STARKLE®

Starkle contains 200 g/kg dinotefuran (MOA Group 4A)

Starkle® 200 SG is a Novel Insecticide for Control of Mirids, Silverleaf Whitefly (SLW) and Green Vegetable Bug (GVB) in Cotton

Mode of Action

The active ingredient in Starkle, dinotefuran, is a member of the nitroguanidine group of insecticides which is related to the neonicotinoid insecticides. Dinotefuran differs from most neonicotinoids in basic chemical structure and has unique properties not shared with other neonicotinoids.

Starkle is highly water soluble and therefore is quickly absorbed and translocated by plants. For optimum systemic activity, the plant must be actively transpiring and not stressed. Starkle kills target insects through both contact and ingestion. Following ingestion, there is rapid cessation of feeding, however insect death may take several days.

Application Rate

The application rate for mirids is 90–150 g/ha, for SLW is 250–375 g/ha and for GVB is 375 g/ha. Use the higher mirid rate when canopy closure may adversely affect spray coverage. Use a rate that matches the size of the crop, water volume applied, and weather conditions. Use the higher SLW rate when longer residual control is required or during periods of high pest pressure, rapid crop growth, or when crops are well advanced. Starkle will control both nymphs and adults of all pests on the label at the specified rates. When mirids are present with either SLW or GVB at or above industry spray thresholds, use the appropriate SLW or GVB rate respectively.

Application

Starkle moves acropetally (towards the growing points) in the plant from the point of deposition; adequate product deposition (i.e. >30 droplets/cm^2) must be achieved where the pest is located on the plant. This means thorough coverage of the crop is essential. **The minimum water application volumes on the label must be increased to achieve optimal coverage** depending on crop stage, canopy density, target pest location in the crop, and weather conditions. User experience shows efficacy under certain conditions (high temperatures and Delta T of 8–10) and/or denser crop structure, benefits from increasing application volumes. However, spray application should occur when application parameters are optimal, taking into account temperature, relative humidity, delta T and wind speed at the application site.

Aerial application: Apply in a minimum spray volume of 30 L/ha. Increase to 40 to 50 L/ha under suboptimal conditions. The product should be applied with medium (not coarse) spray droplets. Wind speed is important to distribute the spray throughout the crop; user experience suggests between 10 and 20 km/h optimises efficacy.

Ground application: Apply in a minimum spray volume of 80 L/ha.

Apply as a blanket spray or banded spray ensuring thorough coverage is achieved.

A strategy to minimise spray drift should be employed at all times when applying near sensitive areas. Such a strategy is illustrated by the cotton industry's Cotton Pest Management Guide (CPMG).

Mirid Population Assessment and Control Guidelines

It is critical to correctly measure mirid density in the field to establish application timing and monitor product performance. **The CPMG detailed guidelines should be followed.** Both insect counts and crop damage should be taken into account.

It is recommended to sample twice a week beginning at seedling emergence, continuing until the last effective boll is at least 20 days old (when the boll wall is considered hard enough to deter mirid feeding). Once the crop reaches 9–10 node stage, visual assessment will not give an accurate estimate of mirid abundance and either beat sheet or sweep net methods should be used (CPMG). Assessing pest density through crop scouting is difficult due to target pest mobility, patchy distribution of the pest through the crop, and variable pest activity through the day. This is especially so when populations are at low levels. Under these circumstances, increase the number of beat sheet samples to get accurate population estimates.

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The CPMG advises that 8 to 10 beat sheet samples or at least 6 sweep net samples per 50 ha are required to get a reliable, numerical estimate of mirid numbers. **Using a significantly lower number of beat sheet samples per field (i.e. ~1–2 per 50 ha field) will only provide data indicating "presence or absence" of mirids in the crop.** Pre- and post-spray counts based on a low sampling regime provides unreliable numerical population density information, particularly when populations are initially low.

Conduct insect counts immediately prior to an insecticide application so that the impact of the application on the pest can be measured; pest populations can change in a short period of time, particularly with mobile pests such as mirids.

Knowledge of the mirid population composition (nymphal instar size, adults etc.) in the pre- and post-treatment population assessments is important in understanding the effectiveness of mirid sprays. This information is paramount to determine if there is either insect survival or recruitment from eggs that were not affected by an insecticide treatment, or an influx of adults from outside sources. **Starkle controls nymphs and adults; eggs are not controlled.**

The mirid's lifecycle consists of an egg stage, 5 nymphal stages and the adult stage. Temperature is an important determinant of how quickly green mirids develop – the optimal temperature for development is 30–32°C. At 30°C, green mirids take 9–11 days to develop from first instar to the adult stage. In summer, a generation (egg to adult) can take around 3 weeks to complete and adults can live for 3–4 weeks; females can lay up to 80 eggs (McColl *et al*., 2011). When the weather is cloudy and temperatures are around 32°C for several days, green mirid populations can increase dramatically and very quickly. Temperatures of very hot weather can reduce mirid populations.

The rate of mirid feeding varies with temperature, with maximum feeding occurring between 27°C and 32°C.

The mean development time for green mirid life stages is shown below:

LIFE STAGE	MEAN DEVELOPMENT TIME (DAYS)
Egg	4.9
1st instar	1.6
2nd instar	2.1
3rd instar	1.7
4th instar	2.0
5th instar	3.3
Egg – adult	15.6

(Source: Khan & Quade, 2008)

Damage and spray thresholds are based on both mirid numbers and plant damage (fruit retention/boll damage). When applying thresholds and assessing product efficacy, always consider both the crop damage component and mirid numbers.

SLW Population Assessment and Control Guidelines

After egg hatch, SLW pass through 4 nymphal stages and then, after pupating, develop to the adult stage. Adult female SLW can lay up to 300 eggs over their 2-week lifetime. Adults and nymphs feed on plant sap and deposit a damaging honeydew on the plant. SLW can multiply rapidly under hot seasonal conditions. During the cotton season the SLW lifecycle takes around 18–28 days.

Frequent monitoring of SLW populations is the key to achieving effective control: sampling should commence at flowering and be done twice-weekly from peak flowering (1300 day degrees). Follow the CPMG for detailed pest monitoring and use recommendations in the CPMG SLW Matrix.

For optimum spray results with Starkle on SLW, adhere to the following guidelines:

1. Frequently monitor SLW early in its lifecycle; **do not delay spraying when (low) SLW density numbers are increasing over a short monitoring period.**
2. Ensure adequate product deposition **(i.e. >30 droplets/cm²) where SLW is located on the plant.** This means thorough coverage of the crop is essential. Inadequate spray coverage may result in reduced SLW control, especially in the lower crop canopy and against established populations.
3. Use on established SLW populations after canopy closure may result in variable control.
4. Use the higher rate when longer residual control is required or during periods of high SLW pressure or rapid crop growth or when crops are well advanced. For ongoing residual activity, SLW must be feeding.
5. When both mirids and SLW are present and SLW is at or above industry spray thresholds, use the appropriate SLW rate.

GVB Population Assessment and Control Guidelines

Nymphs and adults cause dull to black shiny spots on the boll walls, warty growth inside the carpels and brown staining of lint in developing bolls. GVB damage varies with boll age, small bolls suffering more damage than old bolls; bolls aged up to 7 days

are usually shed. GVBs are most visible early to mid morning; sample bugs and fruit retention at least weekly from start of squaring, more often when close to threshold. Cotton is most susceptible to damage from flowering through until one open boll/m. When spraying Starkle ensure thorough coverage of the target. Starkle has a moderate impact on beneficials. For detailed guidelines follow the CPMG.

Starkle and Impact on Beneficial Species

Starkle has been tested over a number of years under Australian conditions and results are reported in the CPMG.

Beneficial species are a complex and important presence in the field and impact on mirid, SLW, GVB and other pest populations, as well as on various insecticide control options.

Starkle

- Does not flare SLW, GVB, heliothis or aphids when applied at the mirid rates
- Has a very low effect on lacewings
- Has a very low effect on banded ladybeetles
- Has a low effect on spiders
- Has a moderate effect on predatory beetles, predatory bugs, total wasps and thrips
- Has unknown effect on *Eretmocerus hayati* under field conditions but is toxic under laboratory conditions. Since the launch of Starkle into cotton for mirid control, there have been no reports from the field of Starkle reducing the population of *Eretmocerus*.
- For details, review the document "Starkle – effect on beneficials" on the AgNova website

Bee Safety

Spray residues remain toxic to bees for 2–3 days after application.

To protect long term viability of beehives, remove or cover beehives during application and for 5 days after treatment. Follow CropLife guidelines under their BeeConnected program.

Resistance Management

DO NOT use more than 2 applications per crop.

DO NOT re-apply within 14 days of a previous dinotefuran (Starkle) application.

DO NOT use the mirid rates when SLW is at or above threshold in the crop. Use in accordance with current CropLife Insecticide Resistance Management Strategies.

Refer to the SLW MATRIX as published in the CPMG.

Withholding Period

Harvest:

DO NOT harvest for 14 days after application.

Grazing:

DO NOT graze treated cotton crops or cut for stockfeed.
DO NOT feed cotton trash to livestock.

Mixing, Surfactants and Droplet Size

Partially fill the spray tank with clean water and add the required quantity of product to the water surface. Allow the product to submerge before agitating. Top up the tank with clean water to the required volume. Surfactants are not required for use with Starkle but may be used if required with a tank-mix partner. Use only medium spray droplets according to specifications of the nozzle manufacturer that refer to the ASAE S572 Standard or BCPC guideline. When using Starkle in a tank mix, use medium droplet size to optimise Starkle efficacy.

Compatibility

A range of tank-mix partners has been tested for compatibility (physical and bio-efficacy) with Starkle.

These include: Abamectin, Altacor* (+BS1000), Affirm* (+BS1000), Dimethoate, Steward*, Pix* and Round-up Ready* Glyphosate.

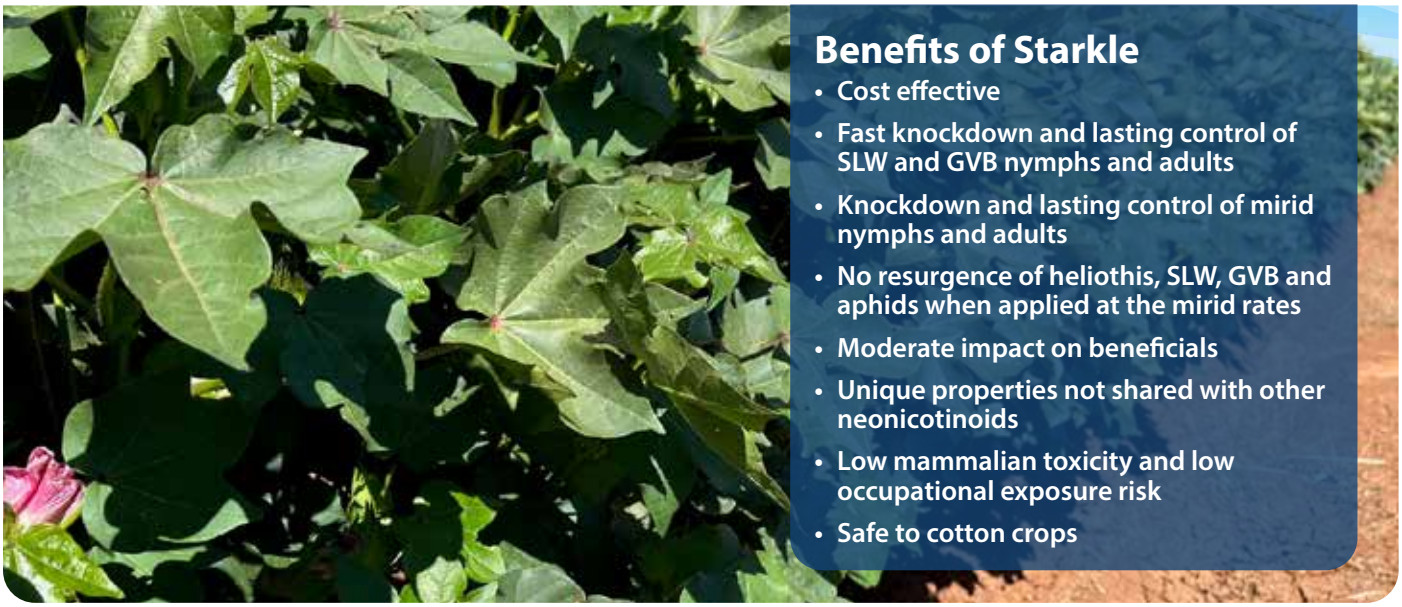
As formulations differ between brands, growers should conduct their own small scale compatibility test prior to mixing commercial quantities.

Tank-mixes should be prepared and sprayed out as soon as possible. Do not leave tank-mixed chemicals overnight.

Mirid

Silverleaf Whitefly

STARKLE®



Benefits of Starkle

- Cost effective
- Fast knockdown and lasting control of SLW and GVB nymphs and adults
- Knockdown and lasting control of mirid nymphs and adults
- No resurgence of heliothis, SLW, GVB and aphids when applied at the mirid rates
- Moderate impact on beneficials
- Unique properties not shared with other neonicotinoids
- Low mammalian toxicity and low occupational exposure risk
- Safe to cotton crops

Directions for Use Table

The following is an extract of the product label and does not constitute the complete directions for use.
The product label should be read thoroughly before opening the packaging.

CROP	PEST	RATE	CRITICAL COMMENTS
Cotton	Green mirid (*Creontiades dilutus*)	90 to 150 g/ha	Monitor crops following industry best practice guidelines and commence applications once local thresholds are reached. Use appropriate rate for the insect pest being targeted for control. Ensure thorough spray coverage of the crop. Inadequate spray coverage may result in reduced pest control, especially in the lower crop canopy and against established populations. Insect death may take several days following ingestion. Pest control should be assessed initially by a reduction in pest activity. Performance can be reduced in stressed crops (e.g. drought affected dryland cotton), or when senescing late season or when pests are not actively feeding in the upper crop canopy. Continue to monitor crops following industry best practice guidelines and make a subsequent application as necessary. Use in accordance with the current Insecticide Resistance Management Strategies. **Green mirid:** Use higher rates when canopy closure may adversely affect spray coverage. Use a rate that matches the size of the crop, water volume applied, and weather conditions. Follow advice of your crop consultant when selecting a rate. Best control of green mirids will be achieved when application is made while green mirids are feeding in the upper canopy. **Silverleaf whitefly:** Use the higher rate when longer residual control is required or during periods of high pest pressure or rapid crop growth or when crops are well advanced. Using STARKLE on established silverleaf whitefly populations after canopy closure may result in variable insect control, especially in the lower canopy. When both mirids and silverleaf whitefly are present and silverleaf whitefly is at or above industry spray thresholds, use the appropriate silverleaf whitefly rate.
	Silverleaf whitefly (*Bemisia tabaci*)	250 to 375 g/ha	
	Green vegetable bug (*Nezara viridula*)	375 g/ha	

Khan M and Quade A (2008) Pictorial identification of mirids life cycle. Cotton Catchment Communities CRC, Narrabri, NSW, Australia. [http://www.insidecotton.com/jspui/bitstream/1/155/2/Mirid_Biology_and_Identification1Moazzem_3.pdf]

McColl SA, Khan M and Umina PA (2011) Review of the biology and control of *Creontiades dilutus* (Stål) (Hemiptera: Miridae). *Australian Journal of Entomology* **50**, 107–117.

The information provided herein may include extracts from the product label and does not constitute the complete directions for use.
READ THE PRODUCT LABEL THOROUGHLY BEFORE OPENING OR USING STARKLE

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