Pest Management in Central Queensland

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General

Cottongrowers in central Queensland (CQ) enjoy no advantage over southern counterparts in the range of insect pests that attack their crop. *Heliothis* species, rough and pink-spotted bollworms, and mirids are major pests which damage the terminal buds and fruiting structures of cotton plants, potentially causing radical loss of yield and profit. While mites and tipworm generally are less active than in the south, a wider planting window means that adult forms of the soil insects that attack early-planted cotton seedlings are available to attack late-planted ones.

Does pest management in central Queensland differ from other areas?

Because control methods are insect-orientated, and insect pests are common among areas, management methods employed for particular species do not vary markedly. However, the need to apply control measures may vary widely both among areas and within areas, depending on the "intensity" of pest populations at particular places and times. The same debates about early insect control, plant compensation, and early maturity, rage here as elsewhere.

Broader planting windows mean CQ cottongrowers focus on an early start-early finish strategy in their production. As growers of anything anywhere tend to use the cheapest chemical options, this strategy effectively avoids the use of costly Stage III chemicals against the most resistant stages of problem species. Early season pest management, at least in the Callide-Dawson valleys and eastern parts of CQ, is aided by a natural enemies complex which is most prevalent in small fields (<50 ha) and fields close to wildlife corridors. Some 61 (38.6%) of the 158 arthropod species taken in CQ cotton fields were parasites or predators of insect pests.

What are the differences between irrigated and raingrown crops?

It is clear that radical lint yield increases occur with increasing volumes of irrigation water to around 8 Ml/ha. With optimum seasonal and agronomic conditions, Australian cotton varieties may even realize their maximum potential yield. Historical climatic data demonstrate seasonal conditions (*viz.* rainfall) are rarely optimal for cotton growth in CQ and irrigation effectively insures against this environmental variability (Bourne 1988, Hearn 1988). In the absence of irrigation, the major limitation to productivity under raingrown conditions is water availability and its management (Pyke *et al.* 1990). The profitability of raingrown cotton production so rests in delicate balance with risk management and cost minimization. Which variety to plant raingrown is a small part of the risk management process growers must consider. No matter how good the variety, it will only compensate for poor agronomic or pest management to a limited degree. Except for harvesting, pest management can be the major cost of raingrown cotton production (Pyke *et al.* 1990), up to 30% of total variable costs in the Callide-Dawson valleys. The profit advantage gained through optimizing pest management levels and costs is obvious.

Any discussion of cost savings however must address ***gross margin***, which we seek to at least maintain, and hopefully increase. A profitability improvement will almost certainly involve reduced pest management costs in raingrown cotton, yet such an improvement in irrigated cotton may not (Watson 1986). Reducing costs need not mean reduced numbers of pesticide applications - an increasing number of growers use ground-rigs and band-spraying to reduce the cost of both application and chemical (B.A. Pyke, these proceedings).

A breakeven yield which recovers growing costs (assuming variable costs of $450 per ha and $400 per bale) amounts to 1.1 bales per ha (1.3 bales @ $350). The risk of failing to break even at Emerald is ~20% or 1 year in 5 (*cf.*~15% at Dalby), due either to climate causing a failure to sow, or yields insufficient to recover growing costs (Hearn 1990). Keefer (1990) suggests the risks with CQ raingrown cotton are so great that production as a single activity enterprise is simply too risky.

Should we be using pesticides less, or using them more wisely?

Most CQ people in the industry accept 8-12 insecticide applications in irrigated cotton as normal, but similar numbers in raingrown cotton usually cannot be justified as yields are both lower and less secure (Pyke *et al.* 1989). Extreme *Heliothis* pressure in the 90-91 season required increased numbers of applications for control, and data from southern areas suggest between 9 and 18 sprays were applied on high-yielding crops of 7 to 10 bales per hectare (Anthony 1991). As growers yields and numbers of applied sprays were NOT correlated, probably reflecting the spatial differences in insect numbers per unit area, could the same yields have been achieved with fewer sprays? (Anthony 1991).

The cotton plant has a demonstrated ability to compensate total lint yield for early damage involving either loss of growing points or squares, without affecting fibre attributes sufficiently to incur commercial price penalties. Light to moderate amounts of early-season damage may even increase yield (Kelly *et al.* 1988). Plant compensation involves damaged squares substituting for normal physiological shedding, an increased rate of flowering, and increased weight of the remaining bolls, but there is no evidence of increased boll set (Brook *et al.* 1992a).

Numerous disbudding trials (Brook *et al.* 1986, 1992a; Titmarsh & McColl unpublished data) show removal of 60 squares per row metre during early squaring (supposedly equivalent to 6 *Heliothis* larvae completing development) does not affect yield or quality but delays maturity for up to 7 days. Total fruit removal at this time causes yield loss and unacceptable delays in both irrigated (Brook *et al.* 1992a) and raingrown cotton (Titmarsh & McColl unpublished data).

The picture is not this clear-cut however, because most studies of cotton plant compensation reported in the literature occurred at low yield levels. Cotton crops with the high yield levels presently achievable in Australia do **not** compensate completely for early insect damage (Brook *et al.* 1992b). The DP90 and Siokra varieties apparently cease to compensate at yield levels of 5.0 and 7.5 bales per hectare, respectively, and many CQ irrigated growers are already achieving such yields with these varieties.

As the popular varieties also largely compensate for reduced plant stand in raingrown situations (B.A. Pyke unpublished data), we won't argue the benefits of spraying pre-squaring cotton plants except in the above context of whether crops are high or low yielding. Current southern practices hold early insect control more crucial for crops with a limited water supply than for normal crops but we believe that the insect control in raingrown fields should be matched to rainfall. Cotton stressed early in the season will not be attractive to insects and will not have much to protect. Certainly heavy expenditures on insect control should be avoided on crops demonstrating low yield potential (Hearn 1988).

Clearly, as raingrown crops are usually substantially lower yielders and may be less attractive to pests, or attractive for shorter periods than irrigated cotton, we should utilize the compensatory plant process and use pesticides less. Many of the failures with CQ raingrown cotton were caused by heavy spray programs on October-November planted crops whose early good moisture status had changed to severe moisture stress by peak flowering. The concept of earliness should be considered carefully before it is promoted in raingrown cotton - at least in its use of early insecticides. It is easy for early insect control in raingrown cotton to get out of hand, destroying the potential for populations of beneficials to develop and making the crop reliant on insecticides for the whole season. (Pyke *et al.* 1989).

On the other hand, with many CQ irrigated crops above the yield threshold at which compensation cuts out, we should aim to use our pesticides more wisely. Pesticides are not the only factor for achieving good yields and early crops although we probably focus on these because they are easy to control and manage. General agronomic attention to weeds, soil conditions, diseases, irrigation, nutrition, planting date, plant stands and defoliation are all very important and their contributions to yield and earliness can be substantial (Anthony 1991).

The problem is how to be confident yield is not being sacrificed when early spraying is reduced. This confidence is gained by spending more money on checking (Watson 1986). Good decisions come from good data, so the trade-off for a grower investing in more detailed scouting should be reduced spraying or increased yields due to better decision making (Anthony 1991).

Recommendations for a sustainable IPM approach

The natural enemies of insect pests are a valuable, although variable, resource in CQ cotton fields. This complex provides a source of natural pest mortality which costs the grower nothing and reduces his need to input pesticides. Unless insecticides are chosen carefully, the application of early-season sprays to control mirids or *Heliothis* can devastate these agents and promote *Heliothis* egg-lays, starting the grower off on an application treadmill. Effective raingrown cotton production in CQ really demands any major commitment to pest control be postponed to around first-flower. The occurrence of follow-up rain by this time indicates whether a viable yield may be expected at all.

In irrigated fields, target yields will usually exceed the levels at which significant plant compensation may be expected, so pest management costs will only be contained through more detailed scouting providing the basis for better management decisions. Potentially, any early in-field natural enemies complex may be protected by choosing microbial ***Bt*** pesticides for early use where appropriate. Ultimately, because of the various pressures building against the effectiveness of our pesticide tools, we need to introduce alternative control options.

Possible options include egg and larval parasites for *Heliothis* control, and egg parasites against other bollworm species. Neem seed extract can be used to reduce the attractiveness of individual fields to moths and so reduce in-field egg-lays. The microbial pesticides can be successfully used for essential caterpillar control.

An integrated application of these options as a sustainable pest management program will be trialled in CQ and Darling Downs raingrown cotton fields over the next 3 years. Success in their application will almost certainly transfer to the irrigated environment.

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