PREMATURE SENESCENCE OF COTTON - THE FUTURE OF CROP NUTRITION PROBLEMS?

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Abstract

The symptoms of premature senescence were assessed in five different commercial cotton fields. Leaf blades with symptoms were found to have substantially lower potassium concentrations than leaves without symptoms (0.4% compared to 0.9% dry matter basis). The symptoms occurred on young leaves which is different to classic potassium deficiency which occur on old leaves. Plants with premature senescence had twice the fruit loads both in mass and number of plants in the same field without symptoms. It is concluded that, despite cotton being predominantly grown on soils with high levels of available potassium, the high yields of modern irrigated cultivars are such that the soils? capacity to supply potassium or cotton?s ability to take up potassium is limiting. As crop yields in general continue to increase disorders like premature senescence are likely to develop in other crops and involve other nutrients.

Keywords: Potassium, cotton, premature senescence

Introduction

In recent years an unusual disorder has been occurring in cotton. Leaves near the top of the canopy turn bronze/red during fruit development. These leaves then fall of and the symptoms move down the canopy, defoliating the crop and reducing lint yields. The disorder is called premature senescence. Evidence is presented in this paper showing that premature senescent leaves are very low in potassium despite having been grown on soils with high levels of available potassium.

Materials and Methods

Plants with or without symptoms of premature senescence within the same commercial field were compared for nutrient concentrations and plant growth. At each site at least five plants were sampled with or without the symptoms. Five different fields were used all with available potassium levels in the soil greater than 200 ppm (ammonium acetate extract). Statistical comparisons were made after pooling all the sites together using a T-test assuming equal variance.

Results and Discussion

The critical value for potassium in leaf blades is between 0.9 and 1.2 % while leaves which had symptoms of premature senescence had concentrations of 0.4% or lower (Table 1) despite most soils used for cotton production having high levels of available potassium.

Nitrogen concentrations were also reduced but not to such a dramatic extent (Table 1). Plants with symptoms had greater fruit loads, on a dry matter basis, than plants without whereas differences in the amount of leaf or stem material were minimal (Fig. 1a). Plants with the symptoms had almost twice the number of fruit as well as a greater proportion of open fruit (Fig. 1b).

Table 1. Leaf potassium and nitrogen concentrations are lower in leaves with premature senescence symptoms compared to healthy leaves. (n=6)

Leaves	K (% dry matter)	N (% dry matter)

Healthy	0.90	4.66
Premature senescence	0.38	3.53
?	P<0.001	P<0.05

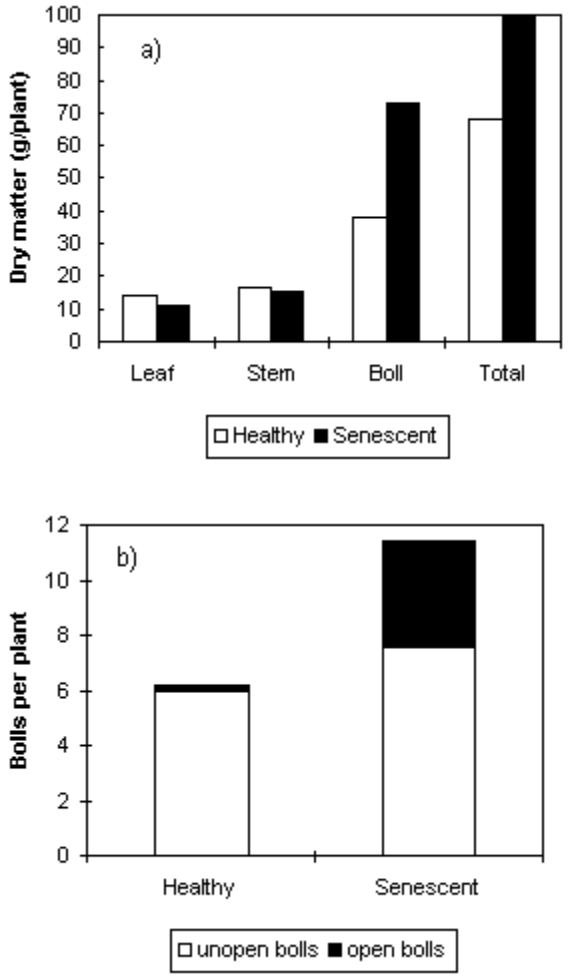

Figure 1. Dry matter a) and boll numbers b) were greater in plants with premature senescence than in plants without symptoms when compared in the same field.

Because potassium is a mobile element in the plant the classic symptoms of potassium deficiency appear on old leaves. In contrast the symptoms of premature senescence appear on young leaves. Australian cotton crops are the highest yielding in the world hence there is a very high demand on plants to supply developing fruit with sufficient potassium. Plants with the symptoms have much greater fruit loads, both in numbers and in mass than unaffected plants, suggesting that an imbalance between potassium supply and demand is the cause of the problem. Differences in cultivar susceptibility have been shown with the differences related to potassium storage in the leaves (1).

Conclusion

It is concluded that premature senescence is a potassium related disorder of cotton that results from the large potassium demand caused by the heavy fruit load of Australian cotton crops. The importance of potassium nutrition of cotton is likely to increase as lint yields continue to increase. Similar disorders may appear in other crops involving other nutrients as yields continue to increase.

Acknowledgments

The financial support of the Cotton Research and Development Corporation, the CRC for Sustainable Cotton Production and the Potash and Phosphate Institute are gratefully acknowledged as is the expert technical assistance of Jenny Roberts and Elizabeth Manchee.

References

1. Wright P.R. 1996. *Proc. 8th Aust. Cotton Conf*. pp 443-450