Bureau for Food Security
Initial Environmental Examination (IEE) Amendment
Pesticide Evaluation Report and Safer Use Action Plan
PERSUAP – Nepal, *tuta absoluta*

Project Information:		
Activity/Project Title: FtF IPM Innovation Lab PERSUAP for Tuta absoluta in Nepal		
Contract/Award Number (if known): N/A		
Geographic Location : Nepal		
Is this is an Amendment to an existing IEE? **Yes**, and this will be Amendment #: 1 Original IEE Tracking #: No Tracking Number on original IEE, BEO Approval Date: 9/29/2014 Title of Original document: Feed the Future Innovation Lab for Integrated Pest Management		
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Implementation Start/End: April 2017 – September 2019		Expiration Date: September 2019
Prepared By: John Bowman	BFS Office: ARP	Date Prepared: April 6, 2017

BFS Initial Environmental Examination (IEE) Amendment

This IEE Amendment is intended to solely to allow for the authorization of the Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) for use in Nepal for the Tomato Leaf Miner *Tuta absoluta*. All other conditions are unchanged and remain legally binding. The attached PERSUAP: 1) shall only be used as an extension of the Feed the Future Innovation Lab for Integrated Pest Management project, 2) shall only be used in the country of Nepal, and 3) shall only be used for control of the Tomato Leaf Miner *Tuta absoluta*.

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

CLEARANCE:

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BFS Tracking #: BFS-17-04-002

Pesticide Evaluation Report and Safer Use Action Plan for the South American tomato leafminer, *Tuta absoluta*

1. Introduction

Agriculture is the backbone for sustainable economic growth, poverty alleviation, and nutritional needs in most developing countries where USAID implements programs. Vegetable crops play a major role in improving nutritional health, food security, and the quality of life of the population. Many countries in Africa, Asia, the Middle East, Europe, and South and Central America export vegetables, either in fresh or processed forms, resulting in increased employment and income, and poverty reduction in rural and urban areas. For farmers in these countries, the tomato is an important part of their diet and plays a key role in diversifying the economy and agricultural sector.

World tomato production in 2013 was 163 million tons with a production area of 4.5 million hectares. The top tomato producing countries in that year were China, India, U.S.A., Turkey, Egypt, Iran, Italy, Brazil, Spain, and Mexico.

The South American tomato leafminer, *Tuta absoluta* (Lepidoptera: Gelechiidae), is a serious pest of tomato and as the name implies, is a native of South America. It was first described in 1917 by Meyrick as *Phthorimaea absoluta* from specimens collected in Peru. It was named as *Gnorimoschema absoluta* by Clarke in1962, *Scorbipalpla absoluta* by Povolny in 1974, and finally *Tuta absoluta* by Povolny in 1994. The potato tuber moth (*Phthorimaea operculella*), pink bollworm (*Pectinosphora gossypiella*), tomato pinworm (*Keiferia lycopersicella*), and Guatemalan potato moth (*Tecia solanivora*) are some of the other important agricultural pests in the family Gelechiidae.

2. Spread of *Tuta absoluta*

Tuta absoluta was introduced accidentally with imported produce from Chile to Spain in 2006 and in the past decade, it has spread to most of the countries in Europe, the Mediterranean, the Middle East, along with some countries in Central and South Asia, and much of the African continent. It has also spread northwards from South America into Panama and Costa Rica (Table 1, Fig. 1). The Climex model (Fig. 2) shows potential areas in the world that *T. absoluta* can spread. This pest seems to spread through the movement of infested tomato fruits via commerce as well as via the flight of moths with the assistance of wind currents.

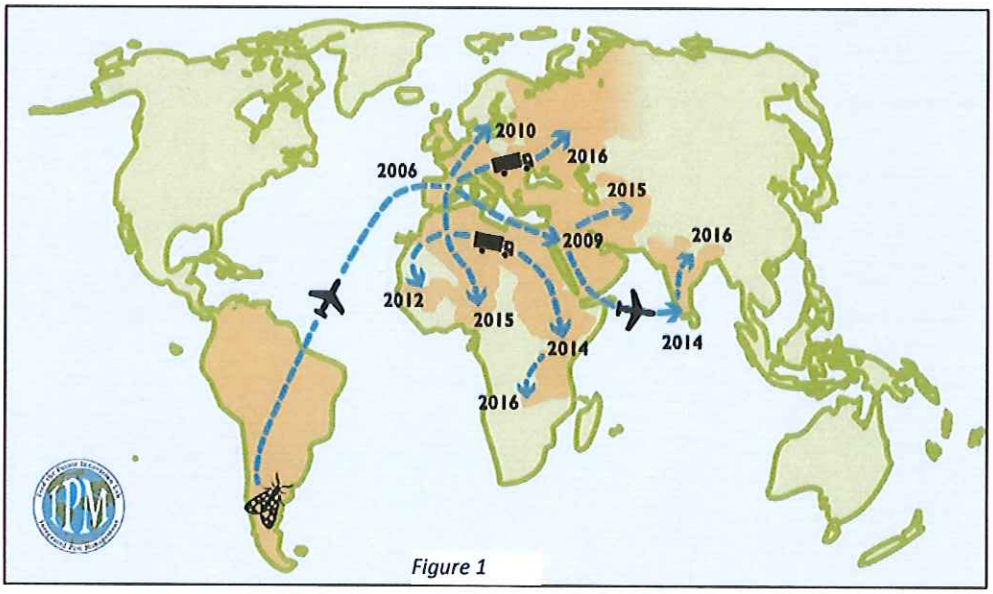

Figure 1

Table 1. Spread of *Tuta absoluta* in the world.

•	Spain	2006	•	Kosovo	2010
•	Italy	2008	•	Israel	2010
•	France	2008	•	Iran	2010
•	Morocco	2008	•	Lebanon	2010
•	Algeria	2008	•	Yemen	2010
•	Malta	2009	•	United Arab Emirates	2010
•	Romania	2009	•	Qatar	2010
•	The Netherlands	2009	•	Montenegro	2011
•	Russia	2009	•	Georgia	2011
•	Albania	2009	•	Oman	2011
•	Slovenia	2009	•	Senegal	2012
•	Switzerland	2009	•	Ethiopia	2012
•	Canary Islands	2009	•	Niger	2012
•	Tunisia	2009	•	Czech Republic	2013
•	Egypt	2009	•	Kenya	2013
•	Libya	2009	•	The Gambia	2013
•	Bahrain	2009	•	Panama	2013
•	Saudi Arabia	2009	•	Ukraine	2014
•	Jordan	2009	•	Tanzania	2014
•	Iraq	2009	•	India	2014
•	Kuwait	2009	•	Costa Rica	2014
•	Syria	2009	•	Nigeria	2014
•	Bulgaria	2010	•	Afghanistan	2015
•	Hungary	2010	•	Guinea	2015
•	Turkey	2010	•	Zambia	2015
•	Serbia	2010	•	Uzbekistan	2015
•	Croatia	2010	•	Mali	2015
•	Cyprus	2010	•	Nepal	2016
•	Germany	2010	•	Bangladesh	2016
•	Guernsey	2010	•	**Malawi**	**2016**
•	Bosnia-Herzegovina	2010	•	**South Africa**	**2016**
•	Lithuania	2010	•	Mozambique	2016

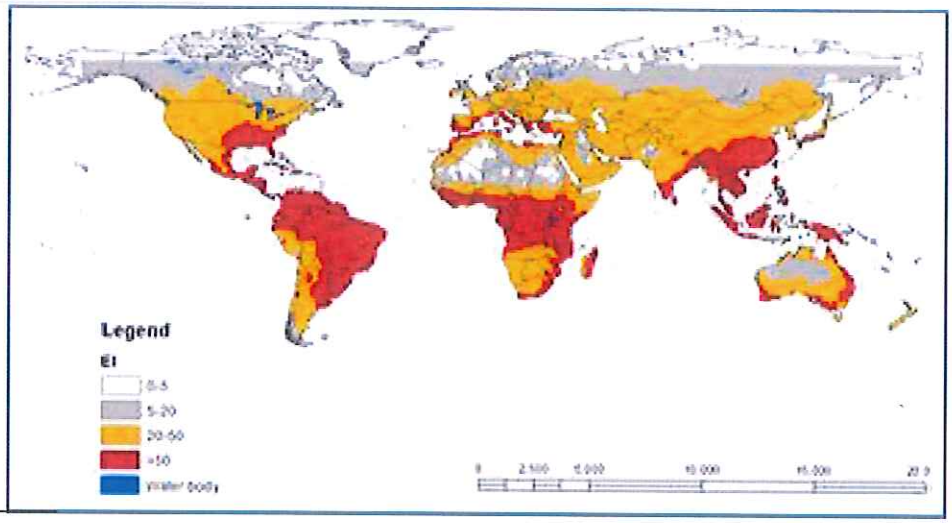

Fig. 2. Climex1 model showing possible area in the world *that Tuta absoluta* can invade.

[1] The CLIMEX model is a software that predicts the response of a species or other taxonomic unit to climate.

3. Lifecycle of *Tuta absoluta*

Tuta absoluta is a multivoltine species with a short life cycle takes 18 to 35 days in the tropics (Fig. 3). Moths are small, silvery-brown in color (Fig. 4), and nocturnal in habit, most active at dusk and dawn. A single female may lay about 260 eggs in its lifetime. Eggs are laid singly (Fig. 5) or in small batches, mostly on the underside of leaves and rarely on stems and pedicels. They are yellow in color and turn dark before hatching.

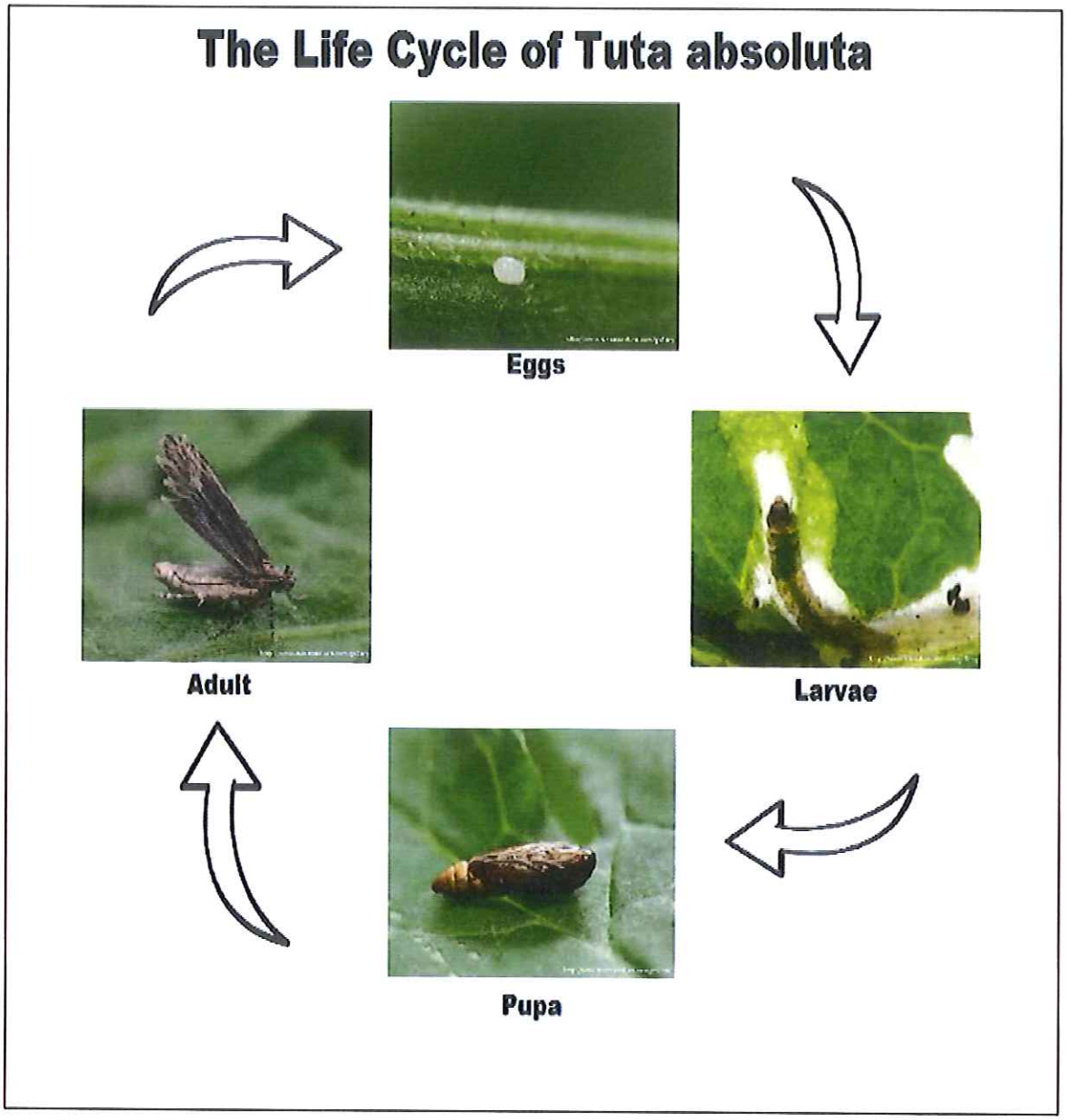

Fig. 3 Life cycle of *Tuta absoluta*

Fig. 4 Adult of *Tuta absoluta*

Fig. 5 Egg of *Tuta absoluta*

Eggs hatch in 2.5 days at 30°C, 7.0 days at 20°C and 24.5 days at 10°C. The larvae, upon hatching, mine into the lamina of the leaves, causing blotches (Fig. 6, 7). Some bore into stems, petioles, and fruits (Fig. 8, 9, 10). Presence of a black band behind the head on the dorsal side of the prothorax is a characteristic identity of T. absoluta larva. (Fig. 11). Larval development is 10.5 days at 30°C, 20.0 days at 20°C, and 56.5 days at 10°C. Mature larvae emerge out of mines, bore holes, and drop to the soil for pupation. Some also pupate in the dried leaves. Pupal stage lasts 5.5 days at 30°C, 10.2 days at 20°C, and 36.8 at 10°C.

Fig. 6 *Tuta absoluta* larva mining in a tomato leaf

Fig. 7 Characteristic *Tuta absoluta* damage on a tomato leaf

Fig. 8 *Tuta absoluta* bore holes in the tomato stems

Fig. 9 *Tuta absoluta* damage on a tomato fruit

Fig. 10. Damaged tomato fruits collected from a field

Fig. 11 Characteristic black band behind the head of *Tuta absoluta* caterpillar

4. Damage

Tuta absoluta is capable of causing total crop loss by mining all leaves and boring into the fruits unless control measures are adopted. It is an oligophagous (Insects which feed only on a limited number of foods, usually within one taxonomic family) insect and its preferred host is tomato, but it will also attack eggplant, potato, pepper, and tobacco, and can survive on some solanaceous weeds. The larvae mine leaves and bore into terminal buds, flower buds, and fruits. Severely damaged tomato fields and greenhouses may appear scorched because of larval mining of all leaves (Fig. 12, 13).

Fig. 12 *Tuta absoluta* damaged tomato field in Kenya

Fig. 13 *Tuta absoluta* damaged tomato crop in a greenhouse in Nepal

In the early 1980s when it was reported in Brazil, some producers carried out 36 insecticide applications in a tomato season. When *T. absoluta* detected in the Mediterranean region, 15 insecticide applications were given in one season specifically targeted at this pest. In Spain, its presence led to an increase of €459 per hectare in costs related to pest management per season. In Nigeria, the price of tomatoes went up 15 times when this pest invaded. In 2015, a $20 million output tomato processing plant had to halt due to lack of supply. When this pest invaded Zambia, the price of tomato in the local markets went up 20 times. According to Dr. Luke Colavito, Country Director of International Development Enterprises (iDE) Nepal, the potential losses could reach $50 million per annum due to *T. absoluta* in Nepal.

5. Control methods

Cultural control:

Cultural control methods include:

- Protecting seedlings by screening nursery beds to exclude *T. absoluta* infestation.
- Crop rotation by planting non-host crop of *T. absoluta* after one season of tomato;
- Adoption of host free period of six to eight weeks on an area wide basis.
- Use of sprinkler irrigation to reduce *Tuta* infestation. When water droplets fall on the leaves, caterpillars wriggle and fall off the leaves
- Disposing of the crop residue by burning or other safe means to prevent larvae and pupae reaching adult stage.
- Tilling the soil immediately after last harvest to destroy pupae in the soil.
- Growing Bottle Gourd (***Lagenaria siceraria***) as border crops to increase the population of natural enemies around the field and Coriander (***Coriandrum sativum***) as a nectar source. Bottle gourd, a cucurbit is a hardy plant with large leaves. It harbors some pests and natural enemies and it does not require pesticide application to control its pests. It is recommended to be grown outside the tomato field as border crop. Pests of bottle gourd do not attack tomato, however, natural enemies move into tomato field and suppress pests. Coriander grown as a border crop serves as a nectar source for the natural enemies.
- In green houses, installation of double doors, screening of vents, and taking additional measures to prevent entry of moths.

Pheromones

Trapping:

For monitoring *T. absoluta,* sex pheromone lures are used in combination with a pan (Fig 18), McPhail, bucket, Delta or Jackson traps, (Fig. 14, 15) and cardboard insert coated with a polyisobutylene sticky material or water with a few drops of soap solution. Pheromone traps are used in detection programs and to monitor populations. Detection survey is for determining presence of a pest in a defined area where its presence not known before.

Rubber septa loaded with lure of 0.3mg is used for survey applications, while 0.1mg in survey of enclosed buildings such as packing houses and 0.5mg in open fields. Some companies that produce these lures and traps are ISCA Technologies (U.S.A), Russell IPM Ltd (United Kingdom), Koppert Biological Systems (Netherlands), and Biocontrol Research Laboratories (India).

Fig. 14 Delta trap

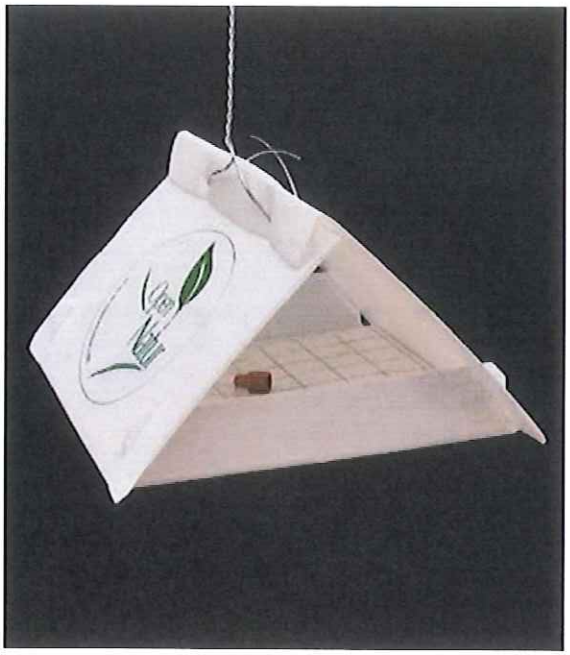

Fig. 15 *Tuta* male moths caught in the stick pad of a trap.

Mating disruption:

This technique will work under greenhouse conditions; however, other cheaper and effective methods preclude its use. Another limiting factor for its use in the open fields is simultaneous existence of several nearby fields serving as continuous source of adults of *T. absoluta* to colonize the area under mating disruption. Area wide use of mating disruption may be a possibility, but is difficult to achieve with the prevailing small farms involved in fresh market tomato production. Mass trapping using pheromone traps is used effectively in greenhouses in combination with other technologies such as augmentative release of natural enemies. It could be used on areawide basis in the open fields, as it will reduce the number of fertile eggs laid by females.

Reported parthenogenesis in *T. absoluta* will also reduce the efficacy of techniques adopted using pheromone.

Light traps:

Both male and female moths are attracted to light and light traps are used in greenhouses by placing them near entry doors. A modified light trap, Ferolite, uses a combination of pheromone lures and a specific light frequency operated by a solar cell is highly attractive to *T. absoluta* (Fig. 16, 17, 18, 19). These traps are used for monitoring *T. absoluta* populations.

Fig 16. Ferolite trap

Fig 17. Commercially made water trap

Fig 18. Locally made water trap

Fig 19. A light trap

Resistant varieties:

Currently there are no resistant tomato varieties to *T. absoluta*. The wild tomato, *Lycopersicon hirsutum f. glabratum,* has been reported to be resistant to *T. absoluta*. The resistance is attributed to the allomones tridecan-2-one and undecan-2-one present in the leaf glandular trichomes. The incorporation of this trait into commercial varieties proved difficult and conflicted with yield parameters. There is a focus on allelochemicals, particularly acyl sugars, in contributing to resistance. Research is being progressing at Asian Vegetable Research and Development Center (AVRDC) Taiwan to develop varieties to *T. absoluta*.

Chemical control:

The primary management tactic for *T. absoluta* in its native South American countries is chemical control. Organophosphates and pyrethroids were used during the 1970s and 1980s and moved to new products such as abamectin, spinosad, tebufonzide, and chlorfenpyr in the 1990s. By early 2000, about 12 classes of insecticides were used to control *T. absoluta*.

Indoxacarb, spinosad, imidacloprid, deltamethrin, and *Bacillus thuringiensis* var. kurstaki, were applied in Spain. Chlorpyrifos and pyrethrins were used in Italy. Abamectin, indoxacarb, spinosad, imidacloprid, thiacloprid, lufenuron, and *B. thuringiensis* recommended in Malta. Indoxacarb and *B. thuringiensis* were recommended in France. In Brazil, abamectin, cartap, chlorfenapyr, phenthoate, methamidophos, spinosad, and indoxacarb were recommended. In Argentina, *B. thuringiensis,* and triflumuron were recommended. In 2010, a temporary permit was granted to use chlorantraniliprole, flubendiamide, emamectin, and metaflumizone in Spain.

Methamidophos, deltamethrin, imidacloprid, spinosad, abamectin, emamectin, *Bacillus thuringiensis*, chlorfenapyr, indoxacarb, chlorantraniliprole, flubendiamide, and azadiractin are used for control *T. absoluta* outside the U.S.A. and registered for tomato in the U.S.A.
Chlorpyrifos, thiacloprid, lufenuron and metaflumizone are used for *T. absoluta* control outside the U.S.A. but not registered on tomato in the U.S.A.

In Bolivia and Chile, *T. absoluta* was reported to be resistant to organophosphates in the 1980s. Recently in Argentina resistant development to deltamethrin and abamectin was reported. Resistance to cartap, abamectin, permethrin, methamidophos, acephate, and deltamethrin has been reported in Brazil.

For resistance management, alternation, sequence, or rotation of compounds with different modes of action need to be practiced.

Biopesticides:

The neem tree (*Azardirachta indica*) is a tropical tree grown widely in Africa, Asia, and central and tropical South America. Seeds of this tree contains azadiractin, which has insecticidal and fungicidal properties. It disrupts insect moulting and may act as a feeding deterrent for some insects. Some small-scale farmers collect the seeds, grind them, and spray the extract on crops to control pests. However, several commercial formulations like Align, Azatin, Ecozin, Neemazal, Neememulsion, Neemix, Ornazin, prepared using azadiractin as the major component are available in the market.

In Brazil, azadirchitin caused heavy mortality of *T. absoluta* larvae and egg laying avoidance on sprayed plants.

Azadiractin could be combined with *Bacillus thuringiensis, Beauvaria bassiana, Metarhizium anisopliae* and other microbial pesticides. However, it could not be combined with entomopathogenic nematodes.

Biological control:

Several species of *Trichogramma* are known to attack eggs of *T. absoluta* and some of the common ones are *Trichogramma acheae, T. pretiosum, T. nerudai, T. exiguum* and *Trichogrammatoidea bactrae* (Hymenoptera: Trichogrammatidae). Out of these, *T. acheae* and *T. pretiosm* are commercially used in Europe and Brazil respectively.

Larval parasitoids recorded are *Necremnus artynes* (Hymenoptera: Eulophidae), *Stenomesius* sp. (Hymenoptera: Eulophidae), *Neochrysocharis formaosa* (Hymenoptera: Eulophidae), *Habrobracon hebetor* (Hymenoptera: Braconidae), *Bracon nigricans* (Hymenoptera: Braconidae) *Dineulophus phthorimaeae* (Hymenoptera: Eulophidae), *Apanteles gelechiidivoris* (Hymenoptera: Braconidae), *Pseudoaphanteles dignus* (Hymenoptera: Braconidae) and *Diadegma ledicola* (Hymenoptera: Ichneumonidae).

Dineulophus phthorimaeae reported to provide 70% parasitism in Chile. *Pseudoaphanteles dignus* was considered as an important parasitoid in Argentina.

Some of the predators recorded on *T. absoluta* were *Nesidiocoris tenuis* (Hemiptera: Miridae) (Fig. 19), *Macrolophus pygmaeus* (Hemiptera: Miridae), *Dicyphus errans* (Hemiptera: Miridae), *Amphiareus constrictus* (Hemiptera: Anthocoridae), *Blaptostethus pallescens popplus* (Hemiptera: Anthocoridae), *Orius tristicolor* (Hemiptera: Anthocoridae).

Microbial pesticides:

- Trichoderma spp.: Plants treated with *Trichoderma* spp. are known to exhibit induced defense through jasmonic acid, salicylic acid or other pathway mechanisms. Under low population pressure, *T. absoluta* avoids egg laying on such defense induced plants.
- *Bacillus subtilus*: Plants treated with B. subtilus exhibit induced defense.
- *Bacillus thuringiensis*: Properties of *B. thuringiensis* as an insecticide is well known. Several commercial formulations of this bacterium are available in the market (Annex – 1). It could be combined with other botanical, microbial and chemical pesticides.
- *Beauveria bassiana*: It is an entomopathogenic fungus, causes white muscardine disease on various insects.
- *Metarhizium anisopliae*: It is also an entomopathogenic fungus and the disease caused by the fungus is sometimes called green muscardine disease because of the green color of its spores.
- Heterorhabditis *bacteriophora*: It is an entomopathogenic nematode used for controlling insect pests.
- *Steinernema feltiae*: It is another entomopathogenic nematode used for controlling insect pests.

Classical biological control:

The larval parasitoid *Apanteles gelechiidivorus* was reported to be effective in Colombia and it was introduced from Colombia to Chile.

Augmentative biological control:

Egg parasitoid *Trichogramma achaeae* is released at the rate of 750,000 adults/hectare every 3-4 days for control of *T. absoluta* in Spain. In Colombia and Brazil, release of 450,000 *Trichogramma* spp. per hectare twice per week for 10 weeks is recommended. In Egypt, inundative release of *Trichogrmmatoidea bactrae* combined with mass trapping with pheromone traps has given effective control of *T. absoluta*.

***Fig. 19** Nesidiocoris tenuis*, a predatory bug

Trichogramma adults that emerged from *T. absoluta* eggs showed poor biological traits such as wing deformation and reduced longevity requiring augmentative releases.

Predators, *Nesidiocoris tenuis* (Hemiptera: Miridae) (Fig. 19) and *Macrolophus pygmaeus* (Hemiptera: Miridae) are released in greenhouses for control of *T. absoluta* in Europe. Inundative release of *Trichogramma euproctidis* and *Trichogramma evanescens* in combination with the predator, *Macrolophus pygmaeus* proved effective in control of *T. absoluta* in France.

Inundative release of *Amblyseius swirskii* (Acari: Phytoseiidae) and *Amblyseius cucumeris* (Acari: Phytoseiidae) for control of *T. absoluta* needs to be verified.

Conservation biological control: It is protecting local natural enemies by reduced use of pesticides. In Israel, reduced use of pesticides and augmentative release of *N. tenuis* successfully controlled T. *absoluta* in the open tomato fields.

Integrated Pest Management (IPM)

IPM is crop, site and season specific. The USAID IPM Innovation Lab has developed IPM packages for vegetable crops. A template for tomato IPM package is given below:

Table 2. Template for Tomato IPM Package.

• Selecting appropriate varieties, for example, with disease resistance
• Raising healthy seedlings
• Treating seeds or seedlings with *Trichoderma*, *Pseudomonas fluorescens,* and *Bacillus subtilis.*
• Solarizing seed beds and greenhouses.
• Using Vesicular-arbuscular mycorrhiza (VAM), neem cake, and other organics.
• Grafting on resistant rootstock for bacterial wilt, Fusarium, and other soil-borne diseases.
• Staking and mulching.
• Setting up yellow sticky trapping of whiteflies, leaf miners, etc.
• Pheromone trapping of *Helicoverpa, Tuta,* and *Spodoptera.*
• Rogueing and host-free period for control of virus diseases.
• Using biopesticides such as neem.
• Using microbial pesticides, such as NPV, *Metarhizium*, and *Beauveria*
• Crop rotation.

IPM practitioners in each country should select technologies that are effective and suitable for their conditions where tomato are grown and incorporate them into the tomato package that has already been developed.

6. Safe Use Action Plan

The SUAP summarizes the conditions are for the safe use of the pesticide a.i.'s recommended in Table 1. Specific safety requirements are provided for each pesticide a.i. individually in Annex 1 (Pesticide Data Sheets).

Conditions for IPs:

1. Only pesticides with approved active ingredients can be procured, used or recommended for use with USAID funds.
2. Pesticide products procured, used or recommended for use must be labelled in a national language and include the following essential information:
    - name and concentration of active ingredient
    - type of formulation
    - instructions for use

- user safety information
- safety periods for re-entry and harvest
- manufacturer and country of origin.

3. Basic training in safer use must be provided broadly
4. Advanced training required for certain AIs and products
5. Pesticides for plant protection must be part of an IPM scheme
6. Appropriate Personal Protective Equipment (PPE) must be available.
7. Observance of label instructions and safe pesticide purchase, handling, storage and disposal practices .
8. Record-keeping & resistance monitoring
9. Regular implementation reporting
10. Pass-down to subcontractors and grantees

See *Pesticide Stewardship of Specialty crops*[2] for information on safe use of pesticides, proper labelling, IPM standards, disposal that can be used in training for IP and USAID staff. Other sources of information include USAID GEMS sector guidelines on IPM[3] and Pesticides[4].

Conditions for USAID staff:

1 All relevant staff must receive an internal short-format training on the requirements established by this PERSUAP.

2 The USAID Mission must put in place effective internal procedures to review **pesticide procurement requests** submitted by IPs. The MEO must review and approve all procurement requests before the AOR/COR can clear.

7. Pesticide Discussion / Information

Pesticides are chemical substances intended to kill or repel pests. The pest in this case is *Tuta absoluta,* and there are a number of pesticides which can be used to control this insect. However, many chemical pesticides can also poison human beings and other life forms. When using pesticides, it is critical to be aware of the toxicological and environmental hazards associated with a particular material. Using the least toxic material makes sense in terms of human health and environmental protection. The attached Pesticide Data Sheets (PDS) contain key information on each of the pesticides approved by this PERSUAP for use in all USAID projects against *Tuta absoluta*, and should be consulted prior to use.

In addition, all pests, including *Tuta absoluta,* will develop resistance to a chemical pesticide that is used repeatedly. It is critical that pesticides be alternated to minimize the occurrence of pesticide resistance.

Other critical elements regarding the use of chemical pesticides include:

1) Training those who will handle and apply pesticides;
2) Use of Personal Protection Equipment (PPE);
3) Storage of pesticides;
4) Disposal of unused pesticide and empty pesticide containers;
5) Environmental precautions.

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[2] http://www.lsuagcenter.com/profiles/aiverson/articles/page1476113935263
[3] http://www.usaidgems.org/Sectors/ipm.htm
[4] http://www.usaidgems.org/Sectors/saferUse.htm

A wide variety of pesticides are available on the market in Nepal, some of which are highly toxic. Because these products are often inexpensive and easily available, farmers may be tempted to buy and utilize such products without being aware of the potential risks involved. The purpose of this PERSUAP is to provide essential information on the pesticides commonly available in the Nepal market which are effective against *Tuta absoluta,* and have the low health and environmental risk levels. The criteria for selection are summarized below and correspond to the attached Pesticide Data Sheets.

Reg 216 pesticide Factor	**Corresponding box on Pesticide Data Sheet (PDS)**	**Requirements**
US EPA registration status	Top box, 3rd line, left: *"USEPA registration status & date"*	Must be registered in the US
Basis for selection	Box 1: *"Basis for Selection"* Annex part 1: *"Selection"*	The selected pesticide must have been tested and demonstrated in the field that it works against the target pest (same or similar pest species), in this case *Tuta absoluta*. These data may come from other countries.
Extent to which IPM is used	Box 6: *"Role in IPM"* Annex part 6: *"IPM"*	The selected pesticide should be used in an IPM approach, so only when needed based on some level of understanding of economic thresholds, and combination with other control tactics should be promoted so as to lower the need for pesticides. In the case of Tuta, this would include mass trapping with pheromone traps, crop rotation and crop hygiene.
Application methods and safety equipment	Box 10: *"Application Methods"* Box 11" "Personal Protective Equipment" Annex parts 10 & 11: *"Application" & "PPE"*	Methods for application (e.g. backpack sprayer) and PPE should be available in the market place

Toxicology and mitigation measures	Box 7: *"Human Toxicological Hazards"* Box 8: *"Environmental Hazards"* Annex parts 7 & 8: *"Toxicology" & "Environmental Hazards"*	Very low and Low Toxicity categories (EPA) are preferred, especially for small-scale farmers; Moderately and High Toxicity only under strictly controlled conditions, by certified and trained staff, with all required PPE and other safety measures applied
Efficacy	Box 4: "Effectiveness" Annex part 4: "Effectiveness"	The pesticide must effectively control the pest for which it has been selected.
Target vs. non-target species	Box 8: *"Environmental Hazards"* Annex part 8: *"Environmental Hazards"*	Mortality of non-target species, especially beneficial insects such as parasitoids, predators and pollinators, should be minimized. Therefore, broad-spectrum pesticides are less preferred. Target-specific pesticides such as Bacillus thuringiensis are ideal.
Environmental conditions at the location of proposed use	Box 9: *"Location Environmental Conditions"* Annex part 9: *"Conditions"*	Where in the country and under which conditions will the pesticide be applied and will that influence its efficacy? For instance, high temperature and humidity may influence efficacy of a pesticide, e.g. in greenhouse conditions. Presence of wetlands or rivers nearby may limit the choice of certain pesticides that are highly toxic to aquatic organisms.

Availability of alternatives	Box 5: "Alternatives" Annex part 5: "Alternatives"	The use of less-toxic or non-toxic pesticide alternatives should be promoted wherever possible. In the case of Tuta, the use of mass trapping (of male adult moths) with pheromone traps will reduce overall population growth if used early on in the4 season. Other alternatives that must be promoted include bio pesticides and biological control with parasitoids and predators. In case of Tuta, only generalist parasitoids and predators are available with low levels of control, these are naturally occurring but some can be purchased from international biocontrol companies for use in greenhouses if host country regulations permit.
Country's ability to control and regulate pesticides	Top box, 3rd line, right: *"Location registration status & date"* Box 13: *"Location Regulatory Issues"* Annex part 13: *"Regulatory"*	The pesticide must be registered in the country it will be used (in this case Nepal). Where regulatory capacity is weak e.g. regarding enforcing safety standards and product quality, highly and moderately toxic products should be avoided
User training	Box 14: *"Training Program Elements"* Annex part 14: *"Training"*	Training must be provided, particularly for safer use but also for IPM. Where opportunity for safety training is lacking or inadequate, highly and moderately toxic products should be avoided
Monitoring provisions	Box 15: *"Monitoring Plan"* Annex part 15: *"Monitoring"*	Farmers should be able to identify the pest (in this case Tuta) and be able to monitor infestation levels in the field, either with pheromone traps or by inspecting plants.

The table below provides pesticides active ingredients registered for tomato in the US against similar pests and used in other countries against Tuta. The attached Pesticide Data Sheets (PSDs) are integral part of this PERSUAP.

Group/ Class	Sub group	Name of the pesticide active ingredient	Countries used	Most common trade names in NEPAL
Fungal		Beauveria bassiana *Metarhizium anisopliae*		Daman Pacer, Kalichakra, Emerald
Bacterial	Direct	*Bacillus thuringiensis*		Biolep, Lipel, Mahastra, Mahashakti
	Fermentation products	Abamectin Emamectin Spinosad	Brazil,Malta Spain Brazil, Malta, Spain	Abamec-36, Allmic, Bortin, Vapcomil, Vertimic-1.9, Kingstar , EMAR, EMAVAP, G-super Traser
Plant Based		Azadarachitin	Spain	Nimbecidine,Niconeem, Ozoneem, Trisul, Neembaan , Niconeem 1% Super Neem+, Margosom
Synthetic	Pyrethroids	Deltamethrin	Spain	AllDell, Decis, Decis 100, Rapier, Savier, Shastra, Dice, Dose, Ki-Six
	Nicotinoid/ Chloro-Nicotinyl	Imidacloprid	Malta, Spain	A-One, Acemeprid,Admire, Betimida, Betal, Flame, Yorker, Victor,
	Pyrroles	Chlorfenapyr	Brazil	Intrepid
	oxadiazines	Indoxacarb	Brazil, France, Malta, Spain	Avant
	Diamide	Chlorantraniliprole	Spain	Corazen, Alclora
	Insect Growth regulator	Novaluron	Nepal	Rimon, Pedestall, Rino-10

Pesticide active ingredients by Group and Sub-group allowed in the PERSUAP for use against *Tuta absoluta* with selected formulations available in Nepal.

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): ABAMECTIN		Pesticide Use Type: insecticide	
Formulation: Emulsifiable Concentrate	% AI: 2%	Location Common Names: Abamec-36, Allmic, Bortin, Vapcomil, Vertimic-1.9	
USEPA registration status, code, & date: Active, 100-898, 7/25/1989		Location registration status & date:add information for specific use location	
US Common Name: Agri-Mek		USEPA Tox Signal word: Warning	USEPA RUP flag: Restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 71751-41-2		USEPA PC Code: 122804	Location Registration Code: specific to location

1. Basis for Selection:

Abamectin is a natural fermentation product of a soil bacterium Streptomyces avermitilis. It is an Insecticide/ miticide/ acaricide with stomach and contact mode of action. It is used to control insect and mite pests of a range of agronomic, fruit, vegetable and ornamental crops.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

Possible teratogenic and reproductive effects

Acute:

LD 50: 11 mg/kg in rats, in mice 14->80mg/k
May cause eye and skin irritation. Pupil dilation, vomiting, convulsions, tremors, coma. Not readily absorbed through skin.

8. Environmental Hazards

General:

Toxic to fish and wildlife; do not apply directly to water; not toxic to birds

Non-Target Organisms:

Highly toxic to bees, aquatic organisms

Non-Target Ecosystems:

Aquatic areas, streams, potential run-off areas

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label for specific application method. Do not apply within 7 days of harvest. Do not apply before a rain event.

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): AZADIRACHTIN		Pesticide Use Type: insecticide	
Formulation: Emulsifiable Concentrate	% AI: 3%	Location Common Names: Nimbecidine,Niconeem, Ozoneem, Trisul, Neembaan , Niconeem	
USEPA registration status, code, & date: Active, 70051-27, 12/15/1994		Location registration status & date:add information for specific use location	
US Common Name: Azatin		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted / WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 0000992-20-1		USEPA PC Code: 121701	Location Registration Code: specific to location

1. Basis for Selection:

The key insecticidal ingredient found in the neem tree, Azadirachta indica, is azadirachtin, a naturally occurring substance that belongs to an organic molecule class called tetra or triterpenoids. It disrupts insect moulting. Azadirachtin may also serve as a feeding deterrent for some insects.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

It has no chronic toxicity and is not carcinogenic, mutagenic or teratogenic.

Acute:

Very safe to humans in its pure form and classified in the least toxic class IV by EPA .

8. Environmental Hazards

General:

This product may be hazardous to fish and aquatic invertebrates

Non-Target Organisms:

Low toxicity tobees

Non-Target Ecosystems:

Aquatic areas, streams, surface water

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label for specific application method. Do not apply before a rain event.

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): Bacillus thuringlensis (Bt)		Pesticide Use Type: insecticide		
Formulation: Wettable powder	% AI: 12.65%	Location Common Names: Mahastra		
USEPA registration status, code, & date: Active, 73049-427, 2/23/2006		Location registration status & date:add information for specific use location		
US Common Name: Dipel, Thuricide		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted	WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 0068038-71-1		USEPA PC Code: 006522	Location Registration Code: specific to location	

1. Basis for Selection:

Bacillus thuringiensis is a bacterium that acts as a biological fungicide. It is a naturally occurring soil bacterium effective against fungal infections and is accepted for use in organic farming. It is not expected to have any adverse effects on nontarget organisms. It is proposed as an environmentally preferred alternative to other more toxic pest management techniques.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

No known mammalian chronic health effects.

Acute:

May cause moderate eye irritation. Practically non-toxic to humans and animals by acute exposure.

8. Environmental Hazards

General:

Do not apply directly to water, or allow run-off to enter a waterway

Non-Target Organisms:

Threatened or endangered Lepidoptera

Non-Target Ecosystems:

Aquatic areas

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label for specific application method. Do not apply before a rain event.

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): BEAUVERIA BASSIANA		Pesticide Use Type: insecticide	
Formulation: Wettable powder	% AI: 22	Location Common Names: Daman	
USEPA registration status, code, & date: Active, 82074-1, 3/10/1997		Location registration status & date:add information for specific use location	
US Common Name: Mycotrol wpo		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted / WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 63428-82-0		USEPA PC Code: 128924	Location Registration Code: specific to location

1. Basis for Selection:

Beauveria bassiana is a naturally occurring fungal insecticide that is commonly found in soils worldwide and is used as a pesticide for controlling many kinds of insects.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

No expected long-term risks.

Acute:

Causes moderate eye irritation. Harmful if absorbed through the skin, inhaled or swallowed. May produce an allergic reaction.

8. Environmental Hazards

General:

May be toxic to bees, fish, aquatic organisms

Non-Target Organisms:

Potentially pathogenic to honey bees

Non-Target Ecosystems:

Aquatic areas, streams, run-off areas

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): Chlorfenapyr		Pesticide Use Type: Insecticide		
Formulation: Suspension Concentrate	% AI: 21.4%	Location Common Names: Intrepid SC		
USEPA registration status, code, & date: Active, 241-374, 1/19/2001		Location registration status & date:add information for specific use location		
US Common Name: Phantom, Pylon		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted	WHO Tox Class: III
Chemical Abstract Service (CAS) Registry Number: 0122453-73-0		USEPA PC Code: 129093	Location Registration Code: specific to location	

1. Basis for Selection:

Chlorfenapyr is an arylpyrrole insecticide which works on contact and by ingestion. It interferes with the cellular electron transport system (conversion of ADP to ATP), thereby causing cellular starvation. It is a pro-insecticide in which an organism's metabolism removes a molecular group of the original molecule to produce the active molecule.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

No mutagenic or carcinogenic effects

Acute:

Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:

Toxic to aquatic organisms, birds, and wildlife

Non-Target Organisms:

Bees on blooming crops or weeds

Non-Target Ecosystems:

Runoff hazardous to aquatic organisms including aquatic invertebrates and fish

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): CHRLORANTRANILIPROLE		Pesticide Use Type: Insecticide		
Formulation: Suspension Concentrate	% AI: 18.5%	Location Common Names: Alcora, Coragen		
USEPA registration status, code, & date: Active, 352-729, 5/1/2008		Location registration status & date:add information for specific use location		
US Common Name: Coragen		USEPA Tox Signal word: n/a	USEPA RUP flag: Not Restricted	WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 0500008-45-7		USEPA PC Code: 352-GA-002	Location Registration Code: specific to location	

1. Basis for Selection:

It acts primarily through ingestion and also through contact. Affected insects rapidly stop feeding, general lethargy, paralysis and ultimate death. Effective against chewing pests pests of cotton, vegetable and fruits.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:
No toxicologically significant effects were found.

Acute:
> 5,000 mg/kg
No toxicologically significant effects were found.

8. Environmental Hazards

General:
Drift and runoff may be hazardous to aquatic organisms

Non-Target Organisms:
Aquatic invertebrates, oysters, shrimp

Non-Target Ecosystems:
Aquatic areas, streams, rivers

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): DELTAMETHRIN		Pesticide Use Type: Insecticide		
Formulation: Emulsifiable Concentrate	% AI: 16.6%	Location Common Names: All Deli, Decis, Decis 100		
USEPA registration status, code, & date: Active, 264-1011, 3/7/1996		Location registration status & date:add information for specific use location		
US Common Name: Decis		USEPA Tox Signal word: Danger	USEPA RUP flag: Restricted	WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 0052918-63-5		USEPA PC Code: 097805	Location Registration Code: specific to location	

1. Basis for Selection:

It is a synthetic, non-systemic with contact and stomach action. It prevents the sodium channels from functioning and no transmission of nerve impulse takes place. Deltamethrin is effective against aphids, mealy bugs, scale insects, and whitefly on glasshouse cucumbers, tomatoes, peppers, potted plants, and ornamentals.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

May cause neurobehavioral effects, but not carcinogenic

Acute:

Fatal if swallowed. Causes irreversible eye damage and skin burns. Harmful if inhaled.

8. Environmental Hazards

General:

Extremely toxic to fish and aquatic invertebrates

Non-Target Organisms:

Highly toxic to bees, direct exposure

Non-Target Ecosystems:

Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): EMAMECTIN BENZOATE		Pesticide Use Type: Insecticide	
Formulation: Emulsifiable concentrate	% AI: 2.15	Location Common Names: EMAR, EMAVAP, G-super	
USEPA registration status, code, & date: Active, Reg no: 100-903		Location registration status & date:add information for specific use location	
US Common Name: Denim		USEPA Tox Signal word: Danger	USEPA RUP flag: Restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 119791-41-2		USEPA PC Code: 122806	Location Registration Code: specific to location

1. Basis for Selection:

Emamectin is a natural fermentation product of a soil bacterium Streptomyces avermitilis. It is non systemic insecticides with translaminar movement.

2. Crop / Target:

Tomato.
Also registered for use on other leaf and stem vegetables.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

May cause tremors but not likely a carcinogen

Acute:

Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:

Extremely toxic to fish, birds, mammals and aquatic invertebrates

Non-Target Organisms:

Highly toxic to bees, direct exposure

Non-Target Ecosystems:

Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): INDOXACARB		Pesticide Use Type: insecticide	
Formulation: Emulsifiable concentrate	% AI: 15.84%	Location Common Names: Avant	
USEPA registration status, code, & date: Active, 352-638		Location registration status & date: add information for specific use location	
US Common Name: Steward		USEPA Tox Signal word: Caution	USEPA RUP flag: restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 173584-44-6		USEPA PC Code: 066710	Location Registration Code: specific to location

1. Basis for Selection:

It is a contact poison. Affected insects stop feeding with poor coordination and paralysis and ultimate death. Effective against lepidopteran pests of cotton, vegetable and fruits.

2. Crop / Target:

Tomato.
Also registered for use on other leaf and stem vegetables.

3. Pest / Disease:

Tuta absoluta.
South American Tomato leaf miner.

4. Effectiveness:

Registered for use on tomatoes in US for other pests.
Has been used against Tuta absoluta in other countries.

5. Alternatives:

Selected biopesticides.

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:
Slightly toxic. Not likely a carcinogen.

Acute:
Harmful if swallowed or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:
Highly toxic to fish, bees, aquatic invertebrates, mammals

Non-Target Organisms:
Toxic to bees

Non-Target Ecosystems:
Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label for specific application method. Do not apply within 7 days of harvest. Do not apply before a rain event.

11. Personal Protective Equipment:

Follow label per formulation.
Long-sleeved shirts and pants, gloves, protective eye wear, shoes, & socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): NOVALURON		Pesticide Use Type: insecticide	
Formulation: Emulsifiable concentrate	% AI: 9.3%	Location Common Names: Rimon, Pedestall, Rimo-10	
USEPA registration status, code, & date: Active, 66222-35		Location registration status & date:add information for specific use location	
US Common Name: Rimon		USEPA Tox Signal word: Warning	USEPA RUP flag: WHO Tox Class: III
Chemical Abstract Service (CAS) Registry Number: 6116714-46-6		USEPA PC Code: 124002	Location Registration Code: specific to location

1. Basis for Selection:

It belongs to the class of insecticides called insect growth regulators (IGR). IGRs slowly kill the insects over a period of few days by disrupting the normal growth and development of immature insects. Novaluron acts as an insecticide mainly by ingestion, but has some contact activity.

2. Crop / Target:

Tomato.
Also registered for use on other leaf and stem vegetables.

3. Pest / Disease:

Tuta absoluta.
South American Tomato leaf miner.

4. Effectiveness:

Registered for use on tomatoes in US for other pests.
Has been used against Tuta absoluta in other countries.

5. Alternatives:

Selected biopesticides.

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:
No known effects

Acute:
Harmful if absorbed through skin.
Causes substantial but temporary eye injury.

8. Environmental Hazards

General:
Low mammalian oxicity and has low risk to environment and nontarget organisms

Non-Target Organisms:

Non-Target Ecosystems:
Toxic to fresh water and aquatic invertebrates

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label for specific application method. Do not apply within 7 days of harvest. Do not apply before a rain event.

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): Metarhizium anisopliae strain F52		Pesticide Use Type: Insecticide		
Formulation: Wettable Powder	% AI: 97.6	Location Common Names: Pacer, Kalichakra, Emerald		
USEPA registration status, code, & date: Active, 70127-7		Location registration status & date:add information for specific use location		
US Common Name: TAE-001 technical Bioinsecticide		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted	WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 67892-13-1		USEPA PC Code: 029056	Location Registration Code: specific to location	

1. Basis for Selection:

Metarrhizium anisopliae is a natural biopesticide based on the naturally occurring fungus. It is effective against a variety of pests.Metarhizium anisopliae should be applied when the temperature is between 18-28°C/65-82°F and the relative humidity is approximately 80% for several days after application.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

No expected long-term risks.

Acute:

Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:

No major threats to non-target ecosystems

Non-Target Organisms:

Non-Target Ecosystems:

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): DELTAMETHRIN		Pesticide Use Type: Insecticide	
Formulation: Emulsifiable Concentrate	% AI: 4.75%	Location Common Names: Rapier	
USEPA registration status, code, & date: Active, 432-763, 3/7/1996		Location registration status & date:add information for specific use location	
US Common Name: Suspend SC		USEPA Tox Signal word: Caution	USEPA RUP flag: Restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 0052918-63-5		USEPA PC Code: 097805	Location Registration Code: specific to location

1. Basis for Selection:

It is a synthetic, non-systemic with contact and stomach action. It prevents the sodium channels from functioning and no transmission of nerve impulse takes place. Deltamethrin is effective against aphids, mealy bugs, scale insects, and whitefly on glasshouse cucumbers, tomatoes, peppers, potted plants, and ornamentals.

2. Crop / Target:

Tomato.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

May cause neurobehavioral effects, but not carcinogenic

Acute:

Harmful if inhaled. Mild skin reaction may occur.

8. Environmental Hazards

General:

Extremely toxic to fish and aquatic invertebrates

Non-Target Organisms:

Highly toxic to bees, direct exposure

Non-Target Ecosystems:

Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): EMAMECTIN BENZOATE		Pesticide Use Type: Insecticide	
Formulation: Soluble Granule	% AI: 5	Location Common Names: Kingstar	
USEPA registration status, code, & date: Active, Reg no: 100-904		Location registration status & date:add information for specific use location	
US Common Name: Proclaim		USEPA Tox Signal word: Caution	USEPA RUP flag: Restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 119791-41-2		USEPA PC Code: 122806	Location Registration Code: specific to location

1. Basis for Selection:

Emamectin is a natural fermentation product of a soil bacterium Streptomyces avermitilis. It is non systemic insecticides with translaminar movement.

2. Crop / Target:

Tomato.
Also registered for use on other leaf and stem vegetables.

3. Pest / Disease:

Tuta absoluta.
South American Tomato Leaf Miner

4. Effectiveness:

Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

May cause tremors but not likely a carcinogen

Acute:

Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:

Extremely toxic to fish, birds, mammals and aquatic invertebrates

Non-Target Organisms:

Highly toxic to bees, direct exposure

Non-Target Ecosystems:

Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): IMIDACLOPRID		Pesticide Use Type: insecticide	
Formulation: Soluble liquid	% AI: 17.1%	Location Common Names: A-One, Betimida, Yorker, Imidore	
USEPA registration status, code, & date: Active, 264-823		Location registration status & date:add information for specific use location	
US Common Name: Confidor		USEPA Tox Signal word: None	USEPA RUP flag: restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 105827-78-9		USEPA PC Code: 097805	Location Registration Code: specific to location

1. Basis for Selection:

It is a systemic insecticide with translaminar activity and with stomach and contact action. It can be applied as soil, seed and foliar treatment for the control of sucking insects as well as soil insects.

2. Crop / Target:

Tomato.

3. Pest / Disease:

Tuta absoluta.
South American Tomato leaf miner.

4. Effectiveness:

Registered for use on tomatoes in US for other pests.
Has been used against Tuta absoluta in other countries.

5. Alternatives:

Selected biopesticides.

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

May be weakly mutagenic.

Acute:

Harmful if swallowed or absorbed through skin.

8. Environmental Hazards

General:

Highly toxic to birds and aquatic inverte
Potential groundwater contaminant.

Non-Target Organisms:

Toxic to bees during 3 hours of treatmen

Non-Target Ecosystems:

Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label for specific application method. Do not apply within 7 days of harvest. Do not apply before a rain event.

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): SPINOSAD		Pesticide Use Type: insecticide	
Formulation: Suspension concentrate	% AI: 22.8%	Location Common Names: Tracer	
USEPA registration status, code, & date: Active, 62719-523		Location registration status & date:add information for specific use location	
US Common Name: Success		USEPA Tox Signal word: NONE	USEPA RUP flag: / WHO Tox Class: III
Chemical Abstract Service (CAS) Registry Number: 131929-60-7		USEPA PC Code: 110003	Location Registration Code: specific to location

1. Basis for Selection: Spinosad is a natural product derived from the bacterium Saccharopolyspora spinose. It uniquely combines the efficacy of synthetic products with the benefits of biological insect pest control products. Spinosad works by contact and by ingestion. While control via contact is highly effective, control via ingestion is 5 - 10 times more effective.	2. Crop / Target: Tomato. Also registered for use on potatoes, peppers, and eggplants.	3. Pest / Disease: Tuta absoluta. South American Tomato Leaf Miner	4. Effectiveness: Has been used against Tuta absoluta with success in a number of countries. Registered for use in US for similar pests.
5. Alternatives: Selected biopesticides.	6. Role in IPM: Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It does not have a significant impact on certain parasitic insects and natural predators and reduces the likelihood of secondary pest outbreaks.	7. Human Toxicological Hazards Long-Term: Not a possible carcinogen. Acute: Causes moderate eye irritation.	8. Environmental Hazards General: Slightly to moderately toxic to aquatic invertebrates Non-Target Organisms: Toxic to bees during 3 hours of treatmen Non-Target Ecosystems: Aquatic areas, streams, ponds,
9. Location Environmental Conditions: Add information for specific use location	10. Application Methods: Follow label for specific application method. Do not apply within 7 days of harvest. Do not apply before a rain event. 11. Personal Protective Equipment: Follow label per formulation long-sleeved shirts and pants, gloves, shoes and socks	12. Storage Provisions and Disposal Issues: Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container. 13. Location Regulatory Issues Add information for specific use location	14. Training Program Elements: - follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
15. Monitoring Plan: use, storage, transport, dispersal, disposal			

USAID Pesticide Data Sheet 2017

Date: 2/21/2017 Project: Tuta absoluta Location: Nepal USAID Tracking Code: n/a

Active Ingredient (AI): IMIDACLOPRID		Pesticide Use Type: Insecticide	
Formulation: Wettable Dispersible Granule	% AI: 70%	Location Common Names: Admire, Betal, Flame, Looper	
USEPA registration status, code, & date: Active, 264-823		Location registration status & date:add information for specific use location	
US Common Name: Provado, Premise, Premier,		USEPA Tox Signal word: Caution	USEPA RUP flag: / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 105827-78-9		USEPA PC Code: 097805	Location Registration Code: specific to location

1. Basis for Selection:

It is a systemic insecticide with translaminar activity and with stomach and contact action. It can be applied as soil, seed and foliar treatment for the control of sucking insects as well as soil insects.

2. Crop / Target:

Tomato.

3. Pest / Disease:

Tuta absoluta.
South American Tomato leaf miner.

4. Effectiveness:

Registered for use on tomatoes in US for other pests.
Has been used against Tuta absoluta in other countries.

5. Alternatives:

Selected biopesticides.

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

May be weakly mutagenic.

Acute:

Harmful if swallowed or absorbed through skin.

8. Environmental Hazards

General:

Highly toxic to birds and aquatic inverteb
Potential groundwater contaminant.

Non-Target Organisms:

Toxic to bees during 3 hours of treatmen

Non-Target Ecosystems:

Aquatic areas, streams, ponds,

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal