Part 4 – Final Report Executive Summary

Provide a one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.

Soil biota communities are one of the most diverse groups of earth's biota. Soil organisms regulate a number of processes in soils that are not only critical for productivity but are also essential for maintenance of ecosystem health. Herbicide use is a vital component of modern agriculture, in particular under reduced till systems. With increased adoption of stubble retention and reduced till practices and the introduction of new herbicides, herbicide use will remain an essential practice in the near future. Non-target effects of herbicides on soil biological activities may (i) cause undesirable effects on essential transformation processes (e.g. reduced nitrification and nitrogen mineralisation) or (ii) result in unexpected damage to crops (e.g. increased diseased incidence). Non-target effects of herbicides could be either positive or negative. If herbicide application is to remain a viable practice in sustainable farming systems, evaluation of herbicide effects especially from repeated and / or multiple herbicide use is essential to ensure optimum nutrient availability and plant growth. We measured the impact of multiple herbicide application on the populations of selected functional groups of soil microorganisms and the biological processes they mediate, using surface soil samples from field experiments were conducted at ACRI farm sites.

A brief summary of the results from our herbicide related research is as follows:

1) It is essential to use an integrated approach of testing key groups of biota and associated activities in order to evaluate and predict unforeseen non-target effects from herbicide use. Effects of each herbicide need to be considered separately as the herbicide-microbe-soil interactions vary for different herbicides.
2) Short-term impacts of most of the herbicides we tested are reversible partly or fully within 10-weeks after herbicide application, hence it may be possible to develop management options to reduce non-target negative impacts.
3) A number of herbicides currently used in cotton soils have a negative impact on key groups of microorganisms, however not all herbicides caused negative impacts.
4) Some herbicides caused a significant shift in bacteria : fungi ratio, reduced decomposition rate of cotton stubble and populations and activities of nitrifying microorganisms, the magnitude of herbicide impacts varied with season.
5) Application of 'lay by' herbicides slowed the recovery in MB levels compared to the treatments with initial herbicide application only. At the final sampling microbial biomass levels in the treatments with 'lay by' herbicide application were lower than those in the single application of herbicides (10-15%).
6) An appropriate recovery period for soil biota should be allowed between herbicide applications and modification of herbicide regimes may be possible to avoid the application of herbicides that either reduce microbial activity or cause microbial stress in sequence before the soil has recovered from the effects of previous application of herbicides.
7) Some herbicides applied in cotton had negative impact on symbiotic N_2-fixation by legumes in rotation (e.g. Pendimethalin, Prometryn > Trifluralin, Diuron). Results also suggest that it is possible to reduce any residual effects of cotton herbicides on N_2-fixation by legumes in rotation through using less persistent herbicides.

Finally these results from cotton soils and other work from dryland cropping systems suggest that appropriate use of herbicides could be less destructive to soil biota and biological processes and by changing herbicide usage pattern (in terms of type of herbicide and time of application) cotton farmers not only could manage the weeds but also reduce any long-term impacts from herbicide use