PREMATURE SENESCENCE. WHAT DOES IT DO TO A COTTON PLANT ?

P.R. Wright and J.M. Roberts
NSW Agriculture, Australian Cotton Research Institute, Narrabri NSW 2390

Introduction

We have conducted experiments on this problem for five years, and summaries of this work have been reported at earlier cotton conferences (1994 and 1996) and in the CSD premature senescence grower information leaflet. In this paper we would like to focus on the topic of how damaging is premature senescence? Is it a problem that growers need to be concerned about, or is it just a sign of a high yielding crop?

Methods

In a field near Warren that regularly gets the problem, we compared affected plants with adjacent healthy plants (within 20 cm). These pairs were assessed for dry weight, plant nutrients and leaf photosynthesis.

Results and Discussion

Plants with premature senescence had the same leaf, stem and root dry weights as unaffected plants (Table 1). The major difference was that the premature senescent plants were carrying twice the boll weight of unaffected plants (Table 1). The differences in boll weights resulted from affected plants having a greater number of bolls (54% greater) and greater individual boll weights (8% greater). These results clearly show that premature senescence is a problem related to high boll loads. Affected plants also tended to be shorter than healthy plants.

Table 1. Plants with the symptoms of premature senescence had greater boll weights and boll numbers and tended to be shorter than unaffected plants.

Premature senescence symptoms	Dry weight (g plant^{-1})				Boll number (# plant^{-1})	Height (cm)
	Leaf	Stem	Root	Boll		
Absent	16.0	16.7	6.6	40.7	6.8	80
Severe	18.0	16.6	5.9	67.6	10.5	75
	ns	ns	ns	*	*	†

† P< 0.1, * P< 0.05

The potassium concentration in the leaves of plants with the symptoms was less than half of that of unaffected plants (Figure 1). In contrast the leaf concentrations of the other cations (Ca, Mg, and Na) and Nitrogen were all slightly greater in affected plants (Figure 1). This indicates that plants with premature senescence are under a double disadvantage when it comes to potassium, having much less K available, but a much greater boll load to supply it to. For example the healthy plants had 3.34 mg of potassium stored in leaves for every 1 g of boll compared to only 1.07 mg K/g boll in plants with the symptoms.

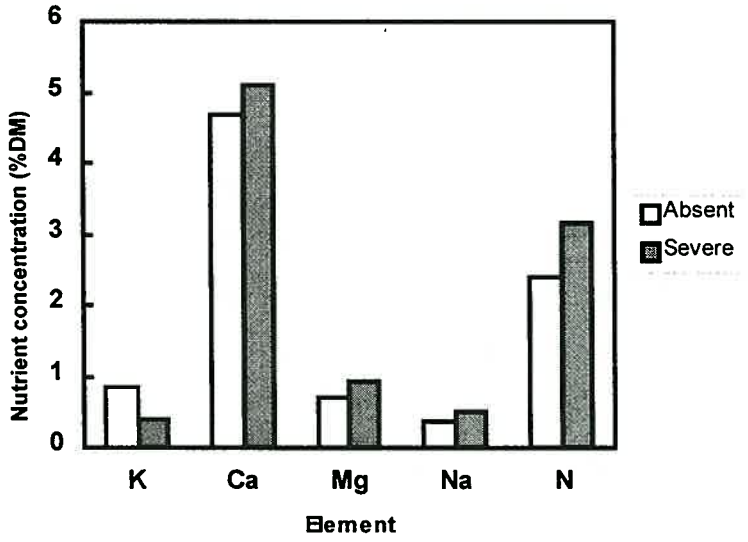

Figure 1. Leaves of plants affected by premature senescence had less than half the potassium concentration of unaffected plants and slightly more Ca, Mg, Na and N.

Leaf photosynthesis in affected plants was less than a quarter of that of unaffected plants and leaf water use efficiency was also greatly reduced (Table 2). This shows that

premature senescence can severely affect a cotton crop, with the potential to quarter the ability of a leaf to capture energy from the sun which in turn must substantially reduce the crop's ability to grow and to produce lint.

Table 2. Young leaves from plants with premature senescence had greatly reduced net rates of photosynthesis and water use efficiencies compared to unaffected plants.

Premature senescence symptoms	Pn (μmol CO_2 m^{-2} s^{-1})	WUE (μmol CO_2 mol^{-1} H_2O)
Absent	21.0	3.11
Severe	5.0	1.64
	***	**

** P<0.01, *** P<0.001

To some extent it could be argued that as premature senescence is associated with high boll loads then it is a good thing. However, our work shows that this problem severely influences the crop's ability to capture energy from the sun and to supply the bolls with potassium. Within a cotton field, patches with premature senescence produce substantially less lint and often have poorer fibre quality. Likewise, if fields genuinely have premature senescence (eg symptoms in January or Febuary), they will yield less than nearby crops that have equal yield potentials but don't have the problem.

Our earlier work has shown that management options are available, such as choosing the correct variety, so growers should treat premature senescence as a serious problem, but one which is avoidable to some extent.

Conclusion

Premature senescence is a problem associated with high boll loads. It profoundly affects the crop and should be taken seriously by growers. It reduces the crop's ability to turn sunlight into growth, and reduces its ability to supply potassium to bolls. The consequence of this is a lower lint yield.

Management options are available to growers - the most important being the selection of the correct cultivar (a more detailed discussion of management options can be found in

earlier cotton conference proceedings, 1994 and 1996 and in the CSD premature senescence leaflet).

Acknowledgments

We would like to thank David Shann for his expert technical assistance, John Quigley for allowing us to conduct this research on his property "Killowen", and the CRC for Sustainable Cotton Production and the CRDC for funding this project.