

Silverleaf whitefly resistance surveillance

2024

Management of silverleaf whitefly (SLW; *Bemisia tabaci*), an important late season pest of cotton, often requires an application of insecticide. Unfortunately, SLW has a history of developing resistance to insecticides, so each year populations of this pest are collected from most cotton-growing regions and tested against products commonly used in cotton (see Table 1). This year, 23 field populations were collected in QLD and NSW and tested for resistance to pyriproxyfen, spirotetramat, buprofezin, acetamiprid and diafenthiuron. Lower priority insecticides including bifenthrin, dinotefuran and emamectin were tested against one population from each region only.

Key points:

- Resistance to pyriproxyfen is still present in many regions, but at a low level compared to previous years. As a result, the requirement for a 30-day window for pyriproxyfen application has been withdrawn from the IRMS.
- Very high resistance to spirotetramat was detected in the Lockyer valley; resistance was detected elsewhere but at low levels.
- Widespread but generally low-level resistance to bifenthrin was detected in all populations.
- In a small number of populations there was reduced sensitivity to buprofezin, dinotefuran and emamectin but further testing indicated this was not due to resistance.
- No resistance was detected to acetamiprid or diafenthiuron.

Table 1. Summary of insecticide resistance in silverleaf whitefly collected from cotton in 2024.

	Pyriproxyfen	Spirotetramat	Buprofezin	Acetamiprid	Diafenthiuron	Bifenthrin	Dinotefuran	Emamectin
Emerald	*	*	*	*	*	*	*	*
Theodore	**	**	**	**	**	*	*	*
Lockyer Valley	**	**	**	**	**	*	*	*
St George	***	**	***	***	***	*	*	*
Mungindi	**	**	**	**	**	*	*	*
Goondiwindi	**	**	***	***	***	*	*	***
Moree	**	**	***	***	***	*	*	*
Namoi Valley	**	**	**	**	**	*	*	*
Narromine	**	**	**	**	**	*	*	*
Griffith	**	**	**	**	**	*	*	*
Hillston	*	*	*	*	*	*	*	*

Each asterisk represents a population; colour denotes resistance: none (*), low (**), moderate (***) or high (****)

How we evaluate if a population is resistant?

Two responses are evaluated:

1. **survival of a population at the discriminating dose** (DD; a concentration of insecticide in a laboratory bioassay that kills 100% of susceptible insects).
2. **the concentration of insecticide required to kill 50% of the tested population** (LC₅₀).

Where there is survival at the DD, there is reasonable confidence that the population tested contains resistant individuals.

Populations with resistance have been highlighted in orange in the individual insecticide results.

Reduced sensitivity in field populations can be measured by dividing the LC₅₀ of the field population by the LC₅₀ of a known susceptible population to give the resistance ratio (RR). The 'known susceptible' population used for SLW resistance testing has been kept in a laboratory without contact with insecticides since the mid-1990s.

A ratio of 1 means there is no difference between the known susceptible population and the field population. A ratio of 10 means that the concentration required to kill 50% of population was 10 times the concentration to kill the known susceptible.

Interpreting RRs can be difficult, especially when bioassays responses are highly variable and when ratios are low. Generally, the following system is used:

- susceptible (RR=1)
- tolerance to low resistance (RR=2-10)
- moderate resistance (RR=11-30)
- high resistance (RR= 31-100)
- very high resistance (RR>100).

Surveillance results for individual actives

Pyriproxyfen

Low level resistance (RR 5.8–11) was detected in six populations (Table 2). While resistance was more widespread (detected in more regions) this year, the actual resistance within each population was often lower than in previous years (Figure 1). Populations Moree 1 and Hillston had low LC₅₀ values but had survivors (0.4 and 0.8%) at the discriminating dose and were therefore still considered resistant.

Table 2. Toxicity of pyriproxyfen to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at DD (10 mg/L)	RR
Emerald	0.086	0	4.6
Theodore (1)	0.073	0	3.9
Theodore (2)	0.082	0	4.4
Lockyer Valley (1)	0.058	0	3.1
Lockyer Valley (2)	0.048	0	2.6
St George (1)	0.270	0	14.5
St George (2)	0.216	0	11.6
St George (3)	0.194	0	10.4
Mungindi (1)	0.116	0	6.2
Mungindi (2)	0.150	0.6	8.1
Goondiwindi (1)	0.205	0.8	11.0
Goondiwindi (2)	0.128	0	6.9
Goondiwindi (3)	0.133	0	7.1
Moree (1)	0.108	0.4	5.8
Moree (2)	0.344	0	18.5
Moree (3)	0.172	0.4	9.2
Namoi Valley (2)*	0.280	0	15.1
Namoi Valley (3)	0.144	1.2	7.8
Narromine (1)	0.176	0	9.5
Narromine (2)	0.115	0	6.2
Griffith (1)	0.187	0	10.1
Griffith (2)	0.162	0	8.7
Hillston	0.128	0.8	6.9

*Namoi Valley (1) failed to establish so no bioassay testing could be completed.

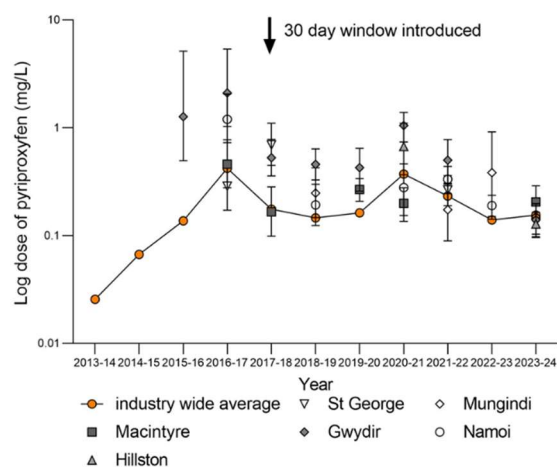


Figure 1. Susceptibility of *B. tabaci* collected from cotton to pyriproxyfen. The lethal concentration of pyriproxyfen to result in 50% mortality (LC₅₀) of each region with resistance is shown as a symbol with errors bars (95% fiducial limits), while the industry wide average LC₅₀ is presented as a line graph. Significant deviation above the line indicates moderate to high resistance.

Spirotetramat

Resistance was detected in 13 populations (Table 3). Very high resistance was detected in two Lockyer Valley populations, with high survival (>75%) at the discriminating dose. Resistance in other regions was low, with survival at the discriminating dose between 0.7 and 5.5%. The last few seasons have seen a steady increase in the spread of resistance across regions and in 2024 there was a slight increase in resistance within populations compared to the previous season.

Table 3. Toxicity of spirotetramat to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at DD (100 mg/L)	RR
Emerald	4.3	2.2	1.1
Theodore (1)	4.1	0.7	1.0
Theodore (2)	5.0	0.7	1.2
Lockyer Valley (1)	>100*	88.7	>24
Lockyer Valley (2)	>100*	76.4	>24
St George (1)	8.7	2.4	2.1
St George (2)	8.5	5.5	2.1
St George (3)	11.1	0	2.7
Mungindi (1)	4.1	0	1.0
Mungindi (2)	4.4	2.8	1.1
Goondiwindi (1)	3.3	1.8	0.8
Goondiwindi (2)	3.7	2.5	0.9
Goondiwindi (3)	3.5	1.7	0.9
Moree (1)	5.0	3.4	1.2
Moree (2)	2.7	0	0.7
Moree (3)	9.2	0	2.3
Namoi Valley (2)	5.0	0	1.2
Namoi Valley (3)	5.6	0	1.4
Narromine (1)	2.7	0	0.7
Narromine (2)	2.5	0	0.6
Griffith (1)	1.8	0	0.4
Griffith (2)	3.9	0.8	0.9
Hillston	4.3	0	1.0

Bifenthrin

All 11 populations tested had resistance to bifenthrin. The Lockyer Valley had a moderate level of resistance with 18% survival at the discriminating dose, while elsewhere resistance is still low (Table 4).

Table 4. Toxicity of bifenthrin to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at DD (320 mg/L)	RR
Emerald	8.64	5.67	2.9
Theodore	8.45	2.55	2.8
Lockyer Valley	84.46	18.39	28.3
St George	5.95	3.57	2.0
Mungindi	6.29	2.22	2.1
Goondiwindi	7.64	10.46	2.6
Moree	12.32	6.74	4.1
Namoi Valley	48.13	7.14	16.1
Narromine	13.22	6.25	4.4
Emerald	8.64	5.67	2.9
Theodore	8.45	2.55	2.8



Collecting whitefly populations for resistance testing.

Acetamiprid

Bioassay results detected 2 populations with survival at 300 mg/L (Table 5). Like last year (which had 3 populations with low level survival), selection pressure in the glasshouse did not convert either of the populations into a resistant strain, suggesting there is no resistance to acetamiprid at this time.

Table 5. Toxicity of acetamiprid to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at 300 mg/L	RR
Emerald	16.03	0	4.0
Theodore (1)	16.77	0	4.2
Theodore (2)	8.32	0	2.1
Lockyer Valley (1)	19.85	0	4.9
Lockyer Valley (2)	21.33	1.2	5.3
St George (1)	17.94	0	4.5
St George (2)	14.18	0	3.5
St George (3)	23.63	0	5.9
Mungindi (1)	25.42	0	6.3
Mungindi (2)	31.24	0	7.8
Goondiwindi (1)	12.75	0	3.2
Goondiwindi (2)	12.73	0	3.2
Goondiwindi (3)	14.98	0	3.7
Moree (1)	17.08	0	4.3
Moree (2)	5.26	0	1.3
Moree (3)	19.96	0	5.0
Namoi Valley (2)	8.75	0	2.2
Namoi Valley (3)	21.66	1.2	5.4
Narromine (1)	15.24	0	3.8
Narromine (2)	6.5	0	1.6
Griffith (1)	5.05	0	1.3
Griffith (2)	16.9	0	4.2
Hillston	14.31	0	3.6

Diafenthiuron

No resistance has been detected in 2024 (Table 6) or in previous years. All populations had 100% mortality at 30 mg/L and in all cases resistance ratios were very low at <2.

Table 6. Toxicity of diafenthiuron to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at DD (30 mg/L)	RR
Emerald	2.352	0	0.7
Theodore (1)	1.582	0	0.5
Theodore (2)	1.472	0	0.4
Lockyer Valley (1)	3.547	0	1.1
Lockyer Valley (2)	3.322	0	1.0
St George (1)	1.627	0	0.5
St George (2)	1.973	0	0.6
St George (3)	3.102	0	0.9
Mungindi (1)	2.458	0	0.7
Mungindi (2)	2.415	0	0.7
Goondiwindi (1)	3.162	0	1.0
Goondiwindi (2)	2.484	0	0.7
Goondiwindi (3)	2.826	0	0.9
Moree (1)	2.817	0	0.8
Moree (2)	2.487	0	0.7
Moree (3)	2.936	0	0.9
Namoi Valley (2)	1.891	0	0.6
Namoi Valley (3)	3.658	0	1.1
Narromine (1)	2.728	0	0.8
Narromine (2)	2.902	0	0.9
Griffith (1)	1.843	0	0.6
Griffith (2)	3.985	0	1.2
Hillston	3.316	0	1.0

Buprofezin

Only the second Lockyer Valley population had survivors (0.8%) at the discriminating dose (Table 7). Additional laboratory and glasshouse experimentation indicate that the initial result was a false positive as no further resistance was detected.

Table 7. Toxicity of buprofezin to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at DD (200 mg/L)	RR
Emerald	1.52	0	1.5
Theodore (1)	1.68	0	1.7
Theodore (2)	1.83	0	1.8
Lockyer Valley (1)	2.74	0	2.8
Lockyer Valley (2)	6.04	0.8	6.1
St George (1)	1.73	0	1.7
St George (2)	2.16	0	2.2
St George (3)	3.45	0	3.5
Mungindi (1)	4.53	0	4.6
Mungindi (2)	5.82	0	5.9
Goondiwindi (1)	0.91	0	0.9
Goondiwindi (2)	0.95	0	1.0
Goondiwindi (3)	0.74	0	0.7
Moree (1)	2.88	0	2.9
Moree (2)	2.15	0	1.5
Moree (3)	1.46	0	1.5
Namoi Valley (2)	2.33	0	2.3
Namoi Valley (3)	1.51	0	1.5
Narromine (1)	1.89	0	1.9
Narromine (2)	1.47	0	1.5
Griffith (1)	0.80	0	0.8
Griffith (2)	1.81	0	1.8
Hillston	1.11	0	1.1

Dinotefuran

Eleven populations were tested. Populations from St George and Namoi valley had low level survival in the bioassay (Table 8). Further glasshouse and laboratory testing could not confirm resistance in either population.

Table 8. Toxicity of dinotefuran to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at 320 mg/L	RR
Emerald	8.88	0	0.7
Theodore	22.42	0	1.8
Lockyer Valley	14.00	0	1.1
St George	29.09	2.5	2.4
Mungindi	14.75	0	1.2
Goondiwindi	16.97	0	1.4
Moree	8.10	0	0.7
Namoi Valley	28.11	1.3	2.3
Narromine	7.95	0	0.6
Griffith	8.27	0	0.7
Hillston	13.09	0	1.1

Emamectin benzoate

Thirteen populations were tested and four have survived 10 mg/L and subsequent glasshouse selection at 30 mg/L (Table 9). However further testing of the selected populations, including laboratory analysis, found no conclusive evidence of resistance. Note, we are still developing a discriminating dose for emamectin benzoate.

Table 9. Toxicity of emamectin benzoate to SLW, 2024.

Population	LC ₅₀ (mg/L)	Survival (%) at 10 mg/L	RR
Emerald	0.74	0	0.82
Theodore	0.85	0	0.72
Lockyer Valley	0.71	0	0.78
St George	1.67	0	1.9
Mungindi	2.14	2.56	2.4
Goondiwindi (1)	3.60	6.67	4.0
Goondiwindi (2)	3.01	5.81	3.3
Goondiwindi (3)	3.40	5.49	3.8
Moree	1.48	0	1.6
Namoi Valley	1.06	0	1.2
Narromine	1.47	0	1.6
Griffith	0.90	0	1.0
Hillston	1.566	0	1.0