



Potato leaf miner

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BACKGROUND

Potato leaf miner, *Liriomyza huidobrensis* has been a serious problem in the Sandveld since 2000 and has spread to other potato production regions soon after.

Once the leaf miner has become established in a potato field, it will spread within a few days and is then almost impossible to control. The management process must therefore start even before the first signs of damage, and for it to be truly effective chemical, cultivation and biological measures must be integrated.



DAMAGE

Punctures (or feeding wounds) measure approximately 1 mm in diameter and appear as whitish speckles on the leaf.

Punctures are made by the female fly in order to feed or to lay eggs. The female uses her ovipositor to puncture the leaf, causing the surrounding cells to die off, giving the leaf a whitish appearance.

The fly feeds on the sap seeping from the puncture and lays eggs in some of the punctures. Studies have shown that under the right conditions, a single female fly can make up to >1 000 punctures.

The loss of green leaf tissue results in reduced photosynthesis and a lower uptake of insecticide. Eggs hatch in the punctures, and the larvae live in the leaf for the entire larval stage.

Fresh puncture wounds may be a point of access for fungal spores such as early blight, late blight and brown spot.

Mines or tunnels are created as the larvae

feed on the mesophyll tissue between the two epidermal layers of the leaf. Flies tend to lay their eggs in punctures situated close to the leaf veins, especially the main vein. The tunnels then spread to the leaf blades. With heavy infestation tunnels can interlink, thus destroying large portions of the functional leaf surface. This can result in serious damage, since photosynthesis is insufficient to meet the plant's energy requirements.

Tunnels can also appear in the leaf petioles. All leaves can be infested (can have punctures). The old leaves, however, are more prone to infestation because they are less vigorous and have weaker defence mechanisms. Insecticide is also less likely to reach older leaves. Flies seem to be least attracted to the youngest leaves with glandular hairs.

MANAGE THE RISK OF LEAF MINER

TIME OF PLANTING

RISK	MANAGEMENT
Favourable season for the leaf miner	Planting during the spring (growing into summer) and summer normally pose the biggest risk. <ul style="list-style-type: none"> • Monitor potato fields daily, and start spraying as soon as the first punctures, flies or mines are observed.

CHOICE OF FIELD

RISK	MANAGEMENT
Favourable microclimate for the leaf miner	In the Sandveld, the summer climate near the coast is more favourable for the leaf miner than the interior. <ul style="list-style-type: none"> • Monitor plantations daily for the presence of flies and mines. • Spray immediately on observing punctures, mines or flies.

CHOICE OF CULTIVAR

RISK	MANAGEMENT
Plants do not recover from feeding damage	Where the leaf miner is difficult to control rather select long growers, as short growers have a limited ability to recover from serious damage.
Certain cultivars are more susceptible to leaf miner infestation	Cultivars with a naturally lighter green colour are more attractive to leaf miner flies. <ul style="list-style-type: none"> • Select a cultivar with a naturally darker green hue.

SEED POTATOES

RISK	MANAGEMENT
Old and small seed potatoes	<ul style="list-style-type: none"> • Plant large seed potatoes. Haulms grown from small seed potatoes are smaller than those grown from large seed potatoes. They therefore have limited ability to recover from feeding damage. • Plant seed potatoes that are at the optimal stage for planting. Plants grown from old seed potatoes are less vigorous than those grown from mature seed potatoes.
Uncertified seed potatoes	Seed potatoes infected with viruses or other pathogens produce less vigorous plants. <ul style="list-style-type: none"> • Plant only certified seed potatoes.

MANAGE THE RISK OF LEAF MINER

PLANT

RISK	MANAGEMENT
Infested plant residues in the near vicinity	<p>Where an infested potato planting is being harvested in close proximity to another potato</p> <ul style="list-style-type: none"> Reduce the risk of infestation by spraying with a systemic agent as a means to kill any colonisers.
Commercial host crops in the vicinity	<p>If possible, potatoes should not be planted in close proximity to other commercial host plants (onion, lupines, legumes and vegetables), since these can host flies that could infest the potatoes at an early stage.</p>

CROP MAINTENANCE

RISK	MANAGEMENT
Sudden mass infestation	<ul style="list-style-type: none"> Monitor the climate. When the weather becomes hotter and dryer and other host plants in the vicinity start falling, flies will relocate to potato plantings. Monitor potato plantings daily for signs of mines and flies. Spray as soon as the first punctures, mines or flies are observed.
Impaired plants hardly recover from leaf miner damage	<p>Ensure that potato fields are managed optimally (fertilisation, irrigation, crop protection) to keep the plants as vigorous as possible to enable recovery from damage.</p>
The spraying programme does not lead to sufficient control	<ul style="list-style-type: none"> Do not allow a leaf miner population to become established. Monitor fields daily, and spray at the first signs of leaf miner. Be sure to spray every leaf, including those at the lower and in the centre of the leaf canopy. Type of spraying equipment, type of spray heads, additives and time of day are important factors.

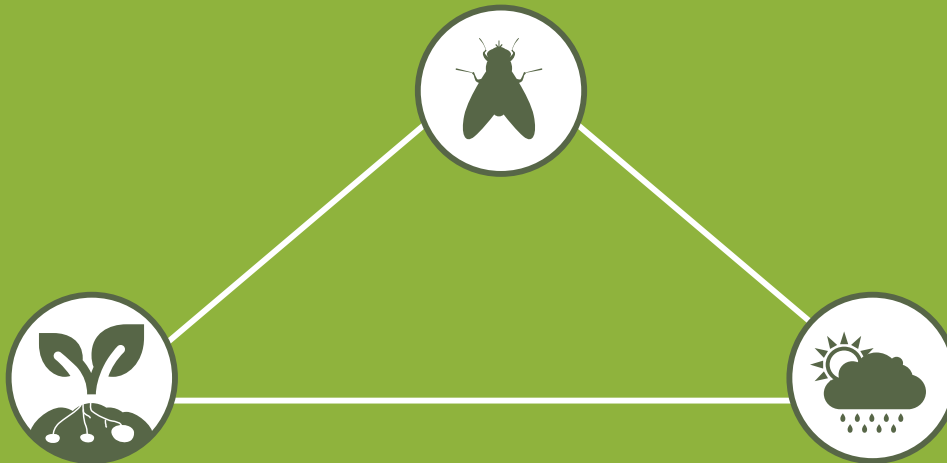
HARVEST AND POST-HARVEST HANDLING

RISK	MANAGEMENT
None	None

INFESTATION

INSECT PEST

- Female fly can lay hundreds of eggs
- Short life cycle when conditions are optimal
- Pupae are a continuous source of infestation



PLANT

- Weak plants are more prone to infestation
- Some cultivars are more attractive to leaf miner
- Many host plants

ENVIRONMENT

- Temperatures of 22-30oC are optimal
- Rain impairs feeding and egg laying

When?

When growth of a planting is terminated and the plant rests are left on the field, these can become an important source of new infestations in other plantings in close proximity.

In the Sandveld, the leaf miner is most problematic from October onwards. In the cool rainy season, the leaf miner commonly affects potatoes, other winter crops and the natural vegetation. At lower temperatures, the insects proliferate at a slower rate, while rainfall hinders feeding and egg laying. As the weather grows warmer, the insect's life cycle is shortened and the females lay large numbers of eggs, with the rapid population growth resulting in a leaf miner plague.

When the rainfall ceases and the natural vegetation and dryland crops start falling, the leaf miner subsequently relocates to potato plantings.

In the Koue Bokkeveld, potatoes are planted in October when the weather grows warmer. By the time onions start falling in December, the potato fields are already well established and infestation can originate from the onion fields.

Where?

In the Sandveld, the leaf miner is usually more problematic in potato fields along the coast than in those towards the interior. The weather along the coast is usually cooler than the weather deeper inland. High temperatures (> 30oC) are detrimental to the leaf miner, and no stage of the insect can survive at a temperature of approximately 40oC and higher.

Plants

Less vigorous plants are more likely to be affected than young, healthy plants, where small/impaired seed potatoes are used, where fertilisation is not optimal, or where some type of pest or pathogen is present. Impaired plants are less able to recover from damage and have a reduced capacity to absorb insecticides, with the distribution thereof throughout the plant also being limited.

The vigour of potato plants tends to become less at approximately the middle of the season when nutrients are translocated to enlarging tubers and during natural foliage dieback.

This makes it easier for larvae to tunnel in leaves leading to seemingly mass infestations. Sometimes foliage die-back is very rapid, leading to sudden leaf miner infestations.

The effect of infestation and the subsequent damage has a more significant yield reducing effect on short growers than on long growers, as short growers have less time to recover before the foliage dies off naturally.

Leaf miner flies are more attracted to yellow objects than to white and green coloured objects. Plants with a relatively light green or yellowish colour (either naturally or due to a deficiency or disease) are more susceptible to damage than plants of a darker green colour. A study in Argentina revealed that the cultivars of a lighter green colour are most attractive to the leaf miner.

How does a planting become infested?

Leaf miner flies fly across short distances from one plant to another.

Where the natural vegetation, comprising numerous alternative host plants, and crops such as lupines in the Sandveld and onions in Ceres and the Koue Bokkeveld, start falling, leaf miner flies will travel over short distances to other living hosts, such as potatoes. It is not known whether leaf miner flies can be dispersed by wind over great distances in the same way as aphids.

Seemingly sudden infestations often occur during the latter part of the growing season as the vigour of plants decreases and larvae are better able to burrow mines inside leaves.

The only way to manage these late infestations, is pro-active spraying early in the season.

Eggs and larvae can be widely spread by humans through infested plant material such as leafy vegetables and ornamental plants.

Where a planting that has been sprayed with lethal levels of insecticide is infested with the leaf miner, and the plants remain in the soil, it can serve as a significant source of new infestations. It can happen that a planting is colonised and that the population unexpectedly multiplies within a matter of days, giving the impression that the potato field has suddenly been infested with a large number of flies.



LIFE CYCLE

Eggs

The female fly lays her eggs individually in the puncture holes. One female lays a few hundred eggs throughout her lifetime, at a rate of approximately 40 eggs per day. In warm weather, eggs hatch within approximately three days.

Leaf miner larvae

are typical grubs (lacking feet and a defined head), approximately 3 mm in length, and found only within plant tissue. Under favourable weather conditions, the larvae undergo a life cycle of three stages before turning into pupae.

Pupae

form on the surface of the leaf and usually fall off, landing underneath the plant where they metamorphose into the fly. The pupae sometimes remain behind on the leaf surface. Pupae are therefore a constant source of flies, which emerge from the pupae after approximately ten days.

Flies

are 1.5 – 2 mm in length, and are black with yellow markings. Male flies live for approximately four to seven days, while females can live for longer than 21 days. The female needs to mate only once in order to fertilise all her eggs. The flies fly over short distances from plant to plant.

Effect of temperature on life cycle

Temperature has an effect on the duration of the various stages in the life cycle of the leaf miner, as well as the number of eggs that are laid. At all stages, the insect will die at temperatures of <0 and >40oC.

The optimal temperature for the leaf miner is approximately 22 – 30oC. Breeding slows down at very high and very low temperatures.

In Israel it was found that flies are most active during the morning hours (07:00-11:00) and less active at hotter times of the day.

ASPECTS OF MANAGEMENT

Managing the leaf miner is a numbers game

The insect has the ability to complete a full life cycle within a very short period of time, and each female is capable of laying a few hundred eggs. It is therefore crucial that the population is kept as low as possible from the start of infestation. Once a leaf miner population has established itself, it is almost impossible to control.

Monitoring

is of cardinal importance in the effort to bring any infestation under control as quickly as possible. Once the weather conditions become hotter and dryer, potato fields must be inspected daily for the presence of flies and mines.

In some foreign countries, yellow traps (“sticky traps” or yellow water-filled pan traps) are set on the outer perimeters of potato fields as a means of detecting infestation in the early stages. Traps have to be inspected daily.

Life stages

Eggs are not affected by insecticides because they are protected by the leaf tissue and egg shell. Where larvae feed on leaf tissue containing a systemic insecticide, they will die inside the leaf tunnel. Insecticides will not kill the pupae, because they do not feed and are protected by the carapace. Flies will die after feeding on plant sap treated with insecticide.

Insecticides

are invaluable in the control of leaf miner infestations. The majority of registered insecticides on the market are systemic in nature or have a translaminar effect.

This means that the insecticide is absorbed by the living epidermis and transported to the mesophyll tissue of the leaves.

The larvae will die after feeding on tissue containing insecticide. Any flies feeding on the poisoned sap will also die through the same means. Once a plant has started to deteriorate, any insecticide will be ineffective due to the plant's reduced ability to transport the insecticide internally.

Translaminar insecticides are absorbed only by living tissue.

Where a large proportion of the leaf surface has been destroyed by punctures and mines/tunnels, only a limited quantity of insecticide can be absorbed by the leaf – another reason why effective control measures are essential from the very start.

Contact insecticides are an effective means of controlling flies. Contact insecticides are ineffective in controlling larvae, which are protected by the dead epidermis of the mines.

Application

There is usually good coverage in the upper parts of the leaf canopy, but poor coverage in the lower parts. As such, the problem lies in the fact that the older leaves are more susceptible to infestation than the younger leaves in the upper parts of the leaf canopy. Since all registered insecticides are classified as either contact or systemic/translaminar, care must be taken to spray all leaves at the lower and inside of the plant canopy. Excellent results have been achieved with the application of insecticides by means of boom sprayers during the evening, with no wind and cooler temperatures.

The manufacturer's instructions must be followed at all times.

Other host plants

The leaf miner can feed and propagate on a wide variety of plants, including the indigenous vegetation of the Sandveld and Ceres, lupines (including serrandella), onions, as well as other vegetable species.

Indigenous vegetation includes the following host families:

Asteraceae, Cucurbitaceae, Liliaceae, Solanaceae and Oxalidaceae.

Host crops cultivated in the area include: Solanaceae (potato and tomato), Brassicaceae, and Leguminosae (lupines).



INSECTICIDES REGISTERED FOR USE IN THE CONTROL OF THE LEAF MINER

ACTIVE INGREDIENT	CHEMICAL SUBGROUP	ACTION
abamectin	6A	translaminar and contact, ingestion
cyromazine	17	translaminar and systemic insect-growth inhibitor active on larvae
oxamyl	14	systemic
chlorantraniliprole (anthranilic diamide)	28	contact, ingestion
spinetoram (spinosyn)	5	contact, ingestion
cartap hydrochloride	14	systemic, contact, ingestion
spinosad	5	translaminar, ingestion



Reduce the risk of resistance to active ingredients

- Avoid exclusive and repeated use of insecticides from the same chemical subgroup.
- Integrate different measures: chemical, cultivation and biological.



DO NOT CONFUSE DAMAGE CAUSED BY POTATO LEAF MINER AND POTATO TUBER MOTH



Potato tuber moth damage

POTATO LEAF MINER DAMAGE

Punctures of feeding wounds, (○) are approximately one mm in diameter and are visible as whitish dots on the leaves.

Mines or tunnels are made between the two epidermal layers of leaves when larvae feed on the mesophyll tissue. Flies tend to lay their eggs in punctures near the leaf veins, particularly the main vein (↑).

Mines spread to the leaf tissue between veins. With heavy infestation, tunnels can coalesce to destroy large portions of functional leaf tissue. Larvae are sometimes visible inside tunnels (↑).

All leaves can be infested, but older leaves tend to be infested most.

1



2



3





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Private Bag X135, Pretoria, 0001, South Africa
Tel: +27 (0) 12 349 1906 | **Fax:** +27 (0) 12 349 2641



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