Mites - guidelines for management and future prospects.

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Introduction

Our knowledge of mites has come a long way in the past 5 years. We have a much better understanding of mite ecology and the factors that promote mite survival in cotton crops. Guidelines to reduce the likelihood of mite outbreaks have been developed from this knowledge. If mites were the only problem these would form an ideal management strategy. However, growers and consultants must manage many factors to produce a crop and prevailing conditions such as weather, insect pressure and disease may well determine how the guidelines are followed. Nevertheless, they can be incorporated into the crop management scheme where feasible, especially in regions mites are a major pest. There are five guidelines, discussed below, followed by a brief outline of some prospects for the management of mites in the future.

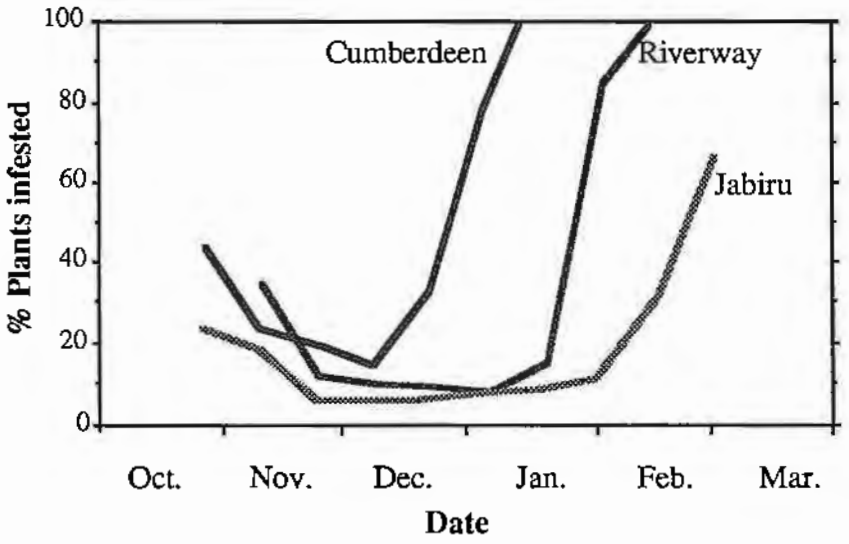
Guidelines:-

1. Clear weeds from fields and field margins well prior to planting.
Weeds can provide hosts for mites to carry over from one season to the next. Mites are present in cotton crops from the time seedlings first emerge from the ground (figure 1). They are blown or crawl into the crop from weeds in and around the field. In spring mites can be found, sometimes in large numbers, on an enormous range of the weed species found on cotton farms. As these weeds hay off, late in spring, mites move to the tops of the plants to enhance dispersal to new host plants, ie your cotton crop. At seedling emergence the edges of fields are more heavily infested than the middle (Table 1), supporting the conclusion that mites come predominantly come from weeds close to the field borders.

Table 1. Percentage of cotton seedlings infested with mites at 0, 30, 60 and greater than 60 metres from the edge of field at seedling emergence.

Metres from Edge	Site			
	Wentworth	Norwood	Carsons Block	Cumberdeen
0	13.6	35.5	57.1	79.2
30	0	14.0	33.3	37.9
60	0	12.0	11.0	21.7
60+	0	0	11.5	14.3

Figure 1. Seasonal abundance of mites at three sites in the Namoi Valley, 1986/87



Fields with more mites at seedling emergence generally have more mites later (figure 1). If colonization by mites at seedling emergence can be reduced then the likelihood of mite outbreaks may also be reduced. Weeds on farms are more heavily infested with mites than those away from farms (Table 2). This suggests that control of the weeds on farms will have a significant impact on the major source of mites. Be aware though that cultivation of weeds just prior to planting may not kill the weeds or the mites. I once visited a farm where seedlings were heavily infested with mites throughout the field even though the it had been cultivated just prior to planting. After turning over some clods of soil I noticed that the although almost all of the weeds had been buried by the cultivation, many were still alive and had the remains of well developed spider mite colonies on them. In this case cultivation occurred too close to planting and simply forced mites off the dying weeds and onto the emerging cotton seedlings. If you are concerned about this problem, inspection of weeds in the field well prior to planting (ie. in early September) can help with decision making. You will need a hand lens. Look at the undersides of the older leaves of any weeds in the field. If you find mites frequently then control weeds early.

Weeds can also be sources of mites later in the season. In March this year I received a report of Athel trees being a source of mites in January. This intrigued me as the needle like leaves of these trees would not seem to be a good habitat for mites, given that they normally seek sheltered sites on the undersides of leaves. We went to this site and sampled not only branches from the Athel trees, but also the wide range of weeds found in the shaded, damp area around the base of the trees. We did not find any mites on the Athel tree branches, but almost all of the

weeds around the base of the trees were heavily infested with mites. These weeds included, bladder ketmia, caltrops, african boxthorn, noogoora burr, sesbania, sowthistle and paddy melon. I would speculate that mite populations had built up to large numbers on this pocket of weeds, which had survived through the summer due to their sheltered location, then crawled onto the Athel trees and were blown from there into the nearby cotton fields.

Table 2. Comparison of the relative 'mitiness' rating of the nine highest rated weeds sampled from cotton fields and from vegetation at least 500m away from cotton fields in September 1987. The 'mitiness' rating ranges from 0 which indicates a weed species on which no mites were found, to 500 which indicates a very abundant weed species with a high level of infestation with mites.

	Relative 'Mitiness' Rating	
Common Name	> 500m away from cotton	Cotton field
Wild Turnip	11.0	102.0
Sow Thistle	1.4	42.3
Wire Weed	0.7	31.9
Variegated Thistle	1.2	20.0
Prickly Lettuce	0	18.1
Burr Medic	0.4	14.0
Paradoxa Grass	0	3.9
Dead Nettle	not found	2.5
Marshmallow	0.7	1.0

2. Preserve beneficial insects by avoiding unnecessary insecticide applications.

Fields with more mites at seedling emergence and high survival of mites through November and December have worse mite outbreaks (fig.1). Through this period there is little colonization of cotton by mites because the major sources of mites, the winter/spring weeds, have all dried up. How the crop is managed through November/December can greatly influence the survival of seedling infestations and the likelihood of mite outbreaks occurring later in the season. Any factor which increases the survival of mites through this period has the potential to lead to earlier mite outbreaks.

Destruction of natural enemies increases mite survival. Application of broad spectrum insecticides to control early season pests (such as *Heliothis* sp. thrips and mirids) kills the natural enemies of spider mites. The insecticides used generally kill few of the spider mites because they are resistant. This result is greater mite survival through November/December, leading to earlier and more severe mite outbreaks (see Aust. Cottongrower Aug/Oct 1989). Mites are therefore induced pests - they are normally maintained at sub-economic levels by natural controls unless some external factor, usually an insecticide, disrupts this control. For

instance, of the four mite species now considered as pests on cotton in California only one occurred in outbreak proportions before the use of synthetic insecticides. The effects of insecticides on mite behaviour, reproduction and on host plant quality may also cause mite outbreaks (see Aust. Cottongrower Feb/April 1988).

Obviously it is essential to control early season pests if they are going to cause economic damage. However, some of the insects considered as pests also eat mites. Flower thrips which attack cotton early in the season are very effective predators of mites. Apple dimpling bugs and nymphs are also mite predators as well as pests. If insecticides are applied only when warranted, predators can reinvade and establish in the crop between applications, especially thrips which can reinvade from late wheat crops. Whereas if insecticides are applied on a routine basis then control is virtually continual and predators are unable to establish in the crop. Other insects we have verified are predators are big-eyed bugs, brown smudge bugs, several lady beetles including two-spotted lady beetles and lace-wing larvae.

Predation can also be particularly effective in January/February. In January this year I noticed that many of the mite colonies I saw had 3 or 4 yellow immature thrips in them, particularly in the Macquarie Valley and in fields with lighter spray histories. Observation with a hand lens showed that these colonies had few eggs or immature mites, and thrips could be seen chewing mite eggs. Clearly biological control was occurring. This also occurred in my research plots at the station, almost wiping out some of my artificial mite infestations. A pyrethroid spray was applied, killing the thrips and other predators, and the mite population increased very rapidly from then on. Avoid using pyrethroids if the crop has an established mite population.

It is obvious that spider mites will continue to be a problem while we rely on broad-spectrum insecticides for control of other insect pests. Unfortunately we have few alternatives at present. However we can aim to preserve predators as well as possible by using such sprays only when economically justified.

3. Be alert to the presence of mites in your crop.

It is important to look for mites in your crop right through the season. Don't wait until January to start. Information is the key to good decision making. If you look for and find mites <u>frequently</u> through November/December then you have the beginnings of a 'bad' mite problem and you should try to preserve predators and monitor mite numbers more closely. If you look and do not find mites then you

can relax until you do. The important point is to look and know the situation, rather than to react to a bad mite problem you have just discovered.

It is most important to know the average level of mite infestation in a crop, rather than to concentrate on looking for 'hotspots'. An estimate of mite abundance in a crop can be obtained quickly and easily. Simply walk into the field about 40m then begin collecting leaves. Take one leaf per plant, from somewhere between the 3rd to 5th leaf below the terminal (ie. the top part of the plant), then walk 5 steps and take another until you have 50 leaves. This will not take long. Then score each of the leaves by turning the leaf over and looking at the underside, firstly near the stalk, then scan the rest of the leaf. If any mite stages are present score the leaf as infested, a hand lens will help for spotting mite eggs which can't be seen with the naked eye. Multiply the number of leaves infested by 2 and you have the % of plants infested with mites. If you are sampling early in the season, before December, pick leaves from the middle or bottom part of the plant rather than the top. Repeat this simple procedure at 4 different places in the field and you can be confident that you know the average abundance of mites in your field. In general sampling for mites specifically need only be done once a week provided it is done properly. More frequent sampling is even better.

4. Select the most mite resistant cultivar in mite prone areas.

Siokra is more resistant to mites than DP90 or Sicala. In trials over the past 4 years I have consistently found that spider mites increase more more quickly on the broad leaf varieties than on Siokra and if uncontrolled cause far more yield loss, this years trial results are no different (Table 3)(also see Aust. Cottongrower Aug/Oct 1987). I have also found that the rate of increase of mites following control is far lower on Siokra than DP90 (fig 2). In other words you get better and longer lasting control with Siokra. We have reported these results in detail in a forthcoming issue of the Australian Cottongrower.

In mite prone regions, such as the Macquarie Valley, it makes sense to plant Siokra. Growing a mite susceptible variety not only increases the likelihood and potential losses from mite outbreaks, but puts more resistance selection pressure on the miticides because more applications will be required to achieve adequate control. Naturally other factors such as disease will also influence the variety selected. In fields with a high level of verticillium wilt it is logical to plant a verticillium tolerant variety. Unfortunately these are all 'normal leaf' varieties. The grower or consultant must decide in each specific case what the major problem is and choose the appropriate variety.

Figure 2. Relationship between % plants infested before spraying and rate of increase of mite populations between 13 and 20 days after application of Comite 600 EC for DP90 and Siokra. NARS 1990.

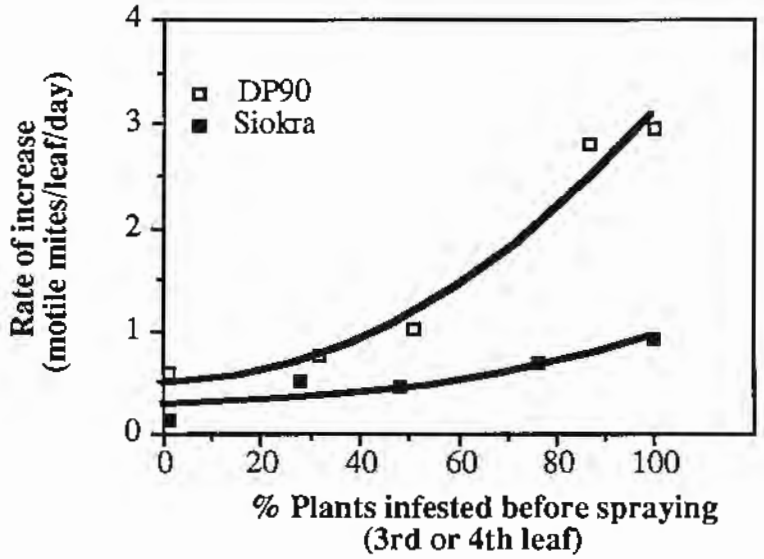


Table 3. Yield (bales/acre) and % yield reduction for DP90 or Siokra infested with mites on 21st Dec, 23rd Jan or 1st Feb compared with mite free controls. NARS 1990.

Time of infestation	Variety	
	Deltapine 90	Siokra
Control	3.5(0%)	3.4(0%)
1st Feb	3.0(-14%)	3.3(-3%)
23rd Jan	2.7(-23%)	3.3(-3%)
21st Dec	0.8(-77%)	2.0(-40%)

5. Timing of control.

High mite populations are harder to control and mites resurge more quickly once control breaks (fig 2). Mite control will appear to last longer if mites are controlled at low population levels. However, this does not mean that mites should always be controlled at low population densities. Yield loss due to mites is a function of mite density, rate of increase and the time of the season. The mite density which justifies control therefore depends on these factors. Higher mite densities and rates of increase can be tolerated later in the season without affecting yield or quality. Hence, the mite threshold increases through the season.

A mite management package will be developed in the future. Until then either use the thresholds reported in the Siratac manual in 1988/89 or use the following 'rule of thumb' recommendations. I recommend you use the sampling method outlined above (Guideline 3) to assess mite infestation levels. Thresholds are higher for Siokra than for DP90 or Sicala for reasons outlined in Guideline 4.

Rules of thumb:-

a) Mites found in January.
When mites are found earlier in the season (ie. early January) potential yield loss is high and control is warranted. Control at 30% of plants infested for DP90 and Sicala and 50% of plants infested for Siokra .

b) Mites found in February until first open bolls.
Control is warranted because mites can still significantly reduce yield, particularly of later formed bolls. Control at 50% of plants infested on DP90 or Sicala and 80% of plants infested on Siokra.

c) Mites found after first open bolls
The potential of mites to reduce yield or quality drops rapidly as bolls open. Control is not normally warranted unless mites are increasing very rapidly and at least 80% of plants are infested.

d) Crop exceeds 20% bolls open
Mites will no longer affect yield or quality. Control not needed.

The Future

Development of a mite management package is a high priority for the next three years. A large database has been accumulated on the relationship between mites and yield loss and on mite distribution patterns in cotton crops. This information will be integrated into a mite management package for growers and consultants to use. Such a package will allow the potential of a mite population to cause yield loss to be assessed, enabling better decisions regarding the need and timing of control measures. It is envisaged that this information would be presented in three ways, firstly as a written booklet, secondly as a package for use on microcomputers and finally as a single page laminated 'summary sheet' that consultants, agronomists and growers could take to the field.

New miticides will be monitored if they are likely to be of value in mite management. Two older selective miticides, dicofol (Kelthane) and propargite (Comite), were tested recently and proved to be extremely effective for mite control. Propargite in particular looks promising as it is effective when applied aerially. When registered these products will reduce the resistance pressure on the miticidal organophosphates. Another new miticide, Abamectin, has also been

tested and provided excellent and long lasting control of mites. Abamectin has translaminar activity making it feasible to obtain good results when aerially applied. Several new miticides are being developed but even if they prove to be effective it will be some years before they are available.

One avenue of mite control that has not been explored is the use of innoculative releases of predacious mites, such as *Phytoseiulus persimilis*, to provide biological control of mites. These mites are voracious predators and capable of holding pest mite populations at low levels. They have been used successfully for control of spider mites in some orchard crops. One problem though is that they are easily killed by several of the chemical groups we rely on at present, particularly the synthetic pyrethroids. However strains of these predators which are resistant to some chemical groups have been bred elsewhere. Such an approach may be limited in scope but in areas where mites are a major problem such as the Macquarie Valley may be useful, particularly if pesticide resistant strains of the predators could be obtained or developed.

Siokra has already shown the benefits that host plant resistance can give in pest management. However we need to look further and in a joint project with Dr Gary Fitt and other scientists from the CSIRO Divisions of Plant Industry and Entomology we will be looking at plant chemicals that make cotton less suitable for mites and *Heliothis*. This is long term research though and is unlikely to bear fruit immediately.

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