BIOCONTROL OF COTTON DISEASES

Subbu Putcha, Kelly Barker and Stephen Allen
CRC for Sustainable Cotton Production, NSW Agriculture
Australian Cotton Research Institute, Narrabri, NSW 2390

Summary

In field experiments biocontrol agents reduced seedling disease severity, increased plant stand and yield as effectively as the chemical fungicides did. Biocontrol agents were also effective in controlling Fusarium wilt of cotton. The results clearly demonstrate that biocontrol agents can be used on commercial cotton farms. Further research will provide an understanding of the ecology of the bicontrol agents and mechanisms of disease control. This knowledge will help in further improving the performance and consistency of the biocontrol agents.

What is biocontrol?

In a broad sense, biocontrol can be defined as the manipulation of a root or soil environment, through non-chemical means, to reduce the activity of pathogens. This broad definition includes the use of resistant cultivars, cultural practices and the introduction of beneficial microorganisms into the root zone.

The cotton disease biocontrol program at the Australian Cotton Research Institute focuses on the use of beneficial microorganisms to control cotton diseases. Several naturally occurring bacteria are antagonistic to pathogens. These bacteria are referred to as biocontrol agents. When introduced into the root zone, the biocontrol agents can interfere with the activity of the pathogens.

Biocontrol of cotton diseases in the field is commercially possible.

Control of cotton seedling diseases caused by *Rhizoctonia solani* and *Pythium* sp.

In field experiments biocontrol agents successfully controlled seedling diseases and increased the seedling survival. Results from an experiment conducted in a field with with very high seedling disease pressure are presented in Figures 1A, 1B and 1C. The disease control subsequently resulted in increased seed cotton yield. The performance of the biocontrol agents was better than, or on par with the standard fungicide treatment (metalaxyl + PCNB). Large scale field trials need to be conducted to confirm efficacy and consistency of the agents.

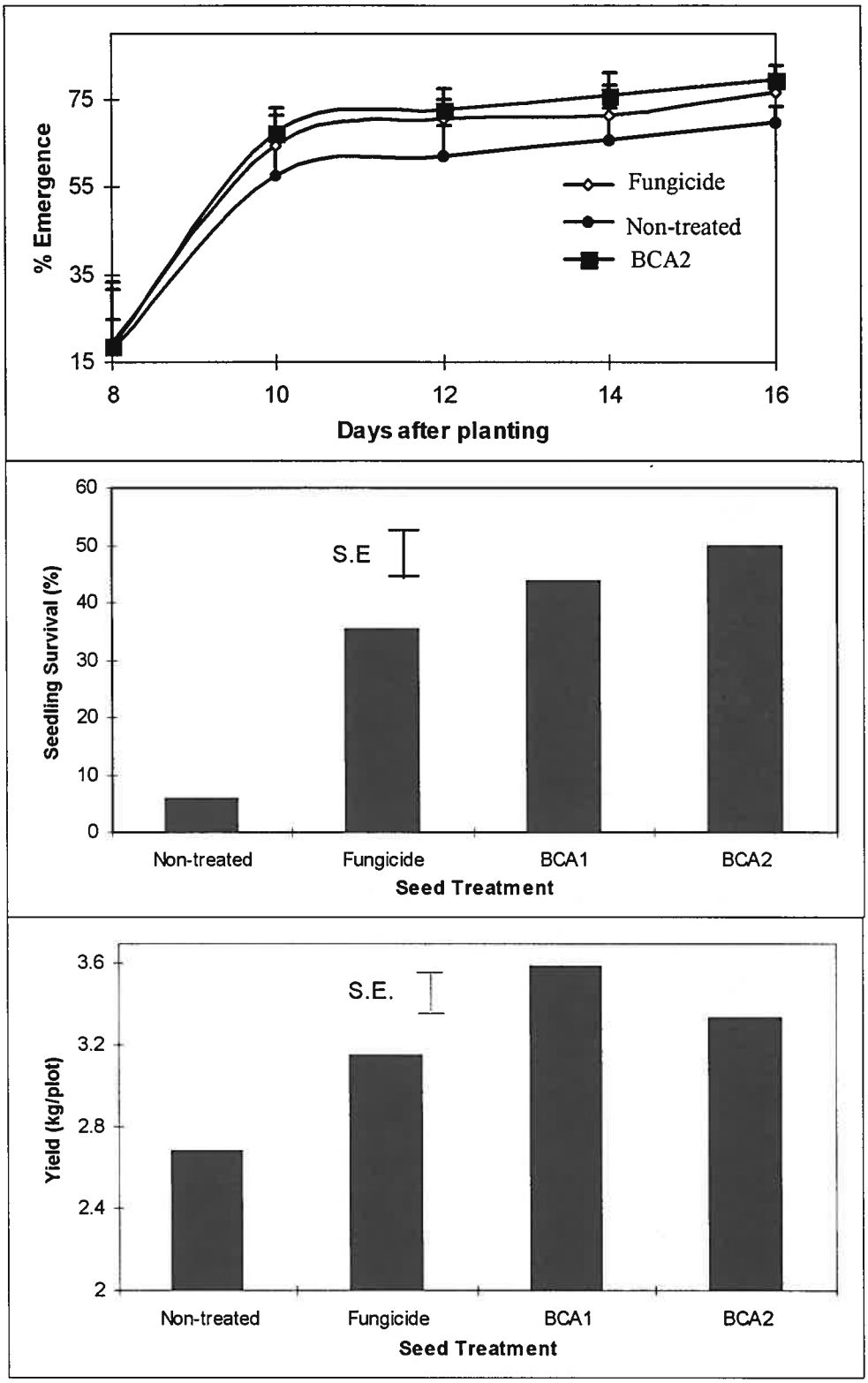

Figure 1. Seed treatment with biocontrol agents increased the rate of seedling emergence (A) and seedling survival (B), and increased seed cotton yield (C). (BCA1 and BCA2 are biocontrol agents).

Hence, biocontrol methods, while needing some further work, do seem to provide commercially acceptable control of seedling diseases.

Control of Fusarium wilt

More importantly, biocontrol agents also appear to be effective in controlling Fusarium wilt of cotton. This research work was carried out on growers fields naturally infested with the wilt pathogen. Seed treatment with a range of biocontrol agents led to acceptable levels of plant establishment and reduced the severity of Fusarium wilt (Figures 2A and 2B).

Currently few control options for Fusarium wilt control are available to growers. Biocontrol agents can achieve acceptable level of disease control when used in conjunction with other management practices such as suitable crop rotations, avoidance of early planting, higher planting density and use of disease tolerant cotton varieties.

Our research also shows that the biocontrol agents that controlled cotton diseases in field experiments colonise a variety of other crops and inhibit the growth of other pathogens.

Can cotton farmers undertake biological control through better management and "housekeeping"?

Cultural practices currently followed by cotton growers can contribute to biological disease control in its broader sense. These practices include suitable crop rotations, use of tolerant or resistant cultivars and incorporation of crop residues into the soil. (At the CRC for Sustainable Cotton Production, research is continuing into management of crop residues, without burning, to decrease pathogen inoculum). In fields where antagonists (bacteria that can interfere with the pathogen activity) occur, certain cultural practices encourage the build-up of these antagonists thereby leading to disease control. Take-all decline in wheat monoculture is an example of this. However, there is not enough evidence to suggest that indigenous antagonists can be exploited in Australian cotton soils.

Enhancing the efficacy and reliability of biocontrol agents

An understanding of the ecology of the biocontrol agents, and the mechanisms through which the biocontrol agents operate are critical to enhance the biocontrol activity. When mechanisms are known, biocontrol activity can be improved by addition of appropriate nutrients and through management of the root environment.

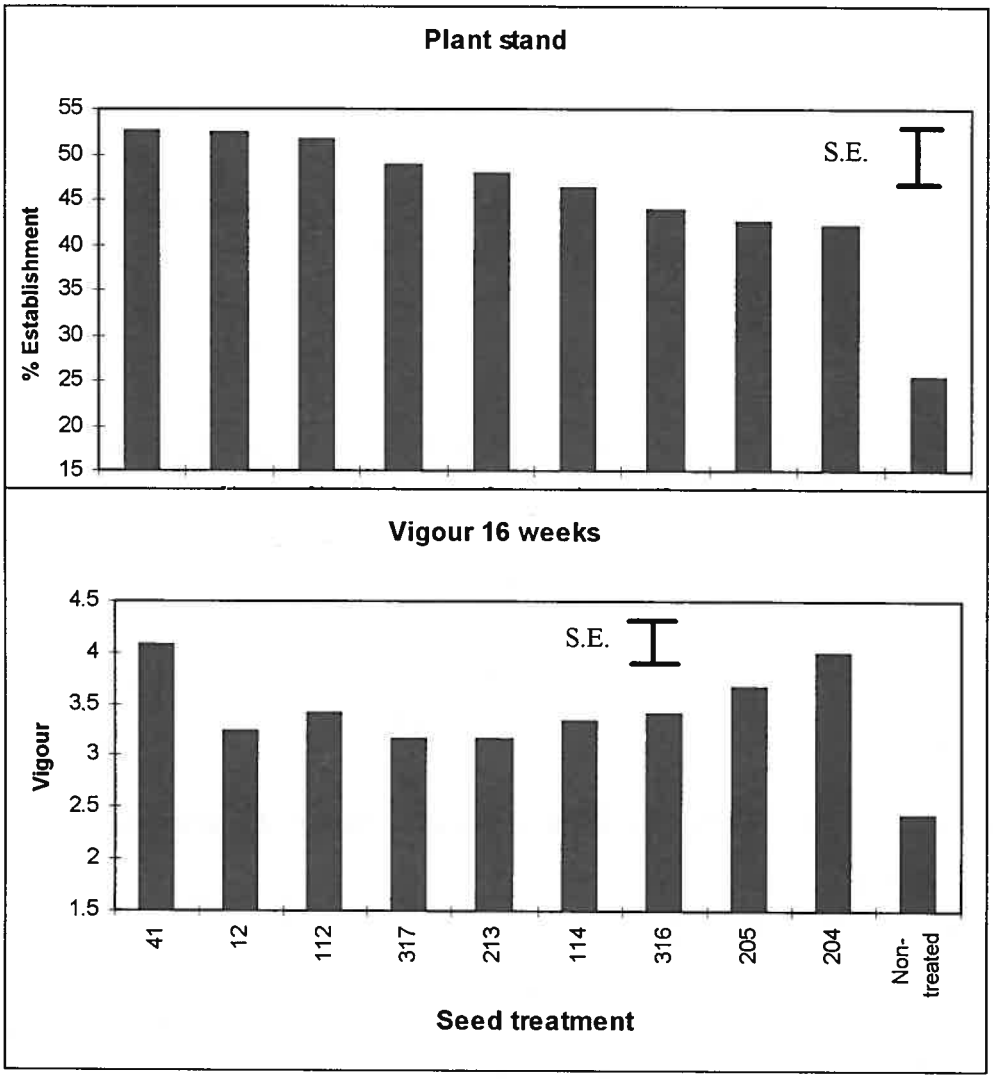

Figure 2. A range of biological control agents controlled seedling mortality caused by Fusarium wilt (A) and reduced the impact of diseases severity on the crop (reflected as plant vigour) (B). The numbers 41, 12, 112 etc are code numbers for different biocontrol agents. Non-treated seed represents seed treated with metalyxyl + PCNB but no biocontrol agent.

Biocontrol will be most effective when used in combination with other disease control measures. Mixtures of compatible biocontrol agents can be more effective than the use of a single biocontrol agent in controlling cotton diseases.

Efficient production of biocontrol agents on a large scale, adequate shelf-life, suitable formulation and application methods are necessary developments for the successful use of biocontrol agents by cotton growers.

References

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