# THRIPS AND YSA
## CONTROL MANUAL

SOUTH AFRICAN SUGARCANE
RESEARCH INSTITUTE

Guidelines for the management of Sugarcane

# Thrips and Yellow Sugarcane Aphid

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# Thrips

Sugarcane thrips is a minute sap-sucking insect originating in south-east Asia. The first record of its invasion of commercial cane in the South African sugar industry was in 2004 when it was found on the Umfolozi flats. Thrips most likely arrived borne by wind from Madagascar. Since then, it has spread rapidly throughout the industry. Thrips has few alternate host plants.

Thrips reside within the tightly rolled leaves of the spindle where they feed by scraping and puncturing the leaf surface. Visible symptoms are only apparent once the damaged leaves expand and unfurl. In many cases thrips numbers in the spindle have declined when symptoms become evident.

Infestations tend to affect entire fields, mainly in young sugarcane, particularly plant crops. A peak in numbers within the spindle is normally seen between November and February.

The damage caused by thrips, such as leaf discoloration and dead tissue, can resemble symptoms of molybdenum deficiency.

**Figure 1:** Sugarcane exhibiting sugarcane thrips damage, with leaf discoloration and dead tissue (left), and joined dead leaf tips (right).


**Figure 2:** Thrips exposed by unfurling the leaf spindle (Inset - magnified view of thrips nymph (left) and adult (right)).

# Yellow Sugarcane Aphid

## *(YSA)*

Yellow Sugarcane Aphid (YSA) originated from the Americas, where it initially was a pest on sorghum and later, sugarcane. It was first noticed in South Africa in 2013 on the Umfolozi flats, at Pongola and in Upper Tongaat. The KZN North Coast and Mpumalanga regions are particularly prone to high infestation levels.

YSA most commonly attacks young sugarcane prior to the development of multiple internodes. Damage during early stalk elongation can cause thin stalks with subsequent lodging. Unlike thrips, YSA is more commonly found on ratoon cane rather than plant cane. YSA feeds by sucking fluids from plant vascular tissues on the underside of leaves, next to the midrib, generally on the older/lower two or more leaves. It injects saliva containing toxins, which causes chlorosis or reddening of leaves leading to premature senescence. Leaf damage symptoms can resemble potassium and/or phosphorous deficiencies.

The apparent preference of YSA for lower leaves first suggests that this aphid benefits from leaf senescence (yellowing of the leaves due to age or stress). During senescence of older leaves, nutrients particularly nitrogen in the form of amino acids, are recycled to younger plant parts via the phloem. Aphid development benefits from this nutritional enrichment of phloem sap. Once numbers reach a sufficient level, the aphid itself seems to be able to induce premature leaf senescence through weight of their population. Environmental conditions, which cause mild plant stress, can also accelerate leaf senescence.

YSA feeds on multiple grass species and prefers many of these ahead of sugarcane. YSA overwinters in low numbers on suitable grasses.

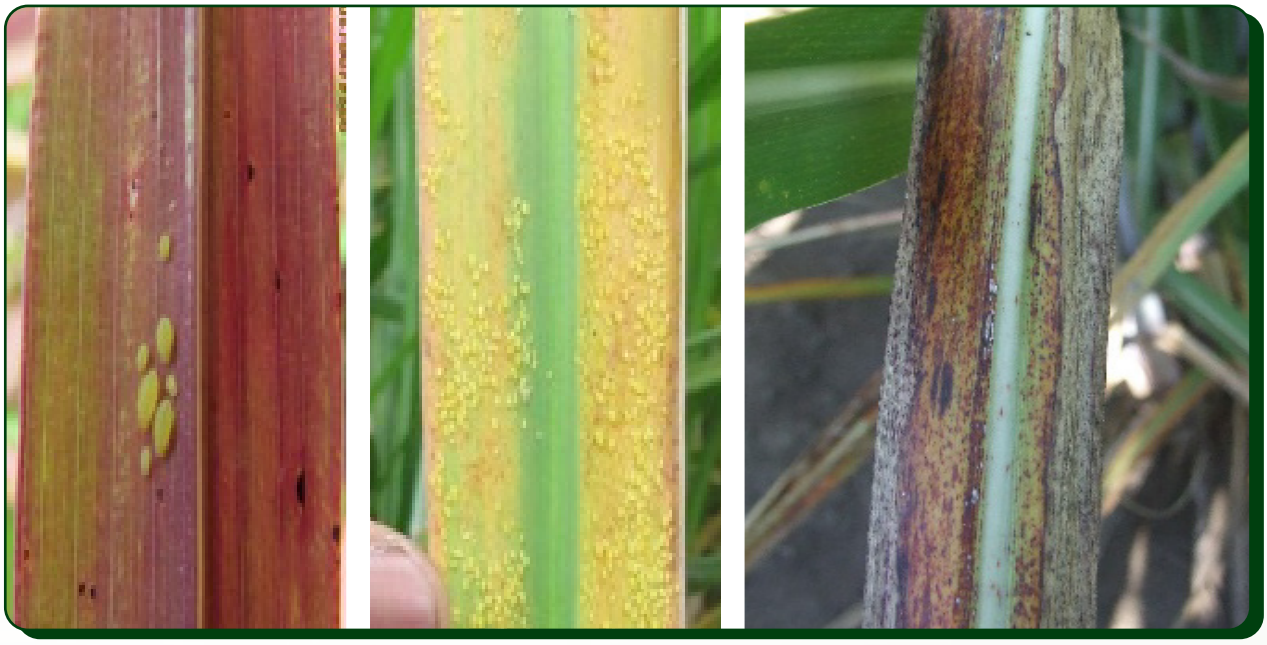


**Figure 3:** YSA feeds on the underside of leaves next to the midrib generally on the older/lower two or more leaves. Typically, leaves turn red/purple (left), yellow (centre). Old damage (right).

Temperature (optimally mid to high 20s $^{0}$C) and low humidity are prime drivers of YSA outbreaks in spring and autumn in the rainfed regions. Under wetter and more humid conditions in summer, infestations may be suppressed by entomopathogenic fungi, but can still be significant during plant stress events. In the irrigated regions infestations tend to be more intense during mid-summer

Conditions suitable for aphid infestation can also occur in winter. YSA populations proliferate rapidly due to their short lifecycle, while larger predatory insects like ladybirds exhibit slower development, causing a lag in their population growth. Infestations tend to be patchy but can extend across entire fields. YSA moves from a patch in a field to another patch at intervals of approximately two weeks.

**Figure 4:** Nymphs, adults (apterous) and winged adults (alates).

### *Factors that may pre-dispose fields or patches within fields to early infestation:*

- Potassium (K) and phosphorus (P) deficiencies accelerate leaf senescence and increase phloem sap amino acid content.
- Excess nitrogen (N) increases phloem sap amino acid content.
- Mild water stress accelerates leaf senescence and increases phloem sap amino acid content (e.g. due to sub-soil acidity).
- Early leaf senescence is readily induced by YSA in susceptible varieties.
- Localised temperature effects, particularly increased night-time minimums (linked to aspect, slope and the formation of temperature inversions) may promote localised infestations.

## *Summary of control measures for*

# Thrips and YSA

### *Manage the natural habitat.*

Many natural enemies of pests need support from the environment in the form of pollen, nectar, resting places, or (alternate) prey availability. Manage a diversity of plantings on the farm to promote natural biocontrol.

### *Reduce plant stress by managing soil physical and biological health.*

A stressed crop is more susceptible to damage. Identify soils that are prone to stress, and that will need priority in treatment for thrips and YSA.

Practices such as strip cropping, conservation structures, mulching at harvest and proper weed control all help conserve moisture.

Implement effective irrigation management, avoiding over-irrigation and waterlogged conditions. Take measures to prevent or alleviate salinity and sodicity.

Practices such as green manuring, controlled traffic, ripping, nematode control and liming to reduce soil acidity and improve root health.

A healthy well-aerated all deep root system ensures optimal nutrient and silicon uptake and stress tolerance.

### *Choose appropriate varieties.*

Select the best and most suitable varieties for your conditions. Planting less susceptible varieties in areas prone to infestation is an effective control measure.

### *Practise stringent field hygiene.*

Effectively control grassy weeds in the fields.

Keep grasses on verges and breaks short and ensure that there is a bare-soil gap between the grass and sugarcane.

Ensure field staff are aware that YSA can stick to clothes, especially within fields with high level of infestation. This can result in further spread to uninfested fields.

Wear clothing to which the insects cannot stick, or clothes impregnated with permethrin. Wash clothes daily.

Disinfect tractors and implements after use in infested fields.

### *Adjust planting date.*

Young plants are vulnerable to attack by YSA and thrips. Consider planting susceptible varieties in months outside of the period October to end of January.

### *Manage nutrition.*

Avoid excessive nitrogen applications as they encourage thrips and YSA. Limit nitrogen available to these pests by following FAS recommendations regarding a realistic yield target. Adjust your yield target downwards if a dry summer is predicted. Consider splitting nitrogen applications so that downwards adjustments can be made if an unexpected dry summer materialises, or upward adjustments if conditions improve.

In most cases plant cane will not require as much nitrogen as subsequent ratoons.

Maintain optimal levels of potassium and phosphate to enhance plant resistance against pests. Ensure adequate potassium levels for improved drought resistance.

### *Scout often.*

Conduct regular surveys to monitor the level of infestation and take timely action. Frequent small surveys, including field edge scouting, are more useful than infrequent detailed surveys.

### *Use of registered insecticides.*

Insecticides containing lamda-cyhalothrin + chlorantraniliprole (pyrethroid + diamide), cyantraniliprole (diamide), imidacloprid and acetamiprid (neonicotinoids) have been registered for foliar application against YSA and/or thrips. Imidacloprid (neonicitinoid), imidacloprid + oxamyl (neonicotinoid + carbamate) and thiamethoxam (neonicotinoid) are registered for soil or stubble application.

Pre-emptive use of soil/stubble-applied insecticides is an option in fields where repeated infestations are noted year after year. Field edge ('barrier') treatments can also be considered. Consult your Extension Specialist.

## *Manage the*
# Natural Habitat

Many natural enemies of pests need support from the environment in the form of pollen, nectar, resting places, or (alternate) prey availability.

Rehabilitation of the sugarcane landscape (along with integrated pest management) will sustain beneficial arthropods, for example, predators of thrips and YSA and forms the foundation for their long-term management.


**Figure 5.** Landscape restoration is foundational for long-term management of sugarcane pests.

### *S-A-F-E Principles to encourage beneficial insects.*

Four primary criteria are needed **to encourage and sustain beneficial insects**:
**S**helter, **A**lternative prey/food source, **F**lower-rich habitat, **E**nvironment.

**Shelter**

Areas protected from insecticides, intensive tillage (or other practices such as burning) provide ideal habitats to sustain beneficials.

Cultivation schemes that may be compatible specifically with sugarcane and/or multicropping systems of sugarcane plus macadamias, bananas and/or avocado include permanent borders and windbreaks.

*Permanent borders* can consist of a strip (or more if resources allow) of permanent vegetation bordering a field or between two fields, e.g. between sugarcane and macadamias. A border such as this can be planted to attract beneficials throughout the cropping season if the proper plants are used. These are ideally perennials.

*Windbreaks, shelterbelts or hedgerows* include linear barriers of shrubs, perennial forbs (herby flowering, not grass), and grasses that are planted along field edges, banks, contours – basically those areas that are not used during the cultivation of the food crop. Indigenous plants can also be planted along natural waterways.

**Alternative Food Source**

YSA and thrips are present all year round, but with fluctuations in population densities. Food can therefore be provided for predators during pest population dips by planting species with nectar and pollen.

**Flower-rich Habitat**

Pollen and nectar are *essential* food for hoverflies and lacewing adults but also provide *alternative* food sources to ladybirds, pirate bugs, soldier beetles, lacewing larvae, and predatory flies. Annual and perennial flowering plants can supply this pollen and nectar.

**Environment**

Beneficials thrive in an environment with floral diversity, with minimal exposure to insecticides, e.g. field margins, contours, waterways, and indigenous bush zones. Maintaining a healthy environment through judicious use of insecticides will also promote beneficial diversity, retention, and health.

### *Key steps to consider before implementing a habitat management plan*

1. Analyse records of where, when and what pests occur and the relative abundance/severity of infestations.
2. Know the pest and the targeted predators: biology, ecology.
3. Select the right plants for your environment. This is cost-dependent but should ideally include perennial and annual flowering plants.
4. Select the zones that you would like to diversify.
5. Start SMALL and SIMPLE!

### *Remember:*

1. Maintenance will be required in the first few seasons, particularly for annuals.
2. Seed/seedlings will need to be sourced.
3. Manpower will be required for planting.
4. The system will most likely require fine tuning, varying the plants etc.
5. This is not a quick, "silver bullet" system, but part of an integrated pest management approach.
6. Plants should ideally be planted in rows of alternating species, e.g. flowering annuals alongside flowering perennials, or strong aromatics alongside softer pollen and nectar producers.

| ***Plants to attract predators of YSA and thrips*** | Hoverflies  | Lacewings  | Ladybirds  | Mantids  |
|---|---|---|---|---|
| Parsley, coriander, dill, cumin, anise  | ✓ | | | |
| Yarrow (different species), arnica, echinacea, comfrey, chamomile  | ✓ | ✓ | | ✓ |
| Fennel, carrots, celery, dill  | | ✓ | ✓ | ✓ |
| Aloes, other flowering succulents  | ✓ | ✓ | ✓ | |
| Basil, lavender, mint, rosemary, oregano, thyme  | | ✓ | ✓ | ✓ |
| Cosmos, daisy, sunflower, marigolds, zinnia  | ✓ | ✓ | ✓ | ✓ |

# Managing Soil Physical and Biological Health

A stressed crop is more susceptible to insect damage. Utilise the information from your soil survey to identify soils that are prone to moisture stress, compaction, acidification, poor drainage, or salinity/sodicity. This will help predict which areas require priority treatment against YSA and thrips.

Implementing a proper Land Use Plan will aid in moisture conservation by ensuring that all appropriate conservation structures are in place.

You can further contribute to moisture conservation by maintaining an efficient weed control programme, which will prevent competition for soil moisture from weeds.

On sandy soils, the use of a nematicide is often beneficial in promoting a healthy root system and reducing stress.

Crop residue conservation is a very effective means of reducing soil and water loss from sugarcane fields, particularly on slopes and highly erodible soils. Mulching increases rainfed yields, reduces erosion and reduces the need for chemical weed control. If practised during spring and early summer, conserved predators can impact upon pest infestations of young ratoons.

Compaction is a long-standing problem in the South African sugar industry. It restricts water intake, water holding capacity and rooting depth, thereby increasing the risk of pest infestations. The tendency to become compacted is greatest when soil water content is near field capacity. Take steps to avoid soil compaction such as controlled trafficking and improvement in the level of organic matter in the soil by green manuring, adding organic matter at planting and crop residue mulching.

Addressing subsoil acidity and aluminium toxicity, or salinity and sodicity, improves root growth and access to soil moisture during periods of water limitation. Take samples of both the topsoil and subsoil layers 0-300; 300-600; 600-900 mm to determine if subsoil acidity problems exist. This should be done before planting a green manure.

Soil re-acidification occurs with nitrogen fertilisation of each ratoon and is one of the causes of ratoon yield decline (along with compaction and stool damage caused by infield traffic, and disease build-up). To limit rapid re-acidification, surface application of dolomitic lime and gypsum can be done after every harvest. Use a less acidifying form of nitrogen fertiliser such as Limestone Ammonium Nitrate (LAN).

Consider ripping as a practice that increases root aeration and improves rooting depth. Ripping of ratoon fields should be restricted to two weeks or less following harvest; ripping later than this may damage new roots.

Under irrigated conditions, avoid under- and over-irrigation by accurate scheduling. Avoid waterlogged conditions. Over-irrigation can lead to salt accumulation at the surface as the result of a rising water table.

Ensure adequate silicon uptake. Silicon is known to be effective against aphids in general. Uptake of adequate silicon requires a well-aerated, extensive, and finely branched root system. It is, therefore, essential to limit compaction by ripping, and to control nematodes when necessary. In addition, soil acidity with the presence of soluble aluminium limits the availability of silicon.

## *Choose Appropriate*

# Varieties

Pest growth and development on resistant sugarcane varieties is reduced relative to susceptible varieties. In the case of YSA, this is in the region of a 1.5–3-fold reduction. Feeding by YSA on resistant varieties also causes less chlorophyll loss than on susceptible varieties, resulting in better yields despite infestation.

N12, N47, N49, N52, N53 and N71 are least damaged by both thrips and YSA whilst N45, N54 and N62 are most at risk for damage by both thrips and YSA.

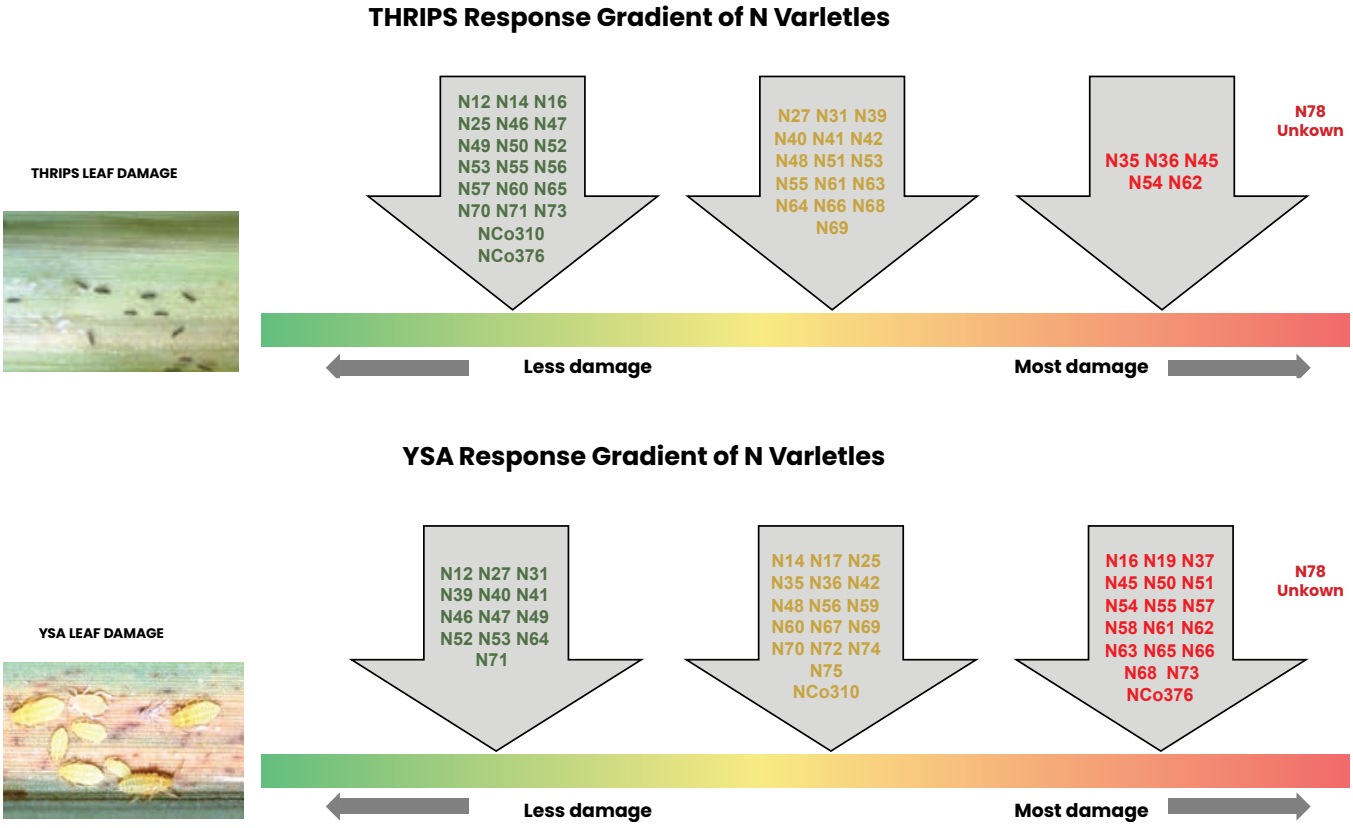



**Figure 7.** Varietal responses to YSA and thrips damage

## *Practise stringent*

# Field Hygiene

Effectively control grassy weeds in the fields as many grasses are preferred by YSA compared to sugarcane. They support a more rapid population increase.

Keep grasses on verges and breaks short and ensure that there is a bare-soil gap between the grass and sugarcane so that aphids crossing to sugarcane are exposed.

Ensure field staff are aware that YSA can stick to clothes, especially within fields with high level of infestation. This can result in further spread to uninfested fields. It is therefore critical that field workers wear clothing to which the insects cannot stick, or clothes impregnated with permethrin. Clothes should also be washed daily.

Wash tractors and implements after use in infested fields using a high-pressure washer to ensure that the spread to other fields is reduced.

# Planting Date

Adjust planting dates to avoid excessive damage from thrips, as their numbers and damage peak between November and February, particularly in plant cane.

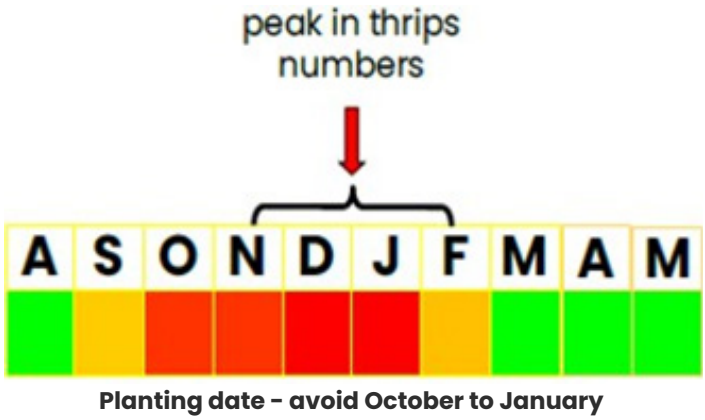



**Figure 8.** Thrips infestation peaks between November and February. Suggested planting months shown in orange and green.

Plant either in early spring (August or latest September) or in late summer - autumn (February to April) to avoid the presence of young cane when thrips numbers peak over the summer period. Planting outside of the conventional planting season requires precautions to prevent problems with germination. Consult your Extension Specialist.

Exploit the benefits of a summer green manure if sugarcane planting is delayed to late summer or autumn (February to April).

YSA infestations are less predictable than thrips infestations and can occur at any time. Temperature (optimally mid to high 20s $^{0}$C) and low humidity are prime drivers of YSA outbreaks in spring and autumn in the rainfed regions. Under wetter and more humid conditions in summer, infestations may be suppressed by entomopathogenic fungi, but can still be significant during plant stress events. In the irrigated regions, infestations tend to be more intense during mid-summer.

If cane must be planted in late spring (October, November) or summer, then use a variety that suffers less thrips and YSA damage and/or pre-emptively protect the young crop over summer with a suitable systemic insecticide applied in the furrow. Insecticides applied in this way can be safer and less damaging to natural enemies than if applied later to the foliage.

# Nutrition

## *Nitrogen*

High pest infestations are linked to excessive nitrogen (N) levels. The FAS N recommendation is tailored to the soil N mineralisation potential of your soil type, and to the yield estimates that you provide.

It is therefore critically important that a realistic yield estimate be provided, considering historical yields and the medium-term rainfall forecast.

This would especially apply to field situations where:

- YSA and thrips are known to be serious recurring problems;
- soils are shallow and/or sandy;
- nematodes are a problem when a nematicide is not used;
- rainfall is low, or irrigation is restricted;
- salinity/sodicity or acidity problems exist; and
- there are soil compaction or stool damage problems caused by uncontrolled infield haulage especially under wet conditions.

N applications should be split when losses are likely, particularly on sandy soils or soils prone to waterlogging.

For example, heavy spring/early summer rains leach N beyond the root zone leading to accelerated soil acidification and a need to re-apply N. Split N reduces the resultant acidification and the amount of N that would need to be re-applied.

Splitting N application also affords an opportunity to reassess the yield target of a field based on short to medium term rainfall forecasts. In the case of the second half of summer being predicted to be drier than expected, less N should be added in the second application in line with a decreased yield target. This reduces pest infestation risk.

Similarly, if drought is initially predicted, split N can accommodate the possibility that the drought does not in fact materialise. An increased amount can be added in the second application. Again, pest infestation risk is reduced.

Increased N mineralisation in some soils due to tillage means that N fertilisation for plant cane may not be required or can be reduced, compared to subsequent ratoons.

## *Potassium and Phosphorous*

Plant nutritional imbalance is known to influence the population density of aphids and thrips in many crops. Plants well supplied or oversupplied with N, but with insufficient potassium, have soft tissue with reduced resistance to pests.

Deficiencies in potassium and phosphorous can be linked to early senescence of the lower leaves. The export of amino acids in the phloem of senescing leaves will be of benefit to YSA.

Ensure that potassium and phosphorous nutrition is not compromised, despite any reduction in N fertilisation.

## Scout
# Often

Effective control of YSA is only possible if done before the pest reaches peak population and when the cane is still young. When severe damage is visible, it is already too late. Scouting must begin before visible symptoms appear. Damage only becomes visible (as below) when infestations are or have been intense. The aphid may have already dispersed away from these patches. Scouting must begin before visible symptoms appear.

**Figure 9.** Aphid infestations tend to be patchy.

### *Edge scouting*

For YSA, begin by scouting grass verges and field edges throughout the farm. Open several sugarcane leaf spindles to locate any thrips. This method gives the earliest possible warning of infestations.

*Early warning field scouting*

Select at least two fields for regular scouting. These fields should include one that YSA has first infested in previous years ("early warning"), and another considered to be at risk, e.g. a susceptible variety between 2-7 months of age.

Scout within these fields at two-weekly intervals. Note that infestations are usually patchy and once a field is infested, aphids move to new patches and other fields. Movement probably depends on population density (overcrowding), predator build-up, and plant decline as a source of nutrition. Field edges tend to be infested first (see Figure 10.).

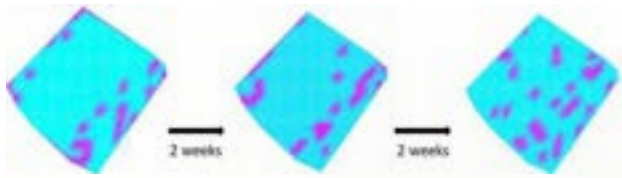



**Figure 10.** Sequential infestation 'heat maps' for a field infestation of YSA.

Whilst traversing the fields take note of any obvious aphid presence. Open several leaf spindles to detect thrips.

Once pest presence has been detected, it is important to determine whether the initial infestation may develop into one likely to cause excessive damage.

Factors, which may limit infestations from becoming damaging include varietal resistance, optimal plant nutrition, reduced plant stress, and time of year. Reduced pest population growth rate allows natural enemies to keep up in terms of their own population growth, further limiting infestation intensities.

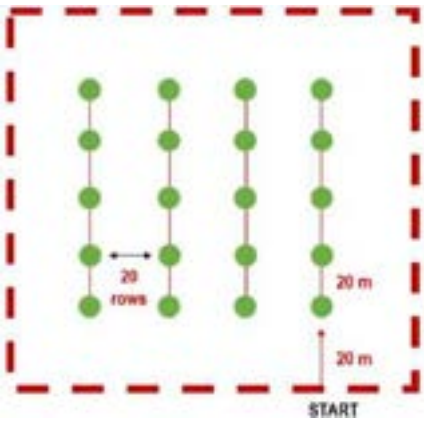
Initial YSA infestations occurring in the same areas of a field as in previous years suggests that soil properties may be a driver. Take top- and sub-soil samples from within the patch, and from outside of it. Submit to FAS for analysis. Soil remedial actions may be possible that reduce the risk of future infestations.

**Figure 11.** Example of in patch and outside patch sampling positions.

### *Determining whether remedial action is required.*

A scouting method for assessing the need for remedial action against YSA requires the determination of percent leaves infested at weekly intervals.

- Select several sampling blocks per field, depending on field size.
- Per scouting block, select at least 4 rows which are at least 20 metres apart.
- Select 5 sugarcane stools per row, again at least 20 m apart.
- Inspect 1 stalk per stool intensively (including the spindle for thrips if necessary).
- Inspect every mature leaf (fully open).
- At each sample block (20 plants) record the total number of leaves inspected and the number of leaves with aphids (at least 1 adult and a nymph).




Note the presence or absence of natural enemies on each leaf as this should influence control decisions.

Calculate the % of YSA infested leaves:

$$\frac{\text{Number infested leaves}}{\text{Total number leaves inspected}} \times 100$$

### *Some general rules can be applied to guide control decisions:*

- If **less than 15%** of leaves are infested, then **no control** is recommended especially if natural enemies are already present.
- If **greater than 30%** of leaves are infested, then **control** is recommended.
- If **between 15 and 30%** of leaves are infested, make a second evaluation 7 days later. Take note whether natural enemies are present.
  - If the infestation has **declined,** then **no control** is recommended.
  - If the infestation has **increased above 30%,** then **control** is recommended.
  - If the infestation has not changed then make an additional evaluation 7 days later.

## *Use of registered insecticides for*

# Thrips and YSA Control

| Registered product(s) | Active ingredient(s): IRAC code | Application | Registered for control of: | Notes |
|---|---|---|---|---|
| **Bandit SC &**<br><br>**Kohinor SC** | Imidacloprid: 4A | **Plant cane furrow only:** Single application only (September to November). Apply to the furrow in 200 to 300 litres water/ha, using a flat fan nozzle. | Thrips | If applied for thrips control, will also control YSA.<br><br>Likely to have a plant physiological stress alleviating effect. |
| **Actara SC** | Thiamethoxam: 4A | Apply once only, in 200 - 300 litres water / ha:<br><br>**Plant cane furrow**: Apply as a single in-furrow band application (30 to 50 cm wide), at planting, after placement of the seed cane, as the last operation before closing.<br><br>**Ratoon cane:** Apply between 7 and 30 days after harvesting. For bee safety, ensure that stubble is dry before applying the product. Apply as a broad band application over the cane rows. | YSA | If applied for YSA control will also control thrips.<br><br>Likely to have a plant physiological stress alleviating effect. |
| **Bandito GR** | Oxamyl & Imidacloprid: 1A+4A | **Plant cane furrow:** Apply granules with the use of a mechanical granular applicator only after the planting sets have been placed in the furrow. Cover setts and granules with soil.<br><br>**Ratoon cane soil:** Apply to moist soils in the rainy season. Band apply on the soil surface on both sides of, or over, the plant rows. | Thrips, YSA & nematodes | Likely to have a plant physiological stress alleviating effect. |
| **Apache SC** | Imidacloprid: 4A | **Plant cane furrow:** Apply a single application only from September to November. Apply directly into the furrow using 200 - 300 litres water/ha. Use a flat fan nozzle.<br><br>**Foliar application:** Apply in at least 250 ml water/ha as soon as the pest is noticed between October and November. Apply when at least 3 – 4 green leaves are present. Sugarcane planted earlier in the season (September) should receive 3 applications at 14-day intervals. October plantings need only 2 applications, also at 14-day intervals. Direct spray at the centre of the developing tillers using a flat fan nozzle. Good coverage is essential. | Thrips | If applied for thrips control, will also control YSA.<br><br>Likely to have a plant physiological stress alleviating effect. |
| **Vydate SL** | Oxamyl: 1A | **Foliar application:** Apply as an early corrective application at first signs of thrips infestation or mottling between the 2-leaf but not later than the 6-leaf stage (at maximum plant height of 0,5m) of the crop. Application timing is critical for the effective control of thrips. VYDATE applied before the 2-leaf and later than the 8-leaf stage of the crop is significantly less effective against thrips. A follow-up application may be required 21 – 28 days after the first application based on scouting of live thrips under conditions of continued thrip re-infestation. | Thrips & nematodes | If applied for thrips and/or nematode control, will also control YSA. |

**... Continued**

| | | | | |
|---|---|---|---|---|
| **Allice SP** | Acetamiprid: 4A | **Foliar ground application:** Apply in at least 250 litres water/ha as soon as pest is noticed. Use a flat fan nozzle and direct the spray to the centre of the developing tillers for thrips or the lower leaves for YSA.<br><br>**Aerial application (thrips only):** Apply in at least 30 litres water per ha. (Use Silhouette at 200 ml per ha.) | Thrips & YSA | Of the neonicotinoids, acetamiprid has higher activity against lepidoptera. If applied for thrips and/or YSA control, may also control eldana. |
| **Maintain SP** | Acetamiprid: 4A | **Foliar ground application:** Apply treatment when at least 6 to 8 green leaves are present. Apply in a minimum volume of 250 litres water per hectare as soon as pest is noticed.<br><br>The use of a twin flat fan type nozzle is recommended. Direct the spray to the centre of the developing tillers.<br><br>**Aerial application:** Apply in at least 30 litres water per hectare. The addition of a registered drift retardant adjuvant, to minimize spray drift to any area not under treatment, is strongly recommended. | Thrips | If applied for thrips control, will control YSA, and may also control eldana. |
| **Wonderland SP** | Acetamiprid: 4A | **Foliar ground application:** Apply in at least 250 litres water/ha as soon as pest is noticed. Use a flat fan nozzle and the spray must be directed to the lower leaves. | YSA | If applied for YSA control, will control thrips, and may also control eldana. |
| **Ampligo ESC** | l-cyhalothrin & Chlorantraniliprole: 3+28 | **Foliar ground application:** Apply at the first sign of infestation. For aphids, direct the spray towards the lower parts of the cane where the pest is present. The action for aphids is contact only. | YSA & eldana | l-cyhalothrin has a short-term knock-down effect on YSA. Chlorantraniliprole is not effective against YSA. |
| **Benevia OD** | Cyantraniliprole: 28 | **Foliar application:** Apply in at least 250 litres of water / hectare. Good coverage of all foliage is essential. Apply as soon as the pest is first noticed. For aphids, direct the spray towards the lower leaves of the cane where the pest is present. A second application should be made 7 days later. A maximum of 2 consecutive applications should be made to the crop. Further application(s) must be with an effective product with a different mode of action (non-Group 28 insecticide).<br><br>The use of Trend 90 or H & R Crop Oil as prescribed under DIRECTION FOR USE table can offer enhanced pest control when added to BENEVIA® 100 OD. | YSA & eldana | If applied for YSA and/ or eldana control, may also control thrips. |

ESC - Encapsulated Suspension Concentrate; GR – Granular; OD – Oil Dispersion; SC – Suspension Concentrate; SL – Soluble Liquid; SP – Soluble Powder.

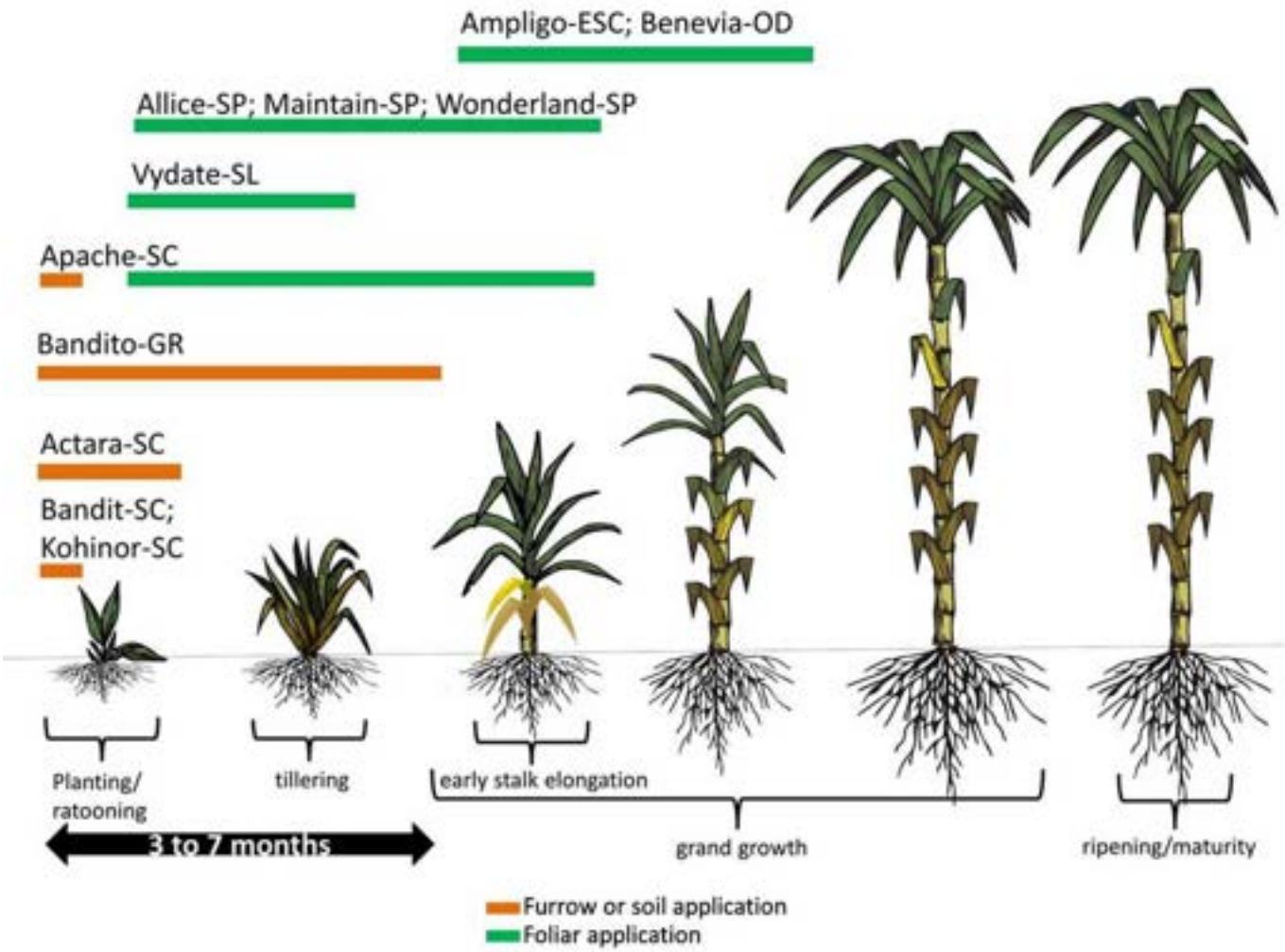



**Figure 12.** Suggested timing of use for registered products considering instructions given in their respective product labels.

### *Using insecticides while conserving natural enemies*

The active ingredients oxamyl, imidacloprid and thiamethoxam can be damaging to natural enemies.

Pre-emptive use of oxamyl, imidacloprid and thiamethoxam as soil/stubble-applied insecticides mitigates negative effects. They are taken up into the plant by the roots, move to the leaves but are not present on the leaf surfaces. In addition, natural enemies are not likely to be as abundant during early crop growth compared to later.

Acetamiprid and cyantraniliprole are less damaging, providing control while minimising negative effects on natural enemies that suppress pests.

### *Barrier treatments*

It is a current recommendation that the need for nematode control be assessed by applying a nematicide to strips in a field. Growth of the strip is monitored and compared to the rest of the field. If nematodes are a factor limiting growth, then a clear growth response will be observed in the treated strips within 8 to 12 weeks. The remainder of the field should then be treated without delay. This is most likely to be the case on sandy soils of 10% clay or less but can apply up to 20% clay.

Since registered nematicides are also insecticides (e.g. oxamyl – in BANDITO®) the strip application approach can be used as barrier treatments against pest invasion.

Thrips disperse by flying. YSA can also disperse by flying (winged adults develop when populations are high) but the aphid can move plant-to-plant by walking (along rows and, after canopy closure, between rows). Overwintering aphids, on grasses in verges, cane breaks and in natural areas, can move plant-to-plant towards and into sugarcane in spring.

Make sure that there is some bare soil separating grass verges and breaks from the sugarcane. Grasses should be kept short, and grass weed control in the cane is important.

Leave one row or one meter of sugarcane field edges untreated for YSA edge scouting. If this cane becomes infested, a registered foliar applied insecticide can be used.

Treat 10 rows or 12 meters to form barrier strips orientated towards areas likely to overwinter YSA.

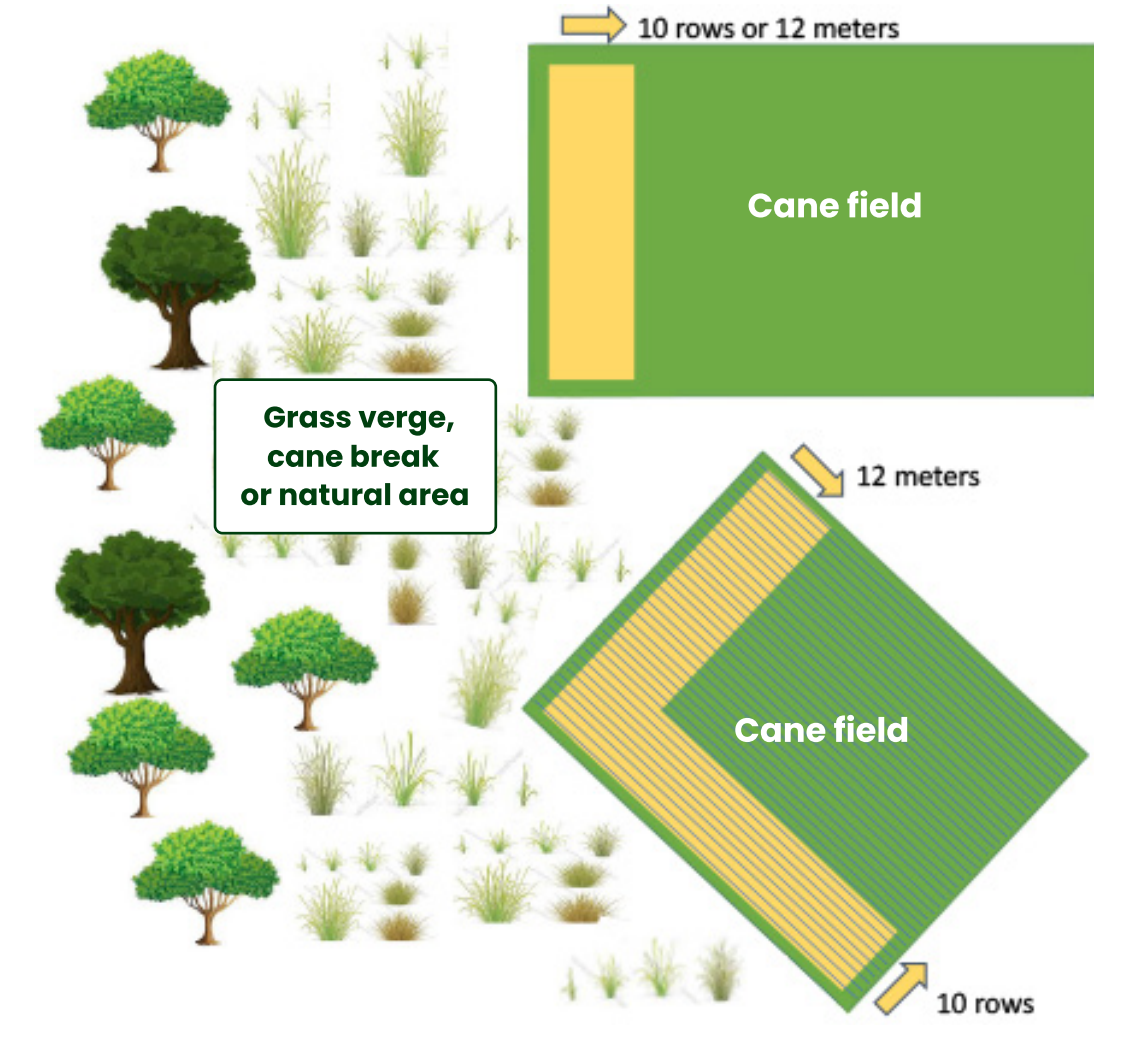



**Figure 13.** Illustration to show strip application of insecticide to act as barrier treatments against pest invasions.

## *The 'SLOW DOWN – SPEED UP'*

# Strategy for Pest Management

For effective control, some elements in the system need to be speeded up, and others slowed down.

Many natural enemies of pests need support from the environment in the form of pollen, nectar, resting places, or (alternate) prey availability. Manage a diversity of plantings on the farm to 'speed up' natural biocontrol.

Varieties with some pest resistance 'slow down' pest development while slower developing natural enemies catch up. Unstressed plants defend themselves better. Reduce plant stress by managing soil physical and biological health.

Plants with optimal nutrition 'slow down' pest development.

Pests are stressed when they feed on resistant plants and become more susceptible to insecticides than those that feed on susceptible plants.

Optimal use of insecticides will 'slow down' pest development while minimising negative effects on natural enemies that suppress pests.

These measures increase predator to prey ratios.

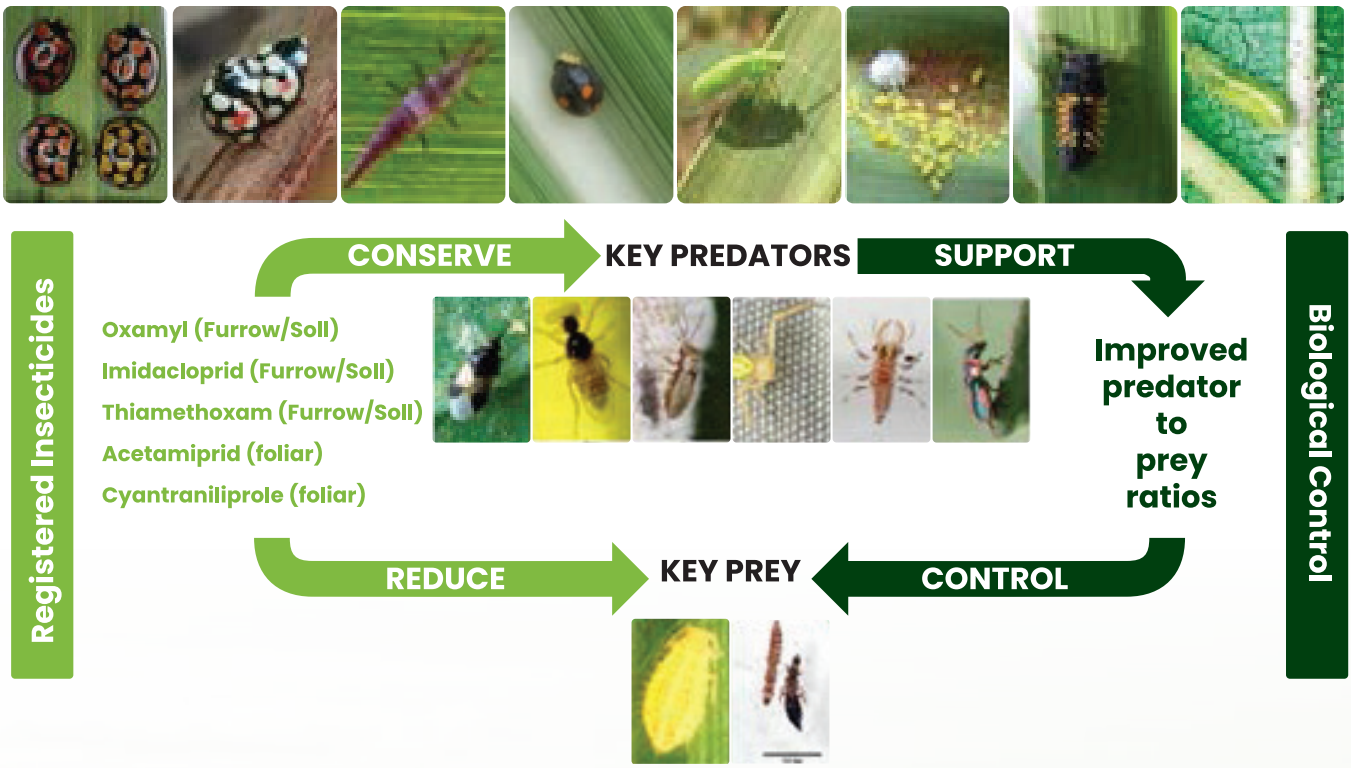



**Figure 14.** When used optimally, negative effects of insecticides on natural enemies can be minimised.

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