ABSTRACTS

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KEYNOTE 1 – Monday 21 June 04

Malcolm Devine

POTENTIAL OF BIOTECHNOLOGY TO IMPROVE WEED MANAGEMENT

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Recent advances in the life sciences, collectively referred to as "biotechnology," can contribute to better weed management. Biotechnology has already brought several major advances in weed management, including the development of herbicide-resistant (HR) crops. In particular, the development of crops resistant to glyphosate and glufosinate, two broad-spectrum, environmentally friendly herbicides, has led to improved weed control, reduced input costs, and improvements in soil conservation. An extension of this approach has been to create HR crops that allow effective control of *Striga* and other parasitic weeds. Other current applications of biotechnology in weed science include the use of sophisticated strategies to discover new herbicide target sites and to fully understand herbicide mechanism of action and resistance. Molecular markers are used in the identification of weed biotypes and in understanding genetic relationships between biotypes. This is useful in understanding weed adaptation and spread, and in helping identify optimum old-world locations to search for natural enemies for biological control programs. In other fields, biotechnology is being used to improve crops by increasing vigor (for example, by facilitating hybrid production) and by improving stress tolerance, disease, and insect resistance. For the future we can imagine additional benefits, from improving plant canopy development, metabolic changes to improve carbon fixation and utilization, and improved nutrient uptake, that will make crops more competitive with weeds.

KEYNOTE 2 – Tuesday 22 June 2004

Steve O Duke

HERBICIDE-RESISTANT CROPS TEN YEARS AFTER INTRODUCTION

Stephen O. Duke

For several decades, herbicides have made up more than 50% of the agricultural pesticide market, reaching about 70% during the past decade. Since transgenic, bromoxynil-resistant cotton was introduced in 1995, planting of transgenic crops, herbicide-resistant crops (HRC) has grown substantially, revolutionizing weed management. Before 1995, several commercial HRCs were produced by biotechnology through selection for resistance in tissue culture. This strategy was technically feasible for some herbicides that targeted molecular targets with significant genotypic and phenotypic plasticity (e.g., acetyl CoA caroboxylase), but not for non-selective herbicides, such as glyphosate or glufosinate. Non-transgenic HRCs have had little commercial impact. The advent of transgene technology ushered in glyphosate- and glufosinate-resistant crops. Since glyphosate-resistant soybean was introduced in 1996, followed by introduction of other glyphosate-resistant crops (GRC), where available, GRCs have taken a commanding share of the HRC market, especially in soybean, cotton, and canola. The high level of adoption of GRCs by North American farmers has significantly reduced the value of the remaining herbicide market. This effect, along with corporate mergers, has reduced the introduction of new herbicides. The future of herbicide use in developed countries is unclear. Introduction and adoption of other HRCs that can be used with other broad-spectrum herbicides has apparently been hindered by the great success of GRCs. Evolution of glyphosate-resistant weeds and movement of naturally-resistant weed species into GRC fields will require increases in the use of other herbicides, but the speed with which these processes compromise the use of glyphosate alone is uncertain. The effects of this situation, as well as lack of European acceptance of transgenic HRCs, on herbicide discovery and research on other strategies for weed management are uncertain. Advances in precision agriculture and/or transgenic crops with greater interference with weeds could greatly impact the future of HRCs.

KEYNOTE 3 – Wednesday 23 June 04 **Mahmoud Solh**

SHAPING THE FUTURE OF AGRICULTURE

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Agricultural development faces three major global challenges in the 21st Century: the persistence of poverty and food insecurity; globalization and its impact on the tarnsformation of traditional agricultural systems; and the continuing pressure on and the deterioration of the natural resource base.. The future of agriculture will be shaped by the dynamics of change and developments in science and technology as well as by economic policy reforms in the "Era of Globalization". Technically, agriculture production will be tapping three main sources for growth: expanding the land area, increasing the land cropping intensity (mostly through irrigation), and boosting yields. The view that we may be approaching the ceiling for all three sources is not supported at the global level, although severe problems exist in some countries and even whole regions. According to FAO, there is adequate unused potential farmland at global level but regions other than tropical Latin America and Sub-Saharan Africa face a shortage of suitable land. In these regions intensification through improved management and technologies will be the main if not the only source of production growth. According to FAO, 80% of increased crop production in developing countries still has to come from intensification: higher yield, increased multiple cropping and shorter fallow periods. Irrigation is crucial to the world food supplies and its role is expected to increase still further. However, one in five developing countries will face water shortage and water availability is already critical in West Asia and North Africa and will be so also in South Asia in 2030. Greater efficiency in water use needs to be achieved. The development and dissemination of new technology is an important factor in determining the future of agriculture. FAO investigated three areas that are particularly critical namely biotechnology, technologies supporting sustainable agriculture and the directions of future research and opportunities for increasing the competitiveness of developing country agriculture. Modern biotechnology promises great potential for both producers and consumers particularly where conventional breeding has failed. However, to utilize its potential, appropriate biosafety policies must be developed. Given a conducive policy environment towards sustainable agriculture, the next three decades should see the spread of farming methods that reduce environmental damage while maintaining or even increasing production. Cost of production will also be reduced by some of the technologies. For example, no-till/conservation agriculture can raise crop yields by 20 to 50%. The direction of research should focus on the benefits and the shortcomings of the green revolution. A doubly green revolution is now needed. Research and technology transfer need to focus on sustainability – minimizing or reducing impacts of agricultural intensification on environment – and for equity – making sure that benefits spread to all agro-ecologies including marginal areas and resource-poor farmers. An integrated multi-disciplinary research approach needs to be followed not only in biological sciences including genetic engineering along side conventional breeding and agronomy but also the socio-economic context where farming occurs (FAO.2002).
The future of agriculture will also depend on the international agreements and conventions namely those of the World Trade Organization (WTO); the United Nations Conventions on Biological Diversity, Climate Change and Combating Diversification; the International Plant Protection Convention (IPPC); the Rotterdam Convention; the International Treaty of Plant Genetic Resources for Food and Agriculture.

KEYNOTE 4 – Thursday 24 June 2004 **Daniel M. Joel**

THE PARASITIC WEED PROBLEM AND ITS FATE IN THE 21ST CENTURY

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Parasitic weeds cause heavy damage in world agriculture and forestry. The most important parasitic weeds are the root parasites *Striga* (witchweed) and *Orobanche* (broomrape), the climber *Cuscuta* (dodder), and some tree parasites such as *Arceuthobium* (Dwarf Mistletoe).
The parasitic weeds have unintentionally been cultivated by man. This has intensified during the 20th century, when their distribution and impact on world economy have particularly grown, due to various factors, e.g. the ease by which seeds are transported from one place to another, and the development of conditions that allow this massive propagation.
The exchange of plant material between regions and between countries allows hybridization between populations and between closely related species. This contributes to an increase in the biodiversity of the parasites, which can lead to the evolution of more virulent populations. In addition, we are likely to find herbicide-resistant parasites.
These processes are expected to intensify. Hence the need for specific measures to prevent the spread of parasitic weeds, to avoid their rapid evolution, and to reduce their damage. While quarantine, hand weeding, trap/catch crops, resistant crops, and herbicides remain relevant, biotechnological methods need to be employed, with three main objectives:
(a) Developing new resistances that are based on knowledge of key genetic and metabolic processes in the parasites;
(b) Improving biological control agents, by increasing virulence and host specificity, and
Developing diagnostic tools that will assist in precision parasitic weed management.