

Effect of thrips on growth, maturity and yield of cotton - Preliminary results

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Thrips are important pests in Australian cotton and are also key predators of spider mites. Despite their pest status thrips have received little attention, with little known of their species composition, ecology, or their effect on cotton maturity or yield. The aim of the experiments described below is to investigate the effect of early season thrips infestations on the development, maturity and yield of cotton in order (1) to derive thresholds for thrips control, (2) to develop appropriate sampling recommendations and (3) to obtain information to enable the effect of thrips to be linked with the Ozcot and Cercot cotton crop models.

Methods

In each experiment the development of cotton treated with Temik 15G was compared with that of untreated cotton. Temik controls thrips for about 4-6 weeks after seedling emergence. The trial area was unsprayed for the first 6 weeks after which it was managed commercially (similar to the rest of the field). *Helicoverpa* were controlled where necessary with ground applications of Dipel. Nine experiments in total have been done on commercial cotton farms in the 1991-92 and 1992-93 seasons. Data is not available for all sites due to hail at one site in 1991-92, and unforeseen water shortage and crop failure at two sites in 1992-93.

Trial Design - Each experiment consisted of four plots of untreated cotton alternating with four plots of cotton treated with Temik 15G, applied at planting at the rate of 3kg/ha. At one site, Redmill, an additional treatment, Semevin seed treatment, was added to the experiment. Each plot was 8 or 12 rows wide, depending on the equipment used at each farm, by the row length of the field. The cotton seed was Siokra 1-4, treated with fungicides (Terrachlor and Apron) only, with the exception of the Semevin treated seed used in one treatment at Redmill.

Insect Counts - Sampling began within a week of seedling emergence and continued for 6 or 7 weeks. Whole plants were collected and taken to the laboratory where the thrips and other

insects and mites were 'washed' off them using a plant washer which provides an extremely accurate estimate of insect numbers.

Plant Development - The effects of thrips on plant development was assessed by recording plant height (above the cotyledons), dry weight, number of nodes produced and by scoring terminal damage of the plants after the insects had been washed from them. The effect of thrips on the initiation of fruiting was assessed by weekly fruit counts for the first 5 weeks of squaring.

Tip damage - Damage to the terminals of plants was scored after insects had been washed from them for 1992-93 experiments. Terminals were divided into two components (i) the small (>4mm) terminal leaves enclosing the growing tip and (ii) the minute growing tip itself. Both the terminal leaves and the growing tip were scored as undamaged, damaged by thrips (darkened margins), destroyed by thrips (blackened and dead), or damaged by other pests (usually indicated by more massive damage in the case of *Heliothis*).

Plant stand, Yield and Maturity - The middle 2 or 4 rows of each plot were picked using either a 2 or 4 row machine picker respectively. Previous research using manual tip damage at Narrabri Agricultural Research Station by Ken Brook and Brian Hearn has indicated that early season (pre-squaring) tip damage rarely affects yield but can significantly delay maturity. Therefore weekly maturity picks were done at two sites in 1991-92 and 3 sites in 1992-93 to determine if thrips had caused any delay in maturity. Estimates of plant stand were obtained when doing fruit counts.

Results

Insect counts - Thrips populations were generally higher in 1991-92 with populations peaking at up to 50 thrips/plant (Fig. 1). In contrast, populations were lower in 1992-93 with peak populations of less than 10 thrips/plant. Temik provided effective control of thrips at all locations except at Oakville in 1991-92. In this case the crop was planted dry and watered up,

perhaps moving Temik away from the root zone. The Semevin seed treatment provided control intermediate between the Temik treated and untreated cotton for about 4 weeks (Fig.1).

Effect of thrips on plant stand, fruiting, yield and maturity of cotton - Data for the two seasons are shown in Table 1. Overall, plant stand was not affected by thrips. The number of days from planting to the production of squares was slightly less (2-3 days) in the Temik treated plots at 5 of the 8 sites for which data were available, indicating that damage from thrips slightly delayed the start of fruit production. Neither yield nor maturity were affected by thrips (Table 1). This indicates that the abundance of thrips experienced at these locations were of marginal economic importance.

Tip damage - The difference in the number of thrips between the Temik treated and untreated plots on each date was regressed against the proportion of growing tips or terminal leaves damaged or destroyed. A significant relationship was found between thrips numbers and the % of terminal leaves damaged or destroyed (combined) (Fig. 2). This is probably because damage to terminals is 'instantaneous' and therefore reflects the recent abundance of thrips. In contrast, no relationship was found between thrips abundance and damage or destruction of the growing tip, possibly indicating the levels of thrips encountered were too low to have any effect (Fig. 2). This indicates that most of the damage caused by these low levels of thrips was cosmetic, only affecting the appearance of leaves, and that there was little tip destruction.

Correlations between thrips numbers and plant growth and development - To allow for the problem of accounting for duration and intensity of damage the cumulative 'thrips-days' for the period of 7 weeks after planting was calculated, where one 'thrips-day' is the feeding of 1 thrips for one day. Analyses were done to test if differences in the cumulative number of 'thrips-days' for this 7 week period between Temik treated and untreated plots could account for differences between these treatments in plant growth (number of nodes plants produced, plant height and dry weight), date of first square or yield at the end of the 7 weeks (Fig. 3). The cumulative thrips days showed a reasonable correlation with the differences in plant height and dry weight (Fig. 3). Poor correlations were found between cumulative 'thrips-days'

and node production, time to first square or yield between treatments. These results confirm those reported in Table 1, and indicate that although thrips clearly affected plant growth (dry weight and time to first square) this did not translate into yield loss.

Discussion

The data available to date indicate;

1. Thrips abundance can be correlated with plant growth parameters, especially plant dry weight and plant height. This suggests that it should be possible to link thrips with the crop models possibly via their effect on dry matter accumulation. In more recent work we have measured other parameters in more detail, including tip damage, leaf area, and partitioning of dry matter to various plant parts, as these factors may assist in modelling thrips damage.
2. Temik has provided an effective means of managing thrips in these experiments. Future experiments will all include a seed treatment as well, this has the added benefit of providing thrips levels intermediate between Temik and the check, and increasing our knowledge of the efficacy and value of seed treatments.
3. The yield response of cotton to thrips damage appears to be very flat, that is, high thrips densities are likely to be needed to significantly reduce yield. The dataset is limited at present because we only have data only in the mid to low range of commercially experienced thrips densities, where peak levels may be in excess of 70 thrips per plant. Data from the high end of the range is needed in order to have more confidence in our understanding of the effect of thrips on yield.

Clearly more research needs to be done - it is hoped to continue these experiments for two more seasons, then to put all the data together to derive sampling and threshold recommendations.

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Table 1. Yield, date of maturity, time to production of squares and plant stand of cotton (Siokra 1-4) either untreated, treated with Semevin or treated with aldicarb (Temik 15G) at 3kg/ha at planting. For each location means with different letters are significantly different at $p < 0.05$, ns indicates not significantly different.

Site	Treatment	Yield (b/ha)	Maturity (60% bolls open)	1st Squares (days from planting)	Plant stand (plants/m)
1991-92					
Abbey Green† (3 replicates)	Untreated	7.70 ns	-	57.5 ns	17.9 ns
	Temik	8.05 ns	-	58.1 ns	15.9 ns
Norwood†† (4 replicates)	Untreated	7.88 a	-	54.2 a	10.9 ns
	Temik	8.63 b	-	50.5 b	10.2 ns
Oakville (4 replicates)	Untreated	9.08 ns	-	60.2 ns	11.8 ns
	Temik	9.15 ns	-	59.8 ns	11.9 ns
Redmill (4 replicates)	Untreated	7.62 ns	11 March ns	51.9 a	9.8 a
	Temik	7.70 ns	8 March ns	47.4 b	8.0 b
Waverley (4 replicates)	Untreated	9.05 ns	17 March ns	52.5 a	11.6 ns
	Temik	9.42 ns	16 March ns	49.9 b	13.3 ns
1992-93					
Norwood (4 replicates)	Untreated	8.30 ns	9 March ns	56.5 a	9.4 a
	Temik	8.53 ns	9 March ns	54.1 b	8.2 b
Oakville (4 replicates)	Untreated	7.98 ns	29 March ns	66.1 ns	11.5 ns
	Temik	8.08 ns	23 March ns	66.8 ns	11.4 ns
Redmill††† (4 replicates)	Untreated	-	-	58.8 a	6.7 ab
	Temik	-	-	55.7 b	6.2 a
	Semevin	-	-	58.1 a	7.5 b

† Slight hail in early Jan.

†† Severely hail damaged on 30.12.91.

††† Yield and maturity data unavailable due to water stress of crop.

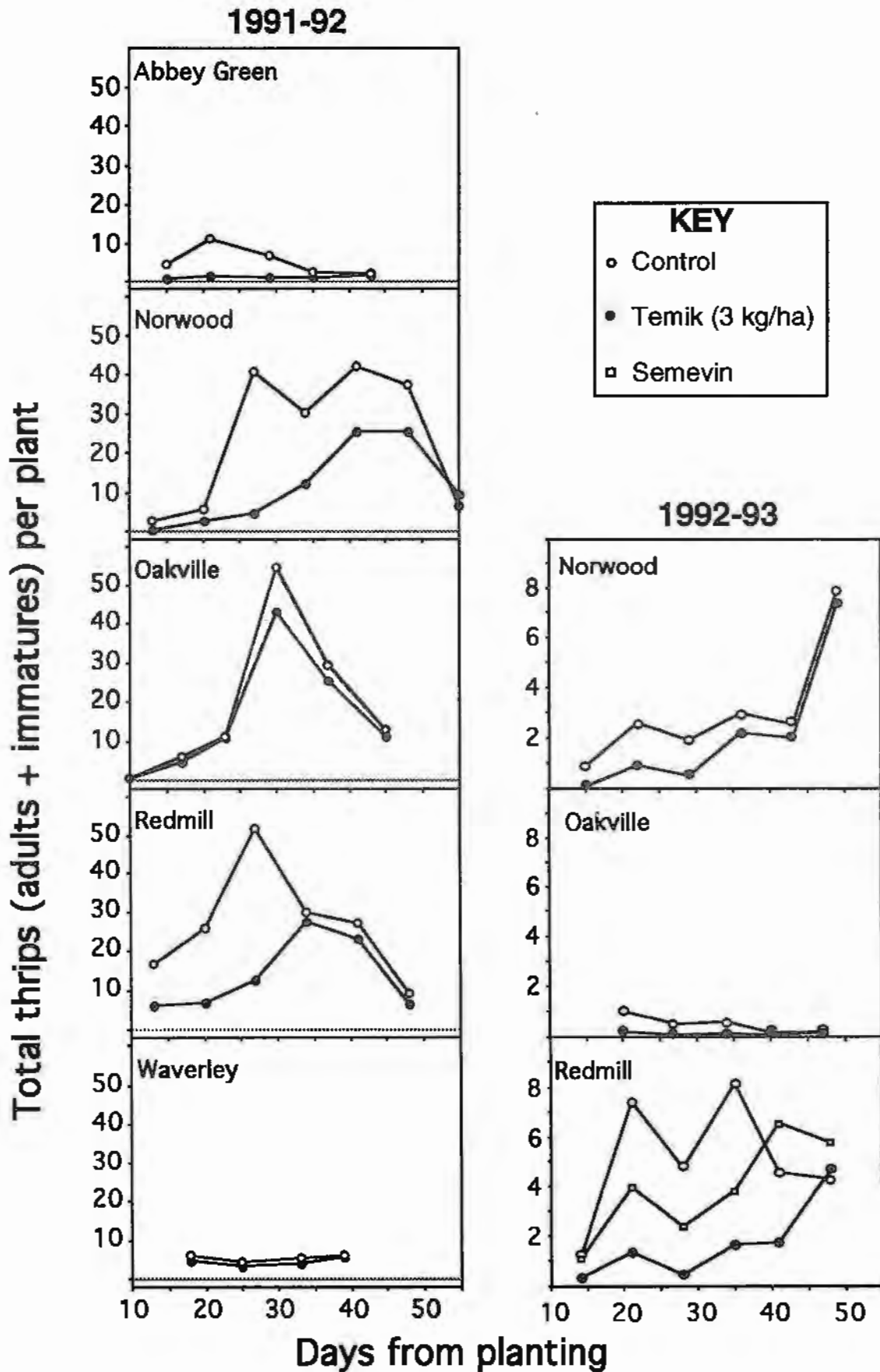


Fig. 1.Thrips populations at experimental sites in 1991-92 and 1992-93. Note difference in scale between years.

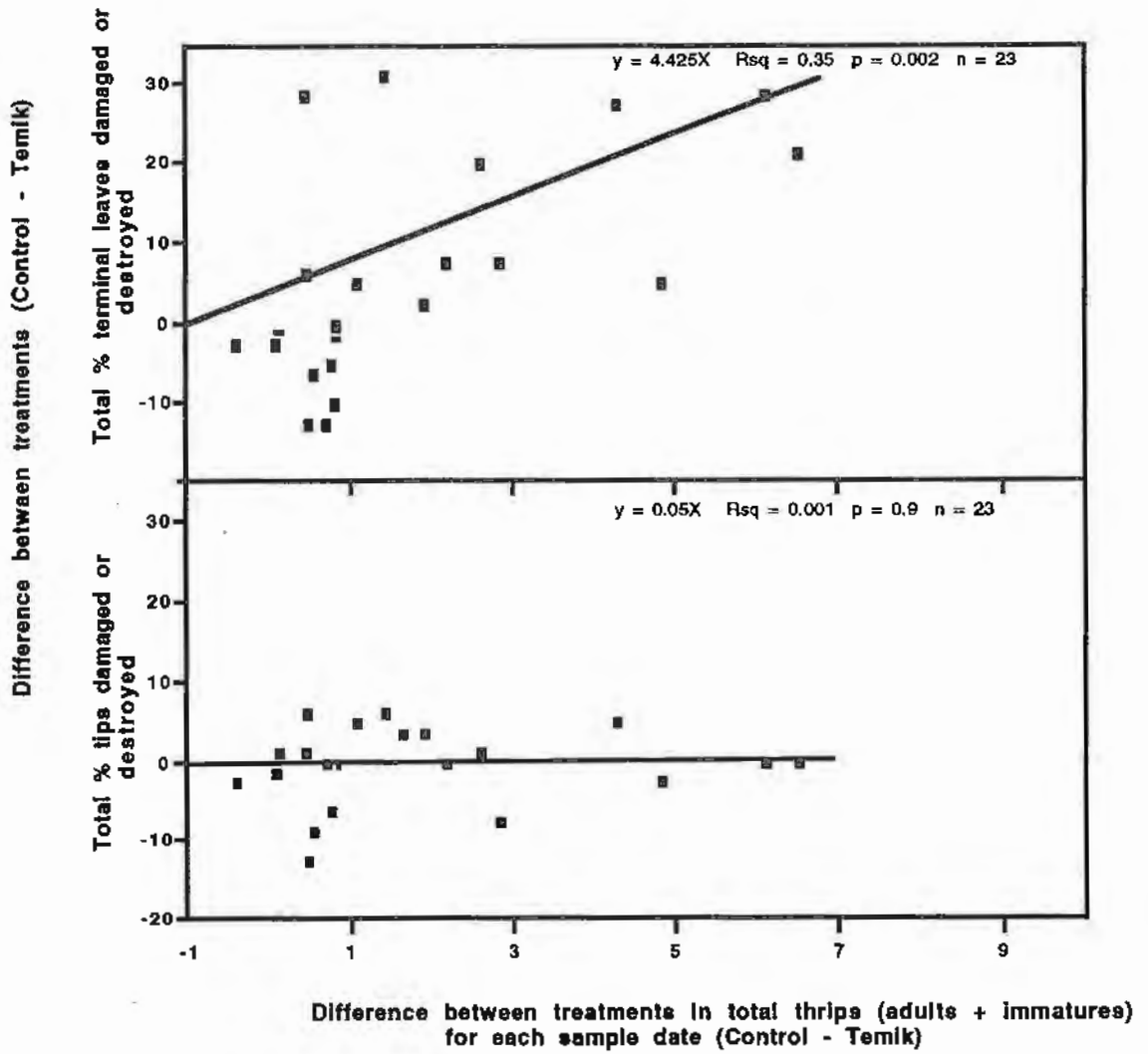


Fig. 2. Relationship between numbers of thrips pre plant and % of terminal leaves or growing tips that were damaged or destroyed by thrips.

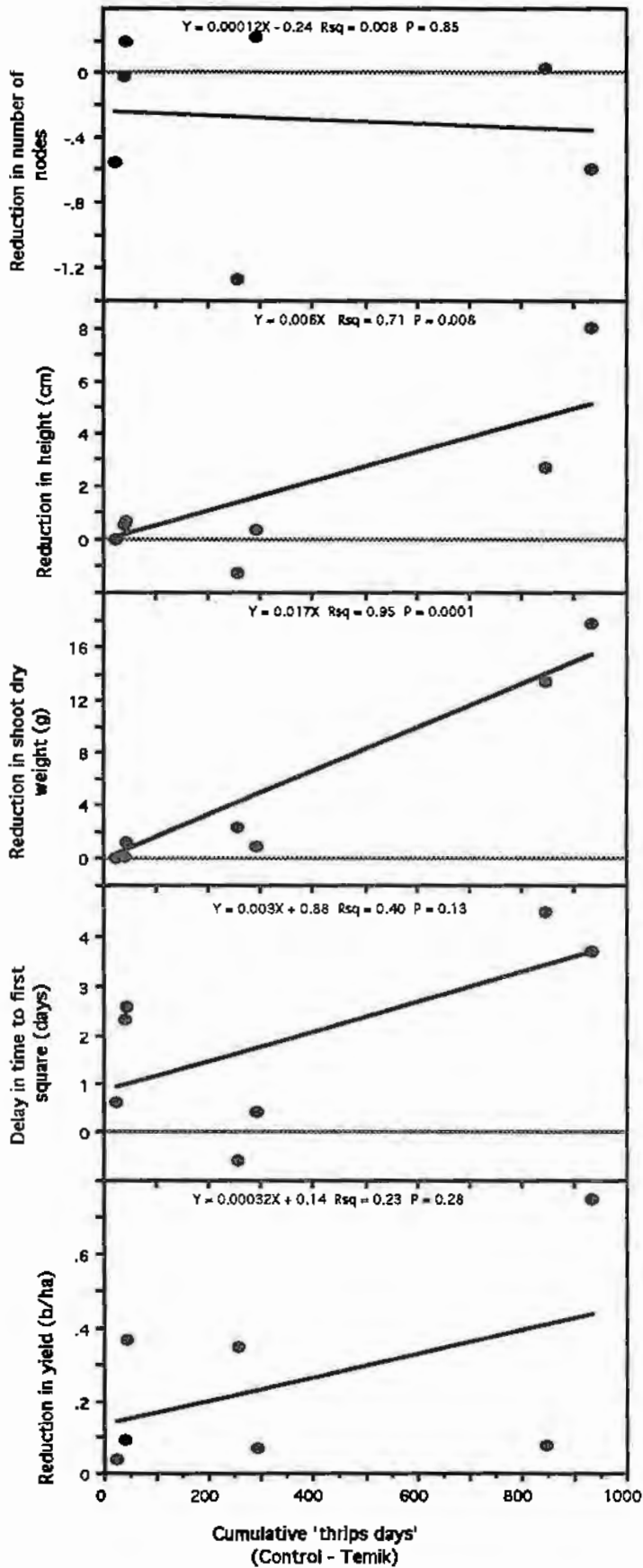


Fig 3. Relationship between 'thrips days', accumulated for 7 weeks after planting, and plant growth parameters at that time, delay in time to first square and reduction in yield (calculated as Temik - Control).