HortiMAP
Horticulture Market Acceleration Program

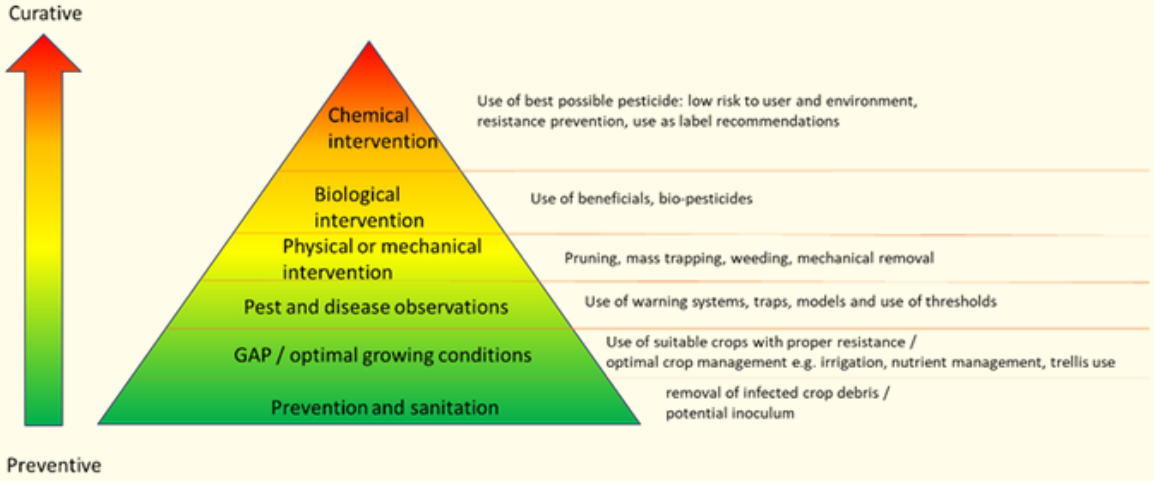
PESTICIDE SELECTION TOOL

user manual

WAGENINGEN
UNIVERSITY & RESEARCH

INTRODUCTION

In vegetable production, pests and diseases can lead to significant yield and income losses. To mitigate these losses Integrated Pest Management (IPM) strategies should be applied, focusing first and foremost on prevention and monitoring.



Farmers can reduce the risk of pests and disease infestations by selecting pathogen-free fields, choosing crops that are less susceptible to prevalent pests and diseases, and opting for crop varieties with resistance or tolerance to pests and diseases. In addition to these preventive measures, proper sanitation practices are crucial. This includes removing infested crop debris, timely removing harvested crops that could infest subsequent crops, and practicing sound crop management. Continuous crop monitoring is also essential for early detection of the presence of pests and diseases. When action is required (when a threshold level is reached), non-chemical methods should be prioritized. Chemical pesticides should only be considered as a last resort.

IPM allows for the use of chemical pesticides, however this should be managed judiciously and responsibly. Preferably low risk products should be considered. Besides, it is important to apply the correct pesticide for a specific pest or disease identified, handle pesticides with care for health and environment, and manage pesticide resistance by rotating pesticides and applying the prescribed doses following the product label specifications.

PESTICIDE SELECTION TOOL

The Pesticide Selection Tool (PST) is an application designed to support users in identifying and selecting appropriate products as a last resort for pest and disease control, following Integrated Pest Management (IPM) principles.

The Open as App platform (free and open access) was chosen as the application to run the PST. This platform is easy to use and maintain by the owner, as the programming and design of the application with Open as App is Microsoft® Excel®-based and can be kept in-house, without the involvement of an application developer. The tool is available in both smartphone and web-based versions.

The Open as App application can be downloaded on the Google Play store or Apple App store, however the PST can only be installed using the QR code or the link below:

https://oaa.app.link/launch-app-be1b2296-c9c7-4625-a918-c91c9dce5ea5

After accessing the link, the tool will automatically download and install on your device.

Once installed, the smartphone application can be used offline, while the web version requires internet connectivity.

INTENDED USE & USERS

The Pesticide Selection Tool has been developed to assist users to select appropriate pesticides from all registered and authorized pesticides in Uganda, to control a specific pest or disease, while providing additional information and selection options on product name, mode of action, toxicity and harmful side effects. The PST aims to support more informed decision-making on pest and disease control.

The tool is not developed as an identification tool and therefore the tool can only be used once the pest or disease has been properly identified.

The tool is primarily developed for use by public and private extension service providers. Additionally, farmers with sufficient agronomic knowledge and literacy may also benefit from using it. To effectively use the tool, users should have knowledge, expertise and understanding in the following areas:

- **Integrated Pest Management (IPM), to assess whether pesticide application is truly necessary for controlling pests and diseases;**
- **Accurate identification of pest and disease symptoms, to input the search criteria for pesticide selection;**
- **Pesticide toxicity and its classification according WHO standards, to understand the related health risks of pesticide use, and how to protect oneself (with PPEs) against these risks;**
- **Environmental risks of using pesticides, to understand the related environmental risks and impact of pesticide use and disposal, and how to handle pesticides judiciously;**
- **Pesticide resistance, to be aware of the resistance effect of overuse and repeated applications of the same pesticide, and how applying different Mode of Action groups of a pesticide can help prevent resistance;**
- **Interpretation of information and symbols on the label of the pesticide product, to be able to review and verify the generated advice against the actual label instructions;**
- **Digital tools, to be able to use and operate the PST on a smartphone, tablet or desk/laptop computer.**

DATABASE OF THE TOOL

The supporting database of the tool (in excel format) contains information of all insecticides and fungicides registered for agricultural purposes in Uganda, and is based on the official publication from MAAIF (Register of agricultural chemicals registered under section 4 of the agricultural chemicals (control) act, 2006 as of 16 December 2022) (ref 1). The following information is included:

- **Registration date**
- **Date of expiry**
- **Registration number**
- **Active ingredient**
- **Formulation**
- **Concentration**
- **Trade/commercial name**
- **Name of registrant**
- **Local agent / distributor**

In addition, the following information has been added to the database and tool (external sources):

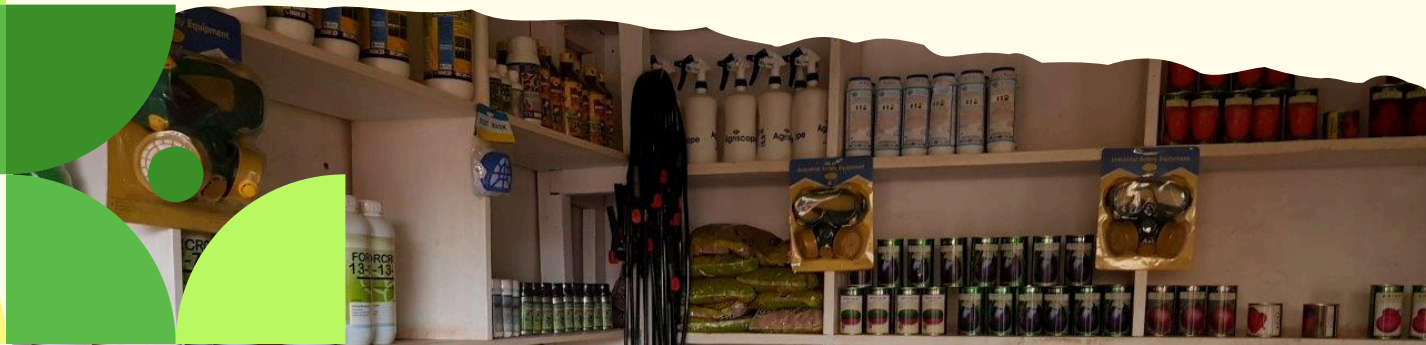
- **Mode of action (ref 2,3)**
- **WHO hazard class (Ib, II, III, U), calculated based on active ingredient and concentration of active ingredient in the formulated product (ref 4)**
- **Pollinator toxicity (high, medium, low, none) (ref 5)**
- **Highly Hazardous Pesticide rating, based on PAN ratings for class 1, 2 and 4, excluding class 3 (environmental risks) (ref 6)**
- **Pesticide efficacy for control of pest and disease groups (ref 7,8)**

References:

1) https://www.agriculture.go.ug/wp-content/uploads/2023/01/Chemical-Register-Dec-2022.pdf
2) https://www.frac.info
3) https://irac-online.org
4) https://www.who.int/publications/i/item/9789240005662
5) https://www.ncagr.gov (traffic light pesticide toxicity to bees)
6) https://www.pan-uk.org/site/wp-content/uploads/PAN-HHP-List-2021.pdf
7) https://sitem.herts.ac.uk/aeru/ppdb/en
8) https://www.bcpc.org

HOW TO OPERATE THE PST

1. Select whether to control a pest or disease
2. Select the specific pest or disease concerned
3. Filter on mode of action previous product
4. Filter on minimal WHO toxicity
5. Filter on Highly Hazardous pesticides
6. Filter on pollinator toxicity
7. Review selected products and product details
8. Select product and consult product label



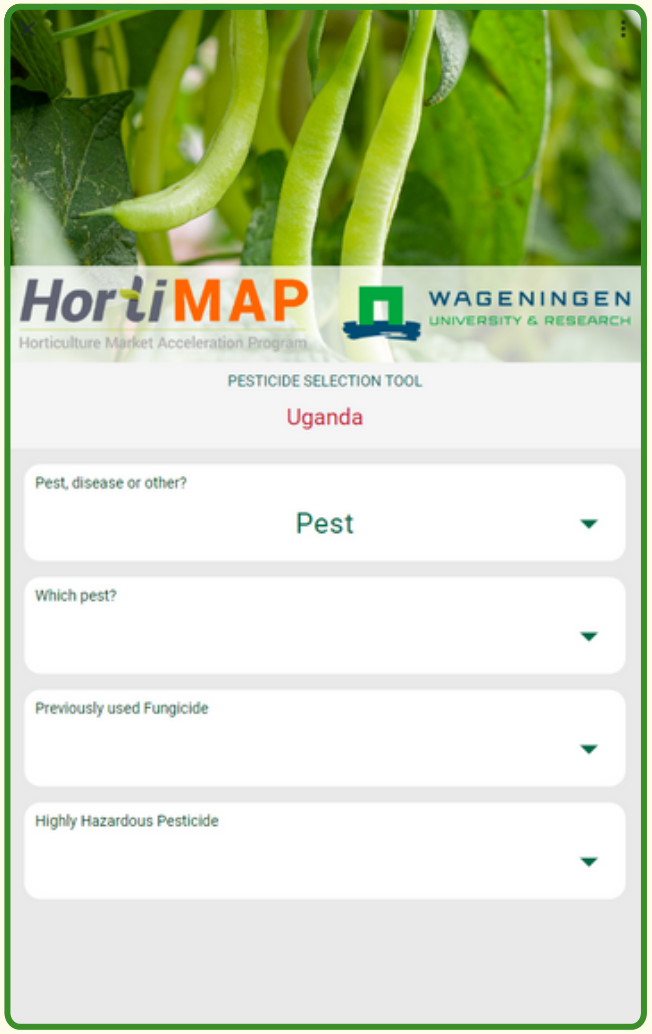
1

SELECT WHETHER TO CONTROL A PEST OR DISEASE

When the PST is launched, an input screen will appear, allowing the user to select the pest or disease they wish to generate a selection of suitable pesticides for.

Accurate identification of the pest or disease in the field is essential before using the tool to generate appropriate pesticide options.

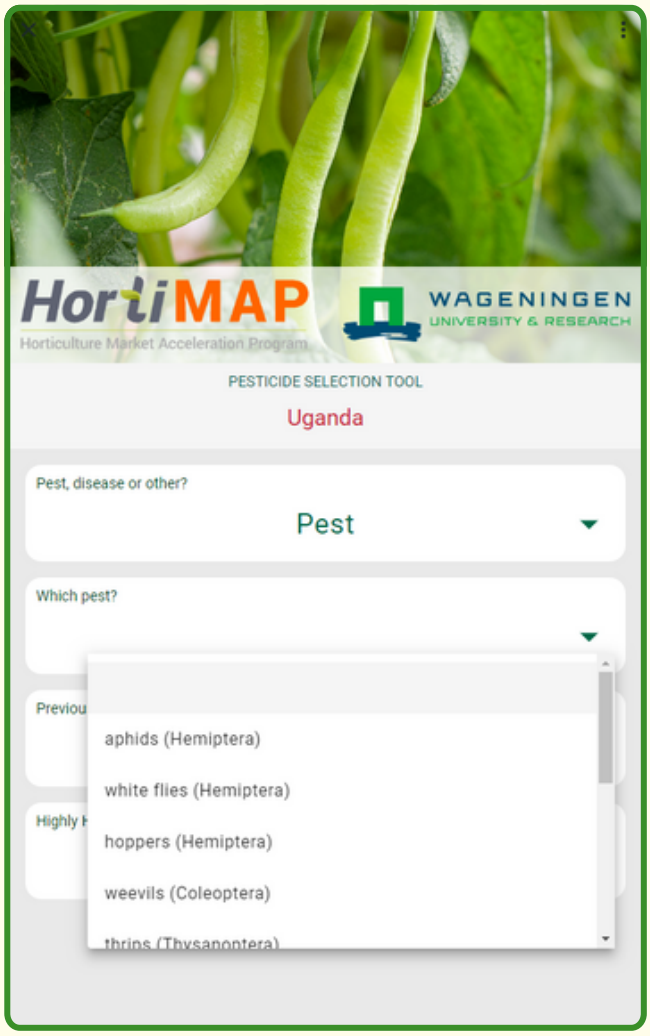
First the selection needs to be made whether a pest or disease is concerned.

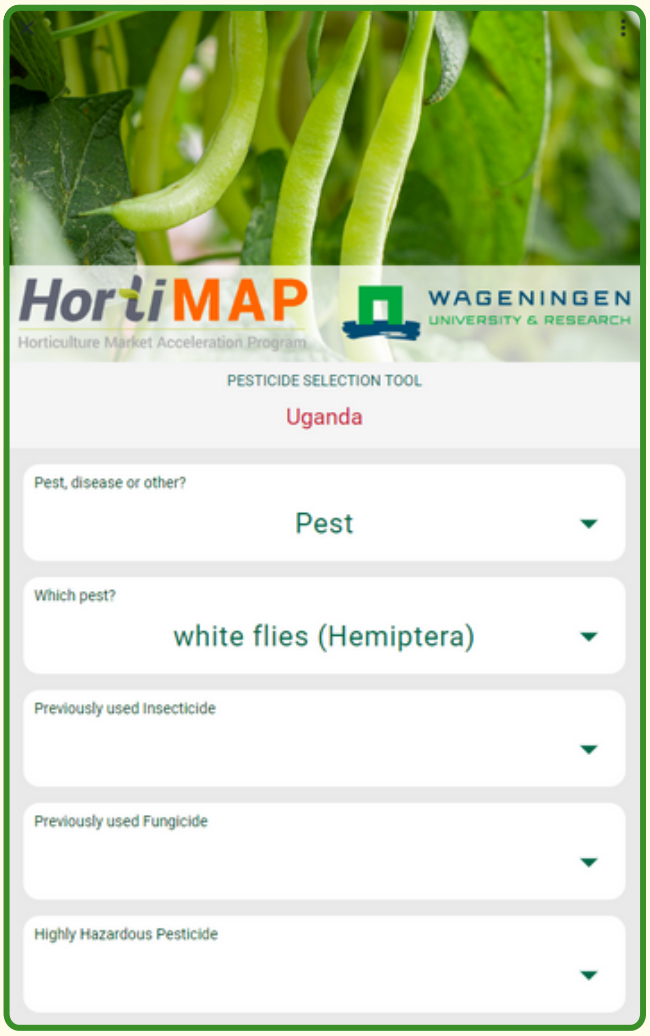


2

SELECT THE SPECIFIC PEST OR DISEASE CONCERNED

Next, choose the specific pest or disease wished to control from the drop-down menu.





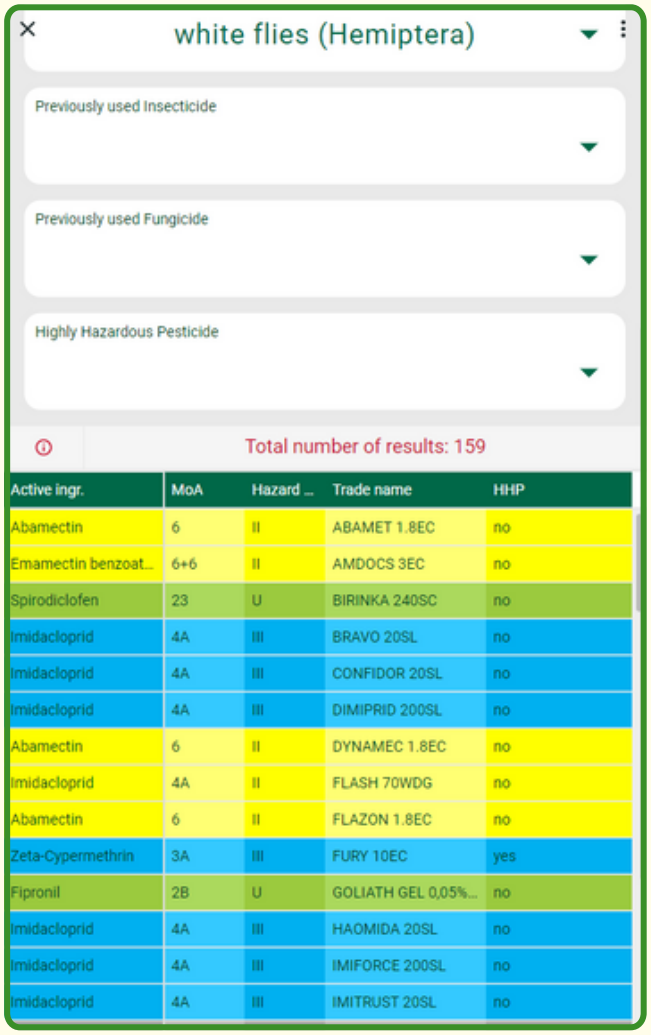
2

SELECT THE SPECIFIC PEST OR DISEASE CONCERNED

After entering the initial selection criteria, by scrolling down, the user can already view the selection of pesticides able to control the pest or disease selected.

Additionally, the number of filtered products will be displayed.

In our example, selecting white flies as the pest to be controlled, results in a selection of 159 available products with an active ingredient that can control whitefly.



Active ingr.	MoA	Hazard ...	Trade name	HHP
Abamectin	6	II	ABAMET 1.8EC	no
Emamectin benzoat...	6+6	II	AMDOCS 3EC	no
Spirodiclofen	23	U	BIRINKA 240SC	no
Imidacloprid	4A	III	BRAVO 20SL	no
Imidacloprid	4A	III	CONFIDOR 20SL	no
Imidacloprid	4A	III	DIMIPRID 200SL	no
Abamectin	6	II	DYNAMEC 1.8EC	no
Imidacloprid	4A	II	FLASH 70WDG	no
Abamectin	6	II	FLAZON 1.8EC	no
Zeta-Cypermethrin	3A	III	FURY 10EC	yes
Fipronil	2B	U	GOLIATH GEL 0,05%...	no
Imidacloprid	4A	III	HAOMIDA 20SL	no
Imidacloprid	4A	III	IMIFORCE 200SL	no
Imidacloprid	4A	III	IMITRUST 20SL	no

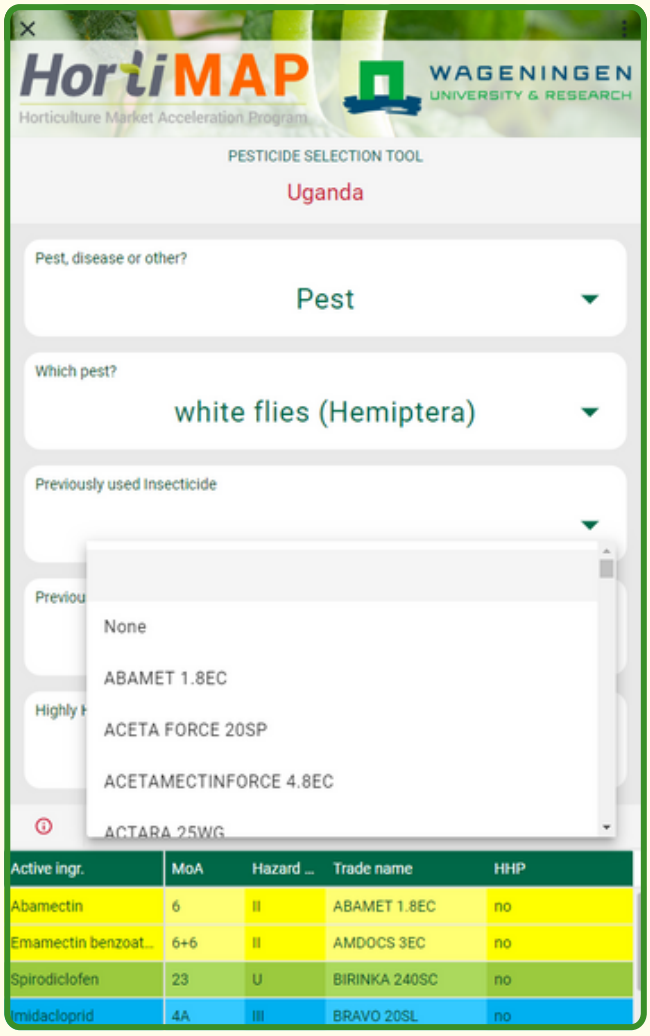
3

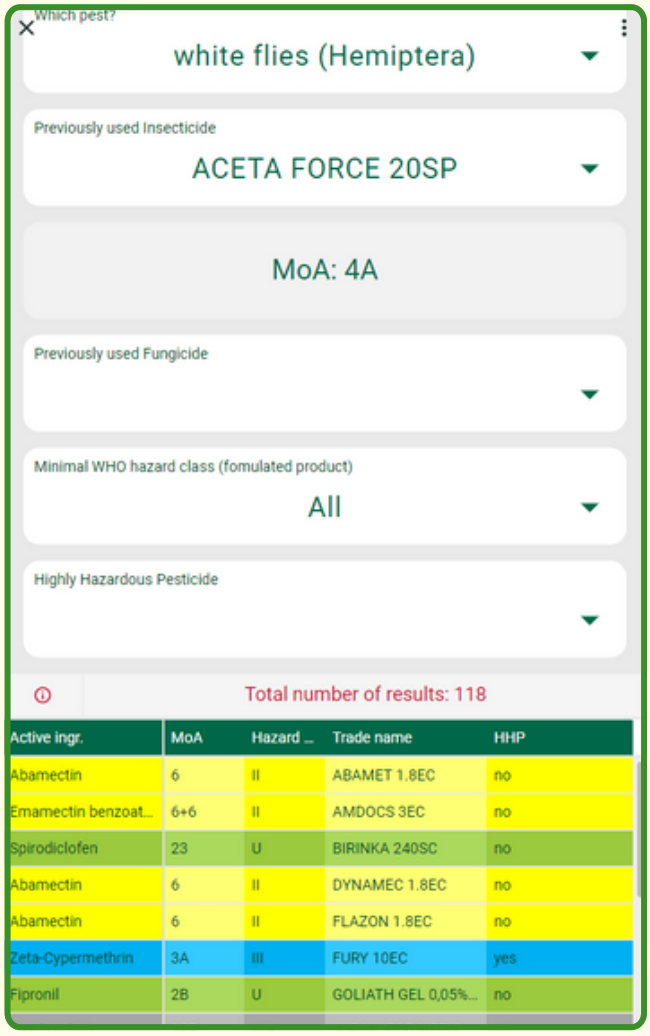
FILTER ON MODE OF ACTION PREVIOUS PRODUCT

For effective resistance management it is recommended to alternate between different mode of action groups.

Therefore, the user can optionally enter the previously used product, which will automatically filter out all products with the same mode of action.

In our example, if Aceta Force 20 SP is selected as a previously used product, all products with an active ingredient from group 4A are filtered out, resulting in a selection of 118 available products.





4

FILTER ON MINIMAL WHO TOXICITY

If the user wishes to make a selection based on toxicity, the minimal WHO hazard class can be selected.

In our example, filtering on WHO class III, results in a selection of 43 available products with toxicity class III or lower.

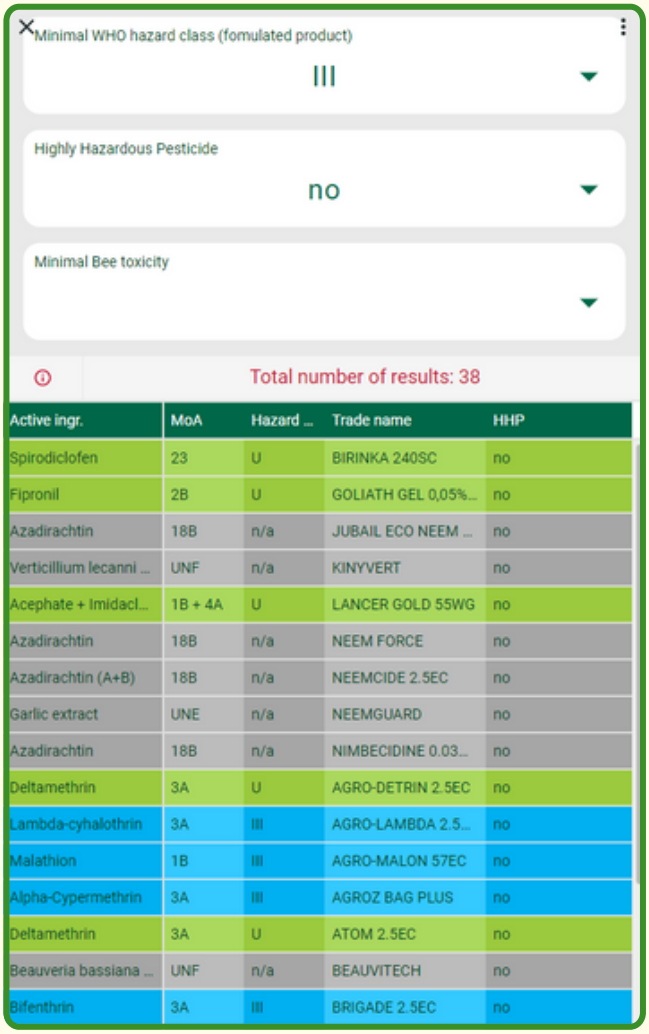
Active ingr.	MoA	Hazard ...	Trade name	HHP
Spirodiclofen	23	U	BIRINKA 240SC	no
Zeta-Cypermethrin	3A	III	FURY 10EC	yes
Fipronil	2B	U	GOLIATH GEL 0,05%...	no
Azadirachtin	18B	n/a	JUBAIL ECO NEEM ...	no
Verticillium lecanni ...	UNF	n/a	KINYVERT	no
Acephate + Imidacl...	1B + 4A	U	LANCER GOLD 55WG	no
Azadirachtin	18B	n/a	NEEM FORCE	no
Azadirachtin (A+B)	18B	n/a	NEEMCIDE 2.5EC	no
Garlic extract	UNE	n/a	NEEMGUARD	no
Azadirachtin	18B	n/a	NIMBECIDINE 0.03...	no
Thyme oil		n/a	NOPATH 32EW	
Deltamethrin	3A	U	AGRO-DETRIN 2.5EC	no
Lambda-cyhalothrin	3A	III	AGRO-LAMBDA 2.5...	no
Malathion	1B	III	AGRO-MALON 57EC	no
Alpha-Cypermethrin	3A	III	AGROZ BAG PLUS	no
Deltamethrin	3A	U	ATOM 2.5EC	no
Beauveria bassiana ...	UNF	n/a	BEAUVITECH	no
Bifenthrin	3A	III	BRIGADE 2.5EC	no
Deltamethrin	3A	U	DECIS 2.5EC	no

5

FILTER ON HIGHLY HAZARDOUS PESTICIDES

Highly Hazardous Pesticides (HHPs) are evaluated not only on acute toxicity, the WHO hazard class, but also on long term effects such as carcinogenic effects. If the user wishes to filter out HHPs, the option "NO" can be selected.

In our example, filtering out HHPs, results in in a selection of 38 available products.



Active ingr.	MoA	Hazard ...	Trade name	HHP
Spirodiclofen	23	U	BIRINKA 240SC	no
Fipronil	2B	U	GOLIATH GEL 0,05%...	no
Azadirachtin	18B	n/a	JUBAIL ECO NEEM ...	no
Verticillium lecanni ...	UNF	n/a	KINYVERT	no
Acephate + Imidacl...	1B + 4A	U	LANCER GOLD 55WG	no
Azadirachtin	18B	n/a	NEEM FORCE	no
Azadirachtin (A+B)	18B	n/a	NEEMCIDE 2.5EC	no
Garlic extract	UNE	n/a	NEEMGUARD	no
Azadirachtin	18B	n/a	NIMBECIDINE 0.03...	no
Deltamethrin	3A	U	AGRO-DETRIN 2.5EC	no
Lambda-cyhalothrin	3A	III	AGRO-LAMBDA 2.5...	no
Malathion	1B	III	AGRO-MALON 57EC	no
Alpha-Cypermethrin	3A	III	AGROZ BAG PLUS	no
Deltamethrin	3A	U	ATOM 2.5EC	no
Beauveria bassiana ...	UNF	n/a	BEAUVITECH	no
Bifenthrin	3A	III	BRIGADE 2.5EC	no

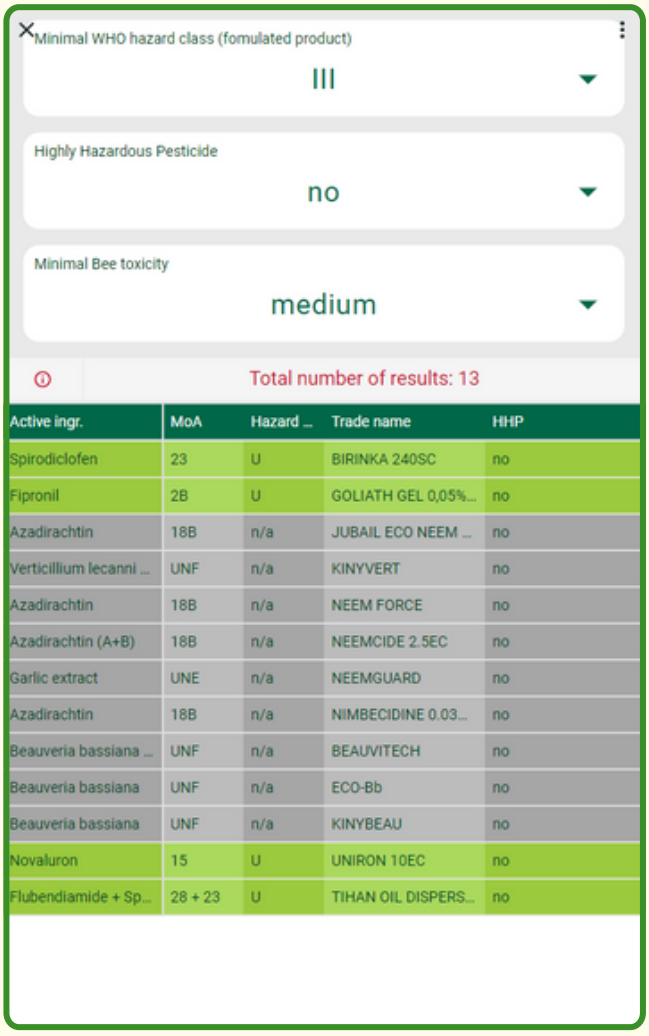
6

FILTER ON POLINATOR TOXICITY

To protect pollinators essential for fruit set and to safeguard biodiversity, users can filter on bee toxicity.

When selecting a filter for medium toxicity, only products with medium and low impact on bee toxicity will be displayed.

In our example, selecting medium bee toxicity, results in a final selection of 13 available products, based on all previously entered selection criteria.

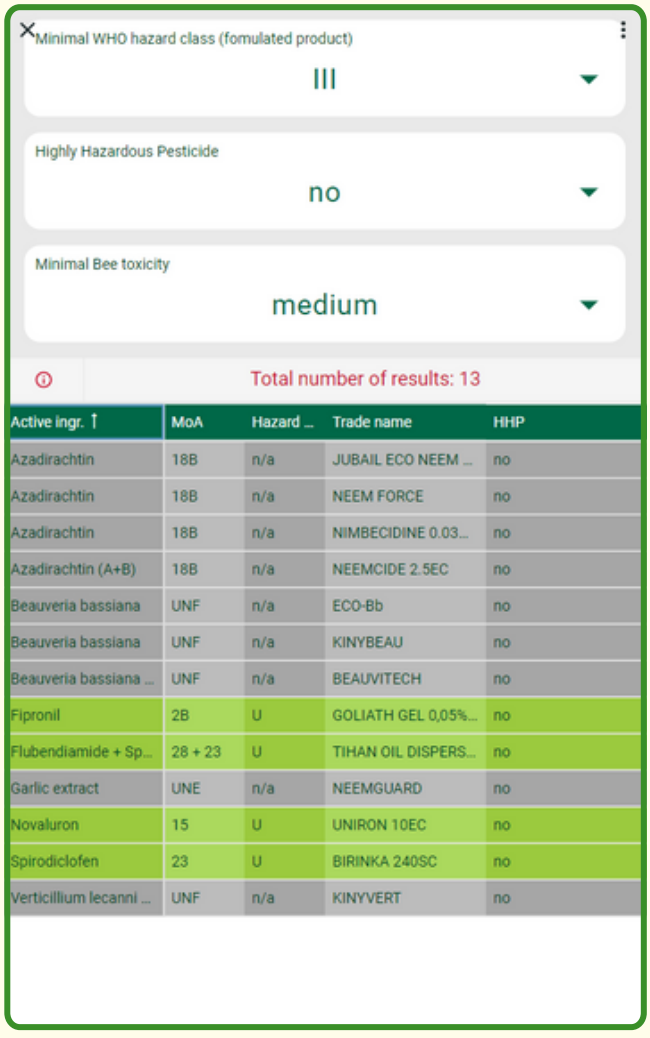


Active ingr.	MoA	Hazard ...	Trade name	HHP
Spirodiclofen	23	U	BIRINKA 240SC	no
Fipronil	2B	U	GOLIATH GEL 0,05%...	no
Azadirachtin	18B	n/a	JUBAIL ECO NEEM ...	no
Verticillium lecanni ...	UNF	n/a	KINYVERT	no
Azadirachtin	18B	n/a	NEEM FORCE	no
Azadirachtin (A+B)	18B	n/a	NEEMCIDE 2.5EC	no
Garlic extract	UNE	n/a	NEEMGUARD	no
Azadirachtin	18B	n/a	NIMBECIDINE 0.03...	no
Beauveria bassiana ...	UNF	n/a	BEAUVITECH	no
Beauveria bassiana	UNF	n/a	ECO-Bb	no
Beauveria bassiana	UNF	n/a	KINYBEAU	no
Novaluron	15	U	UNIRON 10EC	no
Flubendiamide + Sp...	28 + 23	U	TIHAN OIL DISPERS...	no

7

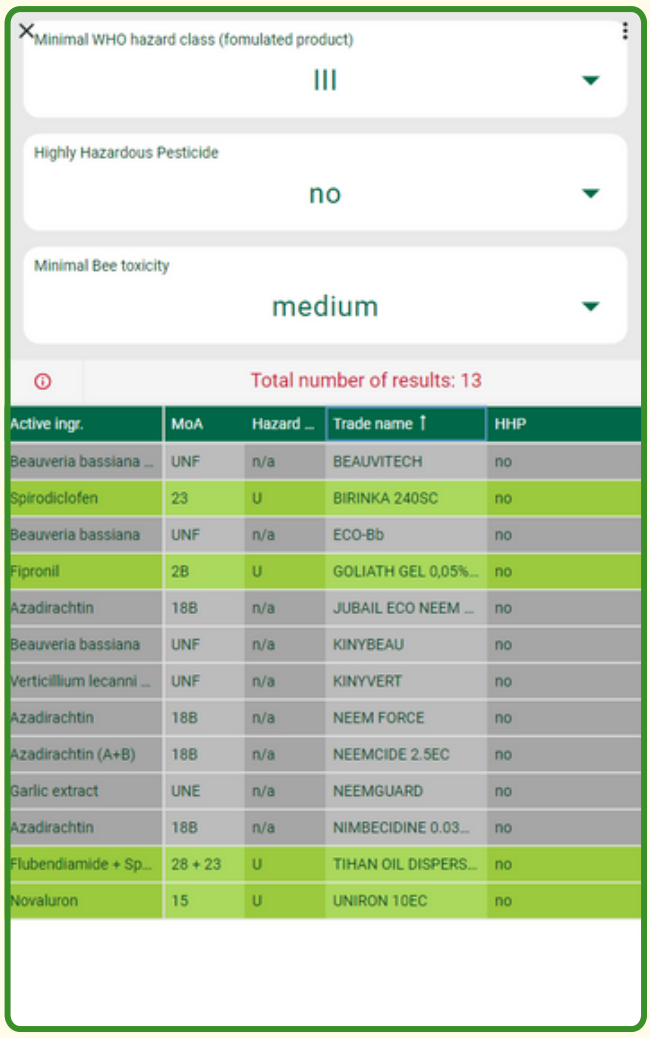
REVIEW SELECTED PRODUCTS AND PRODUCT DETAILS

To further review the final selection, the user can sort on Active Ingredient (A-Z and Z-A), Mode of Action (MoA) group, Hazard Class, Trade Name and Highly Hazardous Pesticide (HHP) by clicking on the respective column headers.



Active ingr. ↑	MoA	Hazard ...	Trade name	HHP
Azadirachtin	18B	n/a	JUBAIL ECO NEEM ...	no
Azadirachtin	18B	n/a	NEEM FORCE	no
Azadirachtin	18B	n/a	NIMBECIDINE 0.03...	no
Azadirachtin (A+B)	18B	n/a	NEEMCIDE 2.5EC	no
Beauveria bassiana	UNF	n/a	ECO-Bb	no
Beauveria bassiana	UNF	n/a	KINYBEAU	no
Beauveria bassiana ...	UNF	n/a	BEAUVITECH	no
Fipronil	2B	U	GOLIATH GEL 0,05%...	no
Flubendiamide + Sp...	28 + 23	U	TIHAN OIL DISPERS...	no
Garlic extract	UNE	n/a	NEEMGUARD	no
Novaluron	15	U	UNIRON 10EC	no
Spirodiclofen	23	U	BIRINKA 240SC	no
Verticillium lecanni ...	UNF	n/a	KINYVERT	no

Sorted on active ingredient



Active ingr.	MoA	Hazard ...	Trade name ↑	HHP
Beauveria bassiana ...	UNF	n/a	BEAUVITECH	no
Spirodiclofen	23	U	BIRINKA 240SC	no
Beauveria bassiana	UNF	n/a	ECO-Bb	no
Fipronil	2B	U	GOLIATH GEL 0,05%...	no
Azadirachtin	18B	n/a	JUBAIL ECO NEEM ...	no
Beauveria bassiana	UNF	n/a	KINYBEAU	no
Verticillium lecanni ...	UNF	n/a	KINYVERT	no
Azadirachtin	18B	n/a	NEEM FORCE	no
Azadirachtin (A+B)	18B	n/a	NEEMCIDE 2.5EC	no
Garlic extract	UNE	n/a	NEEMGUARD	no
Azadirachtin	18B	n/a	NIMBECIDINE 0.03...	no
Flubendiamide + Sp...	28 + 23	U	TIHAN OIL DISPERS...	no
Novaluron	15	U	UNIRON 10EC	no

Sorted on trade name

7

REVIEW SELECTED PRODUCTS AND PRODUCT DETAILS

The user can also review additional details of the selected products by clicking on a product name. The information includes:

- **Trade name (as registered in Uganda)**
- **Active ingredient**
- **WHO Hazard class**
- **Mode of action (MoA)**
- **Highly Hazardous Pesticide (HHP)**
- **Concentration of active ingredient**
- **Bee toxicity**
- **Pre-harvest interval**
- **Re-entry interval**
- **Formulation of the product**
- **Other pests or diseases that the product may control**
- **Registration number of the product**
- **Registrant**
- **Local agent or distributor**

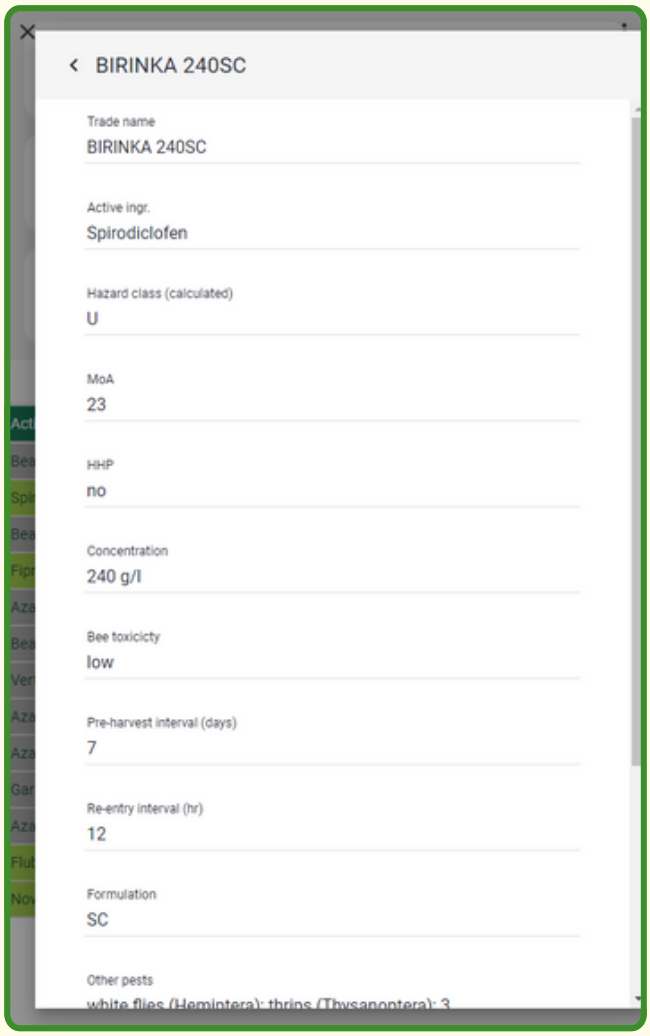
NB concentration active ingredient is NOT the recommended dose for spraying! For the correct mixing & spraying dosage, please consult the label of the product!

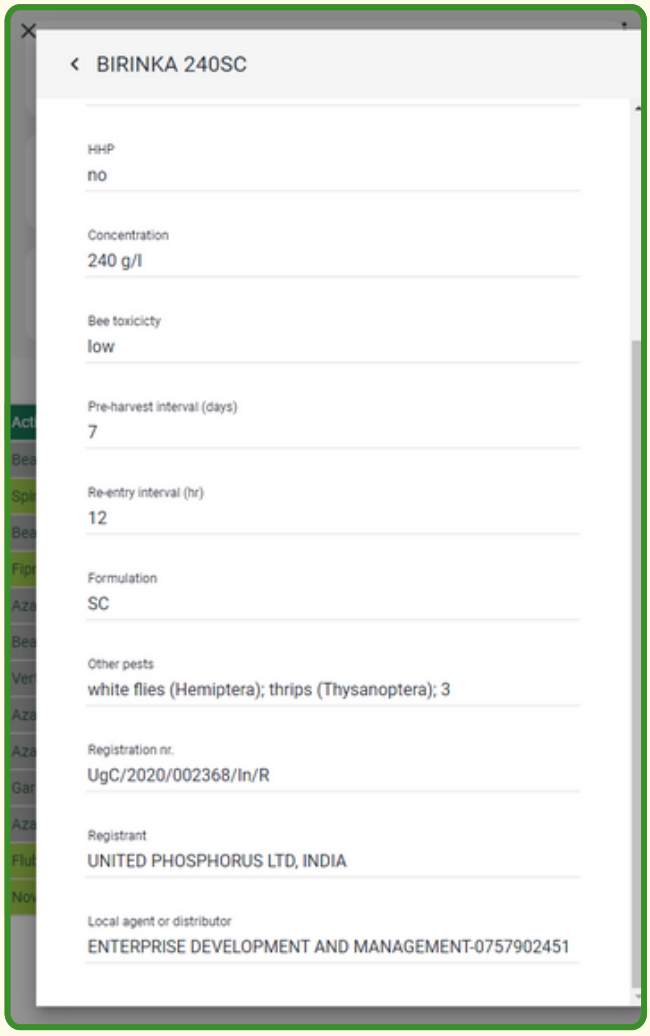
NB the re-entry interval and pre harvest interval shown in the tool are only indicative and may not be correct. For the correct information on REI, consult the label of the product!

7

REVIEW SELECTED PRODUCTS AND PRODUCT DETAILS

After clicking on a product name, a pop-up will appear which displays the additional information. The sliding bar on the right allows the user to scroll down and view all the details.





SELECT PRODUCT AND CONSULT PRODUCT LABEL

Once the user has decided which product is preferred, it is important to review the label of the physical product. The label will inform the user on several aspects and is the actual legal document on how the product may be used.

1. **Actual registered use**

   Although the tool will only show registered products available in Uganda, it is not able to provide detailed information for which crops and which pests or diseases it is actually allowed to use. It is important thus to check the label first to confirm if the selected products is allowed for the intended purpose.

2. **Dose instructions**

   Only on the label information can be found how to prepare the spray solution and what dose per pest/disease in a specific crop should be used. Also, the label will present the specific re-entry interval and pre-harvest interval.

3. **Safety measurements**

   Next to instructions how to use the product to control the pest or disease the label also shows how to prevent poisoning and minimize health dangers and environmental pollution when using the product. The label will provide information on which personal protective equipment should be use and what to do in case of accidental poisoning.

8

SELECT PRODUCT AND CONSULT PRODUCT LABEL

Below an example of Confidor 200 SC, showing the information on the label of allowed and actual registered use of the product for specific crops and pest combinations, inlcuding information on rates to be applied and the witholding period (WHP), indicating the minimum length of time that must elapse between the last application of an agricultural chemical to a crop and the harvest, sale or use of the agricultural produce to which the chemical was applied.

Confidor 200 SC

CROP	PEST	RATE	WHP	CRITICAL COMMENTS
Stone fruit	Green peach aphid, black peach aphid	**Dilute spraying** 25 mL/100 L **Concentrate spraying** Refer to the Application section	21 days	Apply at first sign of aphid infestation. Apply as a full cover spray, ensuring thorough coverage. Apply by dilute or concentrate spraying equipment. Apply the same total amount of product to the target crop whether applying this product by dilute or concentrate spraying methods. Do not use in equipment that requires rates greater than 125 mL/100 L of water (i.e. greater than 5 X concentrate).
Cucurbits	Green peach aphid	25 mL/100 L or 300 mL/ha	1 day	Apply at first sign of aphid infestation.
Capsicum, eggplant potato			7 days	
Tomato			3 days	
Brassicas	Grey cabbage aphid, turnip aphid		7 days	Apply at first sign of aphid infestation. Add a wetting agent.
Sweet potato	Silverleaf whitefly, including type B	25 mL/100 L or 250 mL/ha	7 days	Apply at first sign of whitefly or melon thrips infestation. Apply dilute sprays (25 mL/100 L) to run off. Ensure thorough coverage of underside of leaves. Use of droppers will improve coverage of underside of leaves.
Cucumber			1 day	
Egg plant	Melon thrips		7 days	
Roses	Aphids	25 mL/100 L	–	Apply as a thorough cover spray at first sign of insect infestation.
Ornamental plants	Aphids, azalea lace bug, bronze orange bug, citrus mealybug, Fullers rose weevil, greenhouse thrips, harlequin bug, silverleaf whitefly (suppression)			
	Hibiscus flower beetle	50 mL/100 L		Spray buds and flowers as needed.
	Longtailed mealybug	50 mL/100 L + surfactant		Apply 3 sprays 2 weeks apart. Use a non-ionic surfactant at label rate.
	Psyllids	25 mL/100 L		Spray at first sign and then a week later.
	Soft scales	25 mL/100 L		Spray in late spring or when small scales are first seen. Apply 3 sprays 2 weeks apart. Add a wetting agent.
Duboisia	Green peach aphid	25 mL/100 L		Apply when aphid numbers reach spray threshold levels as determined by regular monitoring. Ensure thorough coverage of all leaves.
Pandanus trees	Flatid (*Jamella australiae*)	**Spot spray** 875 mL/100 L of water		**Spot spray:** Spray 100 mL of mixture directly into the leafy throat of each head.

ACKNOWLEDGEMENTS

The Pesticide Selection Tool (PST) is an application designed to support horticulture stakeholders in Uganda in identifying and selecting appropriate products for pest and disease control as a last resort, following Integrated Pest Management (IPM) principles.

Both the PST and this user manual were developed by Wageningen University & Research as part of the Horticulture Market Acceleration Program (HortiMAP).

HortiMAP is funded by the Embassy of the Kingdom of the Netherlands in Kampala, Uganda, and implemented by TechnoServe in collaboration with Wageningen University & Research.

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Photos: Herman de Putter & Edwin van der Maden

DISCLAIMER

HortiMAP, TechnoServe (TNS) or Stichting Wageningen Research accept no liability for any damage or adverse consequences arising from the use of the Pesticide Selection Tool (PST) or this Pesticide Selection Tool user manual.

Since the PST generates selections of pesticides potentially capable of controlling selected pests or diseases, based solely on available registered and authorized pesticides and efficacy of the active ingredient, it is the user's responsibility to verify the generated recommendations against the actual label instructions provided by the product packaging.

HortiMAP
Horticulture Market Acceleration Program

The Dutch Ministry for Foreign Trade and Development Cooperation

TechnoServe
Business Solutions to Poverty

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