Warfarin is a teratogen and exposure poses risks to pregnant women as it can negatively affect and disrupt fetal development and lead to abortion. Women of child bearing age and young children should be made aware of the developmental toxicity risks and discouraged from handling warfarin products.

For all rodenticides considered here (**except Warfarin**) acute toxicity ranges from moderate to high for non-target mammals (i.e. birds) as well as for aquatic organisms.¹⁶⁵

Warfarin products have been shown to be practically non-toxic to moderately toxic for birds and not acutely toxic to fish or aquatic invertebrates (insects).

¹⁶¹ "R.E.D. Facts: Rodenticide Cluster." US EPA, July 1998. 4

¹⁶² Bitrex is a trademarked commercial name for a particular human bittering agent deterrent named, denatonium benzoate.

¹⁶³ "Restricted use Product (RUP) Report." US EPA, December, 2002. Accessed 6/20/12, <http://www.epa.gov/opprd001/rup/rupdec02.htm>.

¹⁶⁴ "Registration Eligibility Document: Warfarin and its Sodium Salts." US EPA, May 1991. 6.

¹⁶⁵ "R.E.D. Facts: Rodenticide Cluster." US EPA, July 1998. 5.

Also rodents poisoned by these baits (**except Warfarin**) can be secondarily hazardous to mammal and avian predators that consume the rodent carcasses. Brodifacoum and bromadiolone have higher acute toxicities and are potentially lethal to target and non-target species as result of a single feeding. Chlorophacinone a multiple-feeding poison has more moderate acute toxicity for non-target terrestrial and aquatic species.¹⁶⁶

Warfarin products, according to the EPA, pose the lowest secondary hazard risk to mammal and avian predators due to the lower lethal dosage required for target organisms. This low lethal dose results in lower levels of warfarin present in the rodent carcass, the dose levels present in carcasses are likely to be sub-lethal for most predators or scavengers. The predator would have to repeatedly eat the rodent carcass for several days before approaching consumption of a potentially lethal dose.¹⁶⁷

According to the EPA, Brodifacoum and bromadiolone likely pose greater secondary hazards to mammal and avian predators than chlorophacinone and warfarin. Brodifacoum and bromadiolone are more actually toxic, especially for birds, persist longer at toxic levels in the dead rodent's tissues and can be lethal at a single feeding.¹⁶⁸

Mitigation 5: WINNER should only use and promote the use of warfarin and chlorophacinone products for outdoor uses in bait boxes/ houses. Warfarin and chlorophacinone pose lower acute toxicity to mammal and avian predators.

Mitigation 6: Rodenticides should never be applied directly to surface, coastal or in intertidal areas below the high-water line. Care should be taken not to contaminate surface water with rinseaterinsate used to wash protective equipment.

Based on similar EPA studies, concentrations of active ingredient, chlorophacinone, at 0.01% or greater have been found to pose secondary hazards to potential predators.¹⁶⁹

Mitigation 7: WINNER will favor promotion and sourcing of concentrations lower than 0.01% chlorophacinone, for Rozol and other chlorophacinone containing products. Rozol with an active ingredient concentration of 0.005% has been shown by EPA testing to provide effective rodent control¹⁷⁰.

f. Effectiveness of the requested pesticide for the proposed use: Anticoagulant baits (i.e. warfarin) are typically slow acting and most require multiple feedings (except for bromadiolone and brodifacoum these are single dose anticoagulants). It is important to be sure to make anticoagulant

¹⁶⁶ Same as above

¹⁶⁷ "Registration Eligibility Document: Warfarin and its Sodium Salts." US EPA, May 1991. 9.

¹⁶⁸ Same as above

¹⁶⁹ Same as above

¹⁷⁰ EPA field testing for products containing active ingredient concentrations of less than 0.005%, have proven to be effective for control for rodents despite the reduced concentration.

poison baits continuously available for up to 2 weeks to increase likelihood of the pest receiving a lethal dose and to provide complete control.¹⁷¹

Non-anticoagulant baits act quickly and are sometime called single dose poisons (chlorophacinone). For non-anticoagulants pre-baiting with un-poisoned food for several days prior to the use of the poison bait will increase the rat's bait acceptance and the likelihood that it will consume a lethal dose of the poison bait and not a sub-lethal one that will contribute to development of bait shyness.¹⁷²

g. Compatibility of the proposed pesticide use with target and non-target ecosystems: Please see **element e** for more information on hazards posed by rodenticides to non-target organisms.

h. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils: These chemicals are all stable to hydrolysis and moderately persistent in soils, demonstrating half-lives of 26 to 178 days. Based on the registered uses and available US EPA data, warfarin, brodifacoum, bromadiolone, and chlorophacinone pose little, if any, risk of contamination to surface and ground waters. These chemicals tend to be immobile in soils and fairly insoluble in water despite their moderate persistence in the two.

Brodifacoum and bromadiolone products (Kle Rat and Maki) should only be applied indoors and around buildings due to their high acute toxicities to non-target organisms.

These products, applied according to label requirements, as pelleted baits in and around buildings and in protective bait stations, when used outdoors, do not present significant risks to water quality.¹⁷³

i. Availability of other pesticides or non-chemical control methods: All rodenticides have high acute toxicity. These products should be used only when cultural (improved sanitation) and mechanical (rat and mouse traps) controls have not provided adequate crop protection. The controls should be used in the order listed below (from least to most toxic), as is appropriate for the intended usage (indoors or outdoors):

1. Improved sanitation practices (i.e. removal of potential rodent attractants, rotting crop, seed, fruit or crop residues)
2. Mechanical controls
3. Kaput (warfarin)* Least toxic option in terms of eco-toxicity but has developmental toxicity.
4. Rozol (chlorophacinone)
5. Kle Rat (brodifacoum)
6. Maki (bromadiolone)

¹⁷¹ Weaver, David K. and Petroff, A. Reeves. "Pest Control Grain Storage and Seed Treatment Facilities. Montana Department of Agriculture, September 2004. 75.

¹⁷² Same as above.

¹⁷³ "R.E.D. Facts: Rodenticide Cluster." US EPA, July 1998. 4.

IV. Pesticide Evaluation Report Elements J-L

The following content in sections IV and V has been excerpted from the MWP. These findings and recommendations below are still deemed to be relevant for the purposes of the AMWP and should continue to be implemented through WINNER activities.

J. Host country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide.

The Ministry of Agriculture, Natural Resources and Rural development (MARNDR) regulates pesticide import, distribution, storage, use and disposal of pesticides and also has agricultural extension officers at various parts of Haiti. However, enforcement of regulations is generally not implemented, especially at the local level. For a product to obtain a permit for sale on the market, its sponsor (manufacturer) must submit paperwork to the MARNDR specifying toxicity information (LD₅₀), target pests, required PPE, etc. The MARNDR does not currently maintain a database of pesticides approved for use in the country, nor does it implement a pesticide container collection program. At agro supply stores, most products have a toxicity labeling system based on color. Labels are usually in English or sometimes French. Therefore we must conclude that Haiti has limited ability to regulate pesticides. As such, the WINNER program should take steps to promote sound pesticide use (including improved handling, mixing, application, and storage and disposal practices) with an emphasis on IPM among partner agro supply stores and beneficiary farmers.

K. Provision for training of users and applicators.

USAID partners promoting reduced-risk pesticide use will train demo-plot, beneficiary farmers and agro-input store staff on proper handling, storage and disposal. WINNER should follow the regulations promulgated by the government of Haiti. If there are no regulations then those of FAO/WHO should be followed. The WHO and FAO have signed a Memorandum of Understanding for a joint programme to promote sound management of pesticides. The "International Code of Conduct on the Distribution and Use of Pesticides," embodies many of the key recommendations and support activities of this joint programme available online at the following link,

<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/Code/Download/code.pdf>.

Additional WHO references on pesticide management and public health can be found online, http://www.who.int/whopes/recommendations/who_fao_meetings/en/index.html.

These partners will also be responsible for providing appropriate PPE for demo plot farmers, partner agro-supply store staff and pesticide use trainees. Partners should also encourage and work with agro-input supply stores in project regions to increase PPE supplies and affordable use options for non-demo plot farmers. Field officers will provide training and technical assistance to farmers on integrated pest management of fruit and vegetable plots (see Section V: MWP Safer Use Action Plan).

The following is a summary of pesticide safer use training topics to be addressed:

- **Chemical knowledge:** Registration, correct use, application procedures and label specifications. This training includes an in-depth review of label information (resources in Creole and/or with photos will be

provided wherever possible), as well as a discussion of dosage, application rates, equipment calibration and maintenance, application intervals, re-entry and pre-harvest intervals and demonstrations of proper equipment use.

- **Storage:** Proper storage of chemicals in relation to other structures on the property. The need for a separate, clearly marked and locked facility will be emphasized for exclusive storage of farm chemicals. Pesticides should be kept away from food for human or animal consumption or sources of drinking water. Pesticides should **always** be stored in their original containers.
- **Transport:** Safe transport of pesticides will be discussed (i.e. not using public transportation if possible, keeping chemicals in a closed environment, how to avoid punctures and torn bags, etc). Not to transport pesticides with food products.
- **Worker protection:** Types of personal protective equipment (PPE), when they should be worn and why, and how they should be cared for. The basic PPE recommended for all pesticide applications includes long-sleeved shirts, long pants, shoes/rubber boots and socks, goggles, gloves, hat. Depending on the toxicity and label directions, chemical-resistant gloves, aprons, and masks may be required, which will be provided by USAID partners and are available at local agro supply stores. Participants will be encouraged to wash PPE separate from everyday clothing and to keep their PPE in good condition.
- **Safety practices:** Proper mixing techniques, the importance of using clean water for mixing, and the importance of not contaminating water sources. The types of containers used in chemical preparation, their proper use, cleaning and storage will be addressed. Applicators are taught not to eat, drink or smoke while applying pesticides. A container of water should be available at the site of mixing to use in case of spills onto the body and then can be washed off.

- **First aid and medical facilities:** First aid materials must be made available (soap, clean water and a towel) in case of spills. Participants will be taught to identify the primary symptoms of chemical exposure and what to do in an emergency.

Waste Management: How to clean up and safely dispose of any chemical not used. For liquids, empty containers should be rinsed 3 times, and rinseate emptied into the spray tank as part of the application mixture. When the product is used completely, chemical containers should be triple rinsed and punctured before being buried. Containers should **never** be reused.

- **Protection of drinking water:** Training will emphasize the importance of protecting potable water sources and avoiding contamination of ground and surface waters and wells. Participants will be trained to identify their drinking water source and to keep all pesticides away from that source especially rinseate after washing sprayers.. Characteristics of the water source and mitigation measures to avoid contamination will be addressed.

- **Environmental safety:** The importance of protecting natural resources and the proper use of pesticides to avoid environmental contamination and impacts on non-target organisms will be addressed.

For groups promoting pesticide use an additional training phase should be targeted towards women and children who may come enter production fields or who may be exposed indirectly to spray drift or residues on the pesticide users clothing at home. Basic training materials in the form of operational pesticide safety field guides in Creole with illustrations will be developed by SMTN for use by partners.

L. Methodology to monitor the use and efficacy of the pesticide.

USAID partner agronomists and field staff spend the majority of their time in the field and on farms, monitoring cultural practices, plant nutrition, crop health and pest control, and providing technical assistance to farmers when problems arise. Pesticide safer use will be monitored as part of these field visits. Farmers and field staff must keep records of any pest problems and pesticide applications. *See Section V: Safer Use Action Plan and Monitoring Tables (See below for more details).*

V. SAFER USE ACTION PLAN

The following content in sections IV and V has been excerpted from the MWP. These findings and recommendations below are still deemed to be relevant for the purposes of the AMWP and should continue to be implemented through WINNER activities.

As mentioned previously, the program faces significant challenges in terms of local availability of reduced-risk options. Partners involved in agricultural use involving IPM and agro-chemical controls will make every effort to promote the locally-available options that do exist:

1. IPM plans by crop (found in the MWP Annex 1) – cultural controls will be recommended first and farmers will be trained to a) monitor and recognize economically damaging pest levels and b) to properly apply pesticides at the correct time, in order to reduce the need for pesticides. Field extension officers will provide technical assistance in pest monitoring, as well as proper pesticide use, throughout the growing season.
2. As less toxic alternatives become available on the Haitian market, these alternatives will be recommended and more toxic chemicals will be phased out of the program. A PERSUAP amendment will be completed for any new products to be recommended which are not included in the present document.
3. Early control of pests when less toxic alternatives are more effective.
4. Preservation of natural enemies through more selective or reduced-risk alternatives.
5. Coordination of planting calendars among all farmers in a region to offset pest life cycles and reduce probability of severe infestations.
6. Use of sticky traps to monitor and control whiteflies.
7. Promotion of reduced-risk or botanical insecticides and nematicides such as insecticidal soaps, garlic and chili sprays, and neem oil, neem or jatropha seed cakes.
8. Promotion of reduced-risk formulations available in Haiti (such as water-soluble packaging or granules instead of sprays whenever possible and effective for the proposed use).

Training on pest management and proper pesticide use, storage and disposal will be implemented on demo plots as part of farmer trainings, including the topics mentioned previously. Because pesticide use is still fairly uncommon in some areas of the project, an awareness campaign in Creole targeting producer family members, particularly women and children, would be an extremely beneficial exercise. This campaign should cover the dangers of improper pesticide use and handling, entering treated fields during REI, possible health and environmental risks of improper use, and will discourage re-use of pesticide containers for water collection or other purposes. Depending on the local context, these campaigns may be implemented through radio programs, schools, or in conjunction with health centers and/or USAID health partners.

Trainings on chemical safety and pesticide risks, labeling, and less toxic alternatives will also target agro supply store staff and Ministry of Agriculture agronomists. USAID partners are also committed and whenever project mandates permit will to building capacity of agro supply store staff and MARNDR technicians. Partner's will maintain a close working relationship with MARNDR staff and will invite MARNDR and agro supply store agronomists to trainings on chemical safety, integrated pest management, and pesticide alternatives. By working with agro supply store agronomists in particular, it is hoped that they will begin importing lower-risk pesticides and non-chemical alternatives which will be available to farmers throughout Haiti in the long-term.

PPE will be provided to demo plot farmers, and is available, to varying degrees, in regional agro supply stores in project regions and Port-au-Prince. The importance of PPE use and maintenance will be emphasized during farmer trainings and will be constantly monitored by field extension officers. Some non-demo plot farmers may not have access to PPE because it is too expensive. This problem could be addressed by expanding and systematizing existing PPE rental options through working with agro-supply stores and farmer associations. Special direction on maintaining PPE that will be used so frequently should be given to these groups to ensure that pesticide residues do not build up on PPE and increase user hazards.

Water contamination is a potential concern, since inhabitants of Haiti wash in rivers. Any proposed awareness campaigns should discourage washing of pesticide containers or sprayer tanks in or near rivers, irrigation canals, or potable water sources. Rinseate should be added as part of the tank mix and not disposed of in rivers or potable water sources. PPE should not be washed in rivers and women and children are prohibited from washing PPE – PPE washers should wear gloves when washing. PPE washing stations designated strictly for this purpose may need to be established to avoid any problems.

Used pesticide containers must NOT be reused – farmers will be taught to rinse 3 times and add rinseate to tank mix, puncture, and bury.

Recycling options should be explored as they are preferable to container burial if done in a safe manner. Used pesticide containers can be melted down and used in the production of certain plastic materials. The products created from these plastics should never be used to contain food or water.

A. MANAGEMENT OF PESTICIDE WASTE:

Five types of common pesticide waste and best practices:

1) Empty containers

- a. Rinsing will occur before pesticide application so that rinse water can be used to dilute the product. Up to 5% of the water used for dilution can be rinse water.
- b. Empty drums, bottles and cans will be triple rinsed or pressure washed.
- c. Holes will be punched in the container to prevent reuse.
- d. The container can then be buried in a sanitary landfill, recycled or burned if local regulations and product label allows.

2) Excess mixture

- a. Excess mixture should be avoided by careful calculations and measurements.
- b. Excess mixture should be applied to a labeled site.
- c. Once mixed, most products cannot be safely stored.

3) Rinse water from containers and application equipment

- a. Rinse water has great potential to contaminate water sources both above and below ground.
 - i. Do not discharge to ground, drains or septic systems.
- b. Rinse water should be minimized and applied to a labeled site.
- c. Reuse rinse water to dilute the next batch of the same product.
 - i. Up to 5% of water used for mixing can be rinse water.

4) Spilled material

- a. Spilled material will be immediately cleaned through the use of an absorbent material.
 - i. For example, soil, sawdust, cat litter, etc.
- b. If done shortly after the spill, the absorbent material can then be placed in a suitable container and applied to an approved site (such as a crop field) in a manner consistent with the product label.

5) Obsolete and Unused Pesticides

- a. Pesticides become obsolete for the following reasons:
 - i. Banned products
 - ii. Substandard storage and management
 - iii. Prolonged storage as a result of overstocking
 - iv. Product expiration
- b. Pesticides should be taken to the nearest hazardous waste management center, if available.
- c. Certain pesticides can be destroyed in normal cement incinerators while others require specific high temperature toxic waste incinerators.
- d. If there is no safe way to destroy the product, field application according to the product label is likely to be the safest alternative.

1. Neutralization of Metal and Glass Containers:

Metals and glass containers (barrels, cans, drum, jars) contaminated with organophosphorous, organochlorine compounds and derivatives of denitrophenol and other pesticides can often be neutralized with alkaline solutions (soda, wood ash, lime). The containers are filled with 5% solution of caustic or washing soda and left standing for 6-16 hours and are then repeatedly washed with water. Containers emptied of carbamate pesticides (thiram, carbayl), for examples, are neutralized using a 1% solution of potassium permanganate acidified with hydrochloric acid (5ml/liter) or a paste of lime chloride.

B. SEED TREATMENT BEST PRACTICE:

Product Selection: Seed treatment is used to control three types of disease including: 1.) smuts and bunts, root rots and seedling diseases. Most seed treatment products are made to target one of these types of disease. Therefore it is very important that the correct product is chosen, taking into account disease history in the area. Seed treatments recommended in this PERSUAP include Maxim XL (EC), Batallion 0.2 (EC) and Thiram 75 (WP). The Pesticide Evaluation Report (Section IV.) should be consulted in deciding which product will most effective for particular crops and diseases. The degree of control will vary with product, application rate, environmental conditions and diseases present.

Application of Chemical Treatment: Seed treatments are applied as a dust, a slurry or a liquid. Liquid and slurry formulations are most effective in coating the seed while dust formulations may not be evenly distributed over the seed's surface due to lack of moisture. Careful measurement and mixing are required to ensure that the appropriate amounts of liquid and slurry treatments are applied. Seed treatment devices typically consist of a mixing tank, a treater head and a coating chamber. In order to insure correct measurements, application and measuring equipment should be frequently cleaned and calibrated. Otherwise, buildup of chemical residue may result in reduced application rates. Some dust treatments are designed to be added to seeds in a planter box and mixed with a stick. However, like other dust applications, this method does not guarantee even distribution of the treatment.

As indicated in the Pesticide Evaluation Report, personal protection equipment must be worn when handling chemical treatments as well as chemically treated seed. The label directions corresponding to products used must be followed closely so as to avoid health risks and environmental damage. Overtreatment may also damage the seed and reduce effectiveness of disease control. Treated seed should never be used for food or feed and should be kept separate from seeds intended for consumption. Containers used for seed treatment should be triple rinsed with water with the rinse water being added to the treatment mixture. The containers should then be punctured and disposed of in a manner compliant with the Safer Use Action Plan of this document.] ¹⁷⁴

¹⁷⁴ Excerpt from: USAID/Haiti Mission-Wide PERSUAP. USAID and partner organizations, SMTN, December, 2010. 101-106

VI. Annex 1: Existing MWP EMMP

Issue	Potential Impact	Mitigation Measures	Monitoring and Indicators of effective mitigation
<i>Selection of Pesticide for promotion / use</i>	<ul style="list-style-type: none"> RUPs or non-PERSUAP approved products may, in contexts where access to in depth training and sophisticated PPE is often impossible, lead to serious immitigable health/ environmental impacts 	<ul style="list-style-type: none"> Select products included in the table of PERSUAP recommended products (p. 23-25) for promotion and use by beneficiary farmers 	<p>Field officer observations report partner agro-chemical stores or field agents promoting:</p> <p>j. No RUP or non-PERSUAP products sales/use</p>
<i>Spray drift</i>	<ul style="list-style-type: none"> Contamination of nearby water bodies or potable water sources Exposure of nearby residents 	<ul style="list-style-type: none"> Spray in the early morning or late afternoon when winds are low Apply largest droplets (> 150-200 microns) which provide sufficient coverage and control Use high flow rate nozzles to apply the highest practical spray volume Use the lower spray pressures recommended for the nozzle Train sprayers on proper spray techniques using fluorescent dye For chemicals with high aquatic toxicity: do not spray on farms with nearby streams or other natural water bodies 	<p>Field officer observations report no incorrect spray applications:</p> <ul style="list-style-type: none"> No spraying near water bodies No spraying in heat of afternoon Minimal drift observed during spraying Sprayers have been trained in safe spray technique

<i>Runoff</i>	<ul style="list-style-type: none"> Contamination of nearby streams and groundwater (especially where water table is shallow) 	<ul style="list-style-type: none"> Do not apply known or potential groundwater contaminants where water table is shallow, or adjust soil pH accordingly to enhance adhesion Recommend granular formulations when available and effective 	<p>Field officer observations report no incorrect spray applications:</p> <ul style="list-style-type: none"> No spraying near water bodies or potable water sources No spraying in afternoon
<i>Runoff</i>	<ul style="list-style-type: none"> Contamination of potable water sources (wells, streams) 	<ul style="list-style-type: none"> Do not apply chemicals with high aquatic toxicity on farms adjacent to streams, rivers, ponds, etc. Establish trenches or vegetative barriers to minimize runoff 	<ul style="list-style-type: none"> Products toxic to aquatic species are not applied near surface waters Minimal drift observed during spraying Trenches and/or vegetative barriers established on all demo plots
<i>Wet and dry season applications</i>	<ul style="list-style-type: none"> Repetitive sprays during the rainy season (increased chemical exposure to spraymen) Heat exposure effects on spraymen in association with pesticides (skin, eye, or respiratory tract irritation) 	<ul style="list-style-type: none"> Favor spraying in the early morning when rains are not likely Never spray when foliage is wet Avoid applying spray products in temperatures that exceed 36 degrees C 	<p>Field officer observations report no incorrect spray applications:</p> <ul style="list-style-type: none"> No spraying in afternoon or in hot weather No spraying when leaves are wet PPE used properly to prevent exposure

<i>Non-target organisms</i>	<ul style="list-style-type: none"> ▪ Negative impacts on beneficial insects such as honeybees ▪ Negative impacts on birds ▪ Negative impacts on aquatic organisms 	<ul style="list-style-type: none"> ▪ Recommend more selective, less toxic alternatives when available and effective ▪ Do not spray when and where honeybees are actively foraging. Spray in early morning ▪ Do not spray chemicals that are toxic to birds in foraging areas or on crops that attract birds ▪ Minimize spray drift and runoff using measures described above 	<p>Field officer observations report no incorrect spray applications:</p> <ul style="list-style-type: none"> ▪ No spraying during bloom periods/when bees are actively foraging ▪ No spraying near water bodies or potable water sources ▪ No drift observed during spraying ▪ No dead fauna observed in the area ▪ Trenches and/or vegetative barriers established on all pesticide use demo plots
<i>Acute human health risks</i>	<ul style="list-style-type: none"> ▪ Exposure effects on spraymen and farm staff (skin, eye, or respiratory tract irritation) ▪ Systemic effects ▪ Exposure effects on nearby residents 	<ul style="list-style-type: none"> ▪ Recommend less toxic alternatives when available and effective ▪ Train farm staff in pesticide safety practices (use of personal protective equipment, proper handling, mixing, application, storage and disposal according to labels) ▪ Ensure that appropriate personal protective equipment is available at all times ▪ Obey restricted entry intervals, pre-harvest intervals and post clearly-marked signs in Creole and with drawings around fields that have been recently sprayed ▪ Ensure that clean water, soap and towels are available in case of spills/accidents and for general clean-up ▪ Train farm staff in exposure symptoms and first aid 	<p>Field officers observe:</p> <ul style="list-style-type: none"> ▪ Lowest application rates being applied ▪ Less toxic alternatives being used ▪ Established pesticide storage facility with clear signs ▪ No evidence of pesticide containers littered in fields, or reuse as water containers etc. ▪ Proper use of PPE ▪ No women or children applying or handling pesticides or PPE, or entering fields during REI ▪ Product label information is available in Creole or is well understood by USAID partner field staff and/or partner agro-supply store staff

		<ul style="list-style-type: none"> Discourage re-use of pesticide containers; training on triple-rinse, puncture and burying of containers 	
<i>Chronic human health risks</i>	<ul style="list-style-type: none"> Carcinogenic and organ toxic effects Developmental toxicity 	<ul style="list-style-type: none"> Recommend less toxic alternatives when available and effective Rotate spraymen when using chemicals with known chronic toxicity Do not permit women or children to apply pesticides Train local resident women and children to stay away from pesticide storage areas, fields that have been sprayed, etc. 	<p>Field officers observe:</p> <ul style="list-style-type: none"> Lowest application rates being applied Less toxic alternatives being used Established pesticide storage facility with clear signs on demo plots No evidence of pesticide containers littered in fields, or reuse as water containers etc. Proper use of PPE
<i>Chronic human health risks</i>	<ul style="list-style-type: none"> Carcinogenic and organ toxic effects Developmental toxicity 	<ul style="list-style-type: none"> Prevent potable water source contamination by minimizing spray drift and runoff 	<ul style="list-style-type: none"> No women or children applying or handling pesticides or PPE, or entering fields during REI
<i>Disposal of chemicals and containers; PPE washing</i>	<ul style="list-style-type: none"> Spills leading to contamination of water sources or exposure Inappropriate use or reuse of pesticide containers, Inappropriate disposal of expired pesticides or rinseate 	<ul style="list-style-type: none"> Train farm staff in appropriate chemical and container disposal practices Discourage re-use of pesticide containers; training on triple-rinse, puncture and burying of containers Establish washing stations if necessary All PPE and empty container rinseate should be added to sprayer and used Expired pesticides should be used according to their label's directions 	<p>Field officers observe:</p> <ul style="list-style-type: none"> Washing of containers, PPE or tanks, no disposal of rinseate in water bodies. Rinseate is added to pesticide solution in sprayers and expired pesticides are used according to their label's directions. No evidence of pesticide containers littered in fields, or reuse as water containers etc. Proper use of PPE No women or children applying or handling pesticides or PPE, or entering fields during REI Washing stations in use

VII. Annex 2: Index of recommended chemical products

ACARICIDES

dicofol (48%)	6, 11, 18, 22, 24, 30, 34, 38, 45-53
Horticultural oil (98%)	6, 11, 18, 22, 24, 30, 34, 38, 45-53
Insecticidal soap ¹⁷⁵ (47%)	6, 11, 18, 22, 24, 30, 34, 38, 45-53
Spirodiclofen (22.3%)	6, 11, 18, 22, 24, 30, 34, 38, 45-53
Spiromesifen (21.3%)	6, 11, 18, 22, 24, 30, 34, 38, 45-53

BACTERICIDES Floriculture for crown gall bacteria

2,4 xyleneol (0.46%) + meta-cresol (0.47%) - Gallex	6, 12, 25, 52-56
Agro-bacterium radiobacter strain K84 (99%) – No-Gall	6, 12, 25, 52-56
Agro-bacterium radiobacter strain K1026 (0.025%) – Gall-troll	6, 12, 25, 52-56

BIRD REPELLENT

Methyl anthranilate – Avian control, Rejex-it	6, 12, 29, 35, 57-59
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FUNGICIDES

copper oxychloride, (20-50%) - Cuprosan	6, 12, 13, 23-30, 67-79
fosetyl-aluminum (80%) - Aliette	6, 12, 13, 24, 26, 32, 67-79
pyraclostrobin – Headline	6, 12, 13, 25, 26, 34, 67-79
thiophanate-methyl – Topsin	6, 12, 13, 23, 25, 27, 67-79

Seed Treatment

fludioxonil+mancozeb – Maxim MZ	6, 13, 29, 34, 79-82
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HERBICIDES

bentazon	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
carfentrazone-ethyl	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98

¹⁷⁵ Recommended in MWP, see the relevant PER sections.

sethoxydim	7, 8, 13-15, 26, 29, 82-98
halosulfuron-methyl	7, 8, 13-15, 19, 26, 29, 35,36, 82-98
pendimethalin	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
2, 4-D acids and salts;	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
cyhaliofop-butyl	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
fenoxaprop-p-ethyl	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
propanil	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
thiobencarb	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
triclopy	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98
sodium chlorate	7, 8, 13-15, 19, 26, 29, 35, 36, 82-98

INSECTICIDES

Cockroach controls

avermectin (0.05%) -	8, 15, 19, 23, 98-101
boric acid (1%) – Advantage 1000	8, 15, 19, 23, 98-101
fipronil (0.001-0.05%) – Max force roach killer	8, 15, 19, 23, 98-101

Post-harvest control for seed storage

primiphos methyl (57%) – Actellic 5E	8, 36, 37, 103
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Rice insecticides

buprofezin – Applaud	8, 16, 35, 103-108
spinetoram/spinosad - Entrust/Delegate	8, 16, 35, 103-108
thiamethoxam – Actara	8, 16, 35, 103-108

MOLLUSCICIDES

iron phosphate (1%) - Sluggo	9, 16, 20, 27, 108-111
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PLANT GROWTH REGULATORS

chlormequat chloride (11.8%) - Cycocel	9, 16, 20, 27, 111-113
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paclobutrazol (0.4%) - Bonzi	9, 16, 27, 113-115
ethephon (3.9%) - Florel	9, 16, 27, 115-117
gibberellic acid (1.8%)+ N-6 benzaladenine (1.8%) – Pro-Gibb, Fascination	9, 16, 28, 117-119
uniconazole-P (4%) - Sumagic	9, 16, 28, 119-121

RODENTICIDES

brodifacoum (0.005%) – Kle Rat	9, 17, 23, 27, 121-128
chlorophacinone (0.005%) - Rozol	9, 17, 23, 27, 121-128
bromadiolone (0.005%) - Maki	9, 17, 23, 27, 121-128
warfarin (0.025%) - Kaput	9, 17, 23, 27, 121-128

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