ALTERNARIA LEAF SPOT OF COTTON - A REVIEW

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Introduction

Significant epidemics of alternaria leaf spot occurred in several areas of both NSW and Queensland during February and March, 1988. Prior to the 1987-88 season the disease had not been officially recorded on commercial cotton crops in NSW. Simmonds (1966) described its occurrence in Queensland as "general; slight to moderate, sometimes severe in dry crops".

Alternaria leaf spot of cotton is caused by the fungus *Alternaria macrospora* Zimm. and occurs in most cotton growing areas of the world. Pima cottons (*Gossypium barbadense*) are particularly susceptible to the disease whereas *Gossypium hirsutum* cultivars are considered relatively resistant. Field experiments in Israel (Bashi *et al*. 1983a) have shown yield reductions of up to 24% resulting from alternaria leaf spot on Pima cotton. American literature (Anon) describes the disease as being generally of minor economic importance on *G. hirsutum* cultivars with the potential to cause significant losses only under favourable conditions.

This review of the literature referring to *A. macrospora* indicates the extent of current knowledge about the pathogen and the disease it causes.

Symptoms

Alternaria macrospora can cause leaf spot, stem cankers, defoliation and boll shedding of cotton (Ellis and Holliday,

1970). Initially the spots on leaves are small with a purplish halo, however, under cool, wet conditions they expand to about 1 cm diameter, the centre becoming grey/brown and cracked. Zonations may be apparent, especially on the upper surface. Affected leaves become yellow and eventually drop off. According to Bashi *et al.* (1983a) leaf shedding is induced by spots occupying an average of 1-3% of the leaf area. Lower leaves shed more readily than do upper leaves. Stem lesions begin as a small sunken spot which develops into a canker with splitting and cracking of tissue. Glandular areas on the base of the developing square, flower or boll may also be attacked resulting in the failure of the boll to develop and shedding.

Environmental Requirements

The Physical Environment. - The minimum, optimum and maximum temperatures for growth are 10°C, 20-30°C and 35°C respectively (Bashi *et al.* 1983b). Epidemics may be associated with periods of wet, overcast weather or high humidity (Russell and Hine, 1978) or nightly 8 to 12 hour dew periods (Bashi *et al.* 1983b). Cotty (1987b) reported that exposure to high temperatures within 48 hours of infection suppressed disease development and lesion formation was reduced more than 70% after exposure to 43.5°C for 2 hours. Results indicated that daily temperature maxima may be important in limiting alternaria leaf spot in Arizona and could partially explain increased disease severity during seasons in which daily temperature maxima were relatively low.

The Biological Environment. - Ebbels (1974) and Bashi *et al.* (1983b) found that cotton was most susceptible during the seedling stage. It was shown that disease development was 5.5 to

8.9 times higher in cotyledons than in leaves and a much longer wetting period was required for leaf infection as compared to the infection of cotyledons. Hewison & Symond (1928) claimed that disease incidence was directly correlated with lack of vigour in the host cotton plant. He associated epidemics with "asphyxiation of the roots of young plants through poor soil and continued rain". Sciumbato and Pinckard (1972) also observed that plants under stress tend to contract the disease more. They even suggested that alternaria leaf spot severity could serve as an indicator of nematode attack or nutrient deficiency in cotton. McDonald and King (1948) noted that plant susceptibility increased as the physiological demands associated with flowering and setting bolls increased i.e. susceptibility increased as the boll to leaf ratio increased. Young vigorously growing plants were not affected by the disease and symptoms only appeared when the early bolls were approaching maturity. Early heavy fruiting plants were attacked first while plants stripped of their bolls remained unaffected. Similar results were reported by Rotem *et al*. (1988) who noted that the removal of flowers from plants inhibited the disease. Potassium deficiency also predisposes plants to alternaria leaf spot (McDonald & King, 1948).

Varietal Differences - *Gossypium barbadense* cultivars are very susceptible and *G. hirsutum* cultivars are considered relatively resistant. A recent study (Cotty, 1987a) showed that there is variation in the level of resistance in the *G. hirsutum* cultivars. Deltapine 90 was shown to be significantly more susceptible than Deltapine 61, Acala SJ-5 and McNair 235. Increased susceptibility was evidenced by higher numbers of spots/unit leaf area and by a more rapid rate of leaf spot

expansion. Increased susceptibility allows for a more rapid development of epidemics.

Pathogen Survival

The pathogen is able to survive on infested crop debris, on alternative hosts or within seed (see Pathogen Dispersal).

A. macrospora was recovered from host debris after overwintering on the soil surface but not from debris 127 mm below soil level (Ellis and Holliday, 1970). Bashan (1984) maintained that survival in plant debris under field conditions in Israel was minimal and suggested that survival on volunteer plants growing at the field edges was important.

Various alternative hosts have been reported for *A. macrospora*. These include sida in Tanzania (Ebbels, 1972), sesame in Israel (Minz and Solel, 1959), anoda weed or spurred anoda in the USA (Ohr *et al.*, 1977), passionfruit in India (Ram *et al.*, 1977) and cauliflower and radish in India (Rao, 1977). Studies in the USA have suggested that the anoda strain of *A. macrospora* is different from the cotton strain of the same species (Walker, 1980).

Pathogen Dispersal

Spores of *A. macrospora* are dispersed by wind within a crop and to a certain extent from field to field. Spores are produced on the surface of leaf spots on leaves that have been shed.

The pathogen is also capable of survival within seeds and long range dispersal within planting seed. Bashan (1984) indicated that *A. macrospora* was isolated from seeds only after the natural opening of the bolls and exposure of the seeds to an environment in which the fungus was present. The pathogen is unable to penetrate the boll wall and reach the seed site.

The high susceptibility of cotyledons to pathogen attack increases the effectiveness of seedborne survival and dispersal.

Control

Most references to the control of *A. macrospora* on cotton involve the use of chemicals on *G. barbadense* cultivars. Padaganur and Basavaraj (1984) found that seed borne infections could be controlled by soaking the seed for 1 to 2 hours in fentin hydroxide. The use of aqueous foliar sprays of 50% cuprous oxide at 10 day intervals during the susceptible seedling stage was recommended by Ebbels (1974). Olsen and Cotty (1986) suggested that triadimenol was a systemic fungicide with low phytotoxicity at active levels and high persistence. They therefore suggested field trials with this compound. THERE ARE NO FUNGICIDES REGISTERED FOR FOLIAR APPLICATION ON COTTON IN AUSTRALIA.

Available information about the survival and dispersal of *A. macrospora* indicates that disease control may be achieved by the use of disease free seed, elimination of volunteer host plants during the intercrop period, incorporation of crop debris and control of alternative weed hosts.

Conclusions

* The epidemics of alternaria leaf spot that occurred during the 1987-88 growing season appear to be associated with the cooler wet weather that occurred in February in many areas. Earlier - heavy fruiting varieties are more susceptible than other varieties. Deltapine 90 is more susceptible than was Deltapine 61.

* It is extremely important to eliminate volunteer host plants and crop debris from fields where the disease was present.

* Alternaria leaf spot has not previously been recorded in New South Wales where the majority of pure seed is produced.

* The alternative hosts that allow the pathogen to survive the intercrop period under Australian conditions need to be identified. Weeds that are often found in cotton growing areas in Australia and are closely related to weeds reported as alternative hosts overseas include abutilon (velvet leaf), sida and flannel weed.

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