CHAIRS' SUMMARY PAPER: Forages in Cropping Systems

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Grain crop rotation with pastures is widely recognized as a beneficial practice leading to greater sustainability. Many posters at this congress dealt with these benefits - soil structure improvement, increased biodiversity and higher yields of other crops in the rotation. However, there are several constraints to the adoption and maintenance of forage-based cropping systems.

First, there are many areas of the world where pressure on land to produce food is so great that farmers cannot afford to skip one or more growing seasons without producing grain crops. However, reducing the frequency of grain crops does not necessarily mean a decrease in grain production per unit time/land area. This is supported by experiences from Uruguay, where total grain output in a 3 year crop-3 year pasture rotation was higher than in a continuous grain crop system. Several posters (e.g. Meister et al.) showed declining grain yields with continuous annual cropping.

Several novel systems for including forages in short-term cropping systems were presented, and these offer hope for land scarce areas. In some cases, forage crops are grow between or after grain crop harvest. Posters also dealt with dual purpose legume and cereal crops; this approach allows for production of livestock and grain from the same crop.

A second constraint to forage cropping is a lack of infrastructure for animal production (fences, drinking water, and more importantly, skilled people). Building, or in many cases - rebuilding, this infrastructure may be too costly or impossible. There was ample agreement among participants in the meeting that this lack of skilled people was a major obstacle for adoption of mixed cropping systems. It was interesting to note that while the infrastructure for integrated animal/crop agriculture is declining in many industrialized countries, the sedentarianism of formerly nomadic pastoralists is resulting in the emergence of crop-livestock systems in the moist savannas of Africa.

Third, the recent increase in grain prices relative to animal product prices, and the predictions that this situation will persist in the coming years, are additional factors opposing the adoption of mixed systems. The point was made that external costs of the grain monoculture system, such as pollution, low energy efficiency, unsustainable pest management strategies, etc., are not accounted for. Properly managed forage-based cropping systems are more environmentally sustainable than monoculture grain systems, however they tend to be undervalued.The use of economic incentives to promote forage legumes in cropping systems was proposed by several participants in the discussion period. Perhaps more comprehensive models that integrate forages into cropping systems (as proposed by A. Rotz) will provide a more objective approach for evaluating forage-based systems.

Fourth, there is a belief that producing grain crops without tilling the soil would replace the need for forage crops because erosion would no longer be a major problem and soil is not deteriorated by repeated tillage. The question remains as to the sustainability of these production systems, which would be very much improved by including forages because of reduced dependancy on N fertilizers, higher diversity and fewer weed and pest problems. The deep root system of perennial pasture plants provides unique benefits such as improved porosity and water-holding capacity (Carter and Kunelius), "biological subsoil tillage" and deep sequestration of carbon. Barrios et al. observed an interaction between tillage and root growth of pasture plants.

Finally, constraints to production of individual pasture species, i.e., annual medics in traditional Australian ley systems (Denton et al.) or alfalfa persistence in temperate zones (Sheaffer and Lake) also need to be better understood.

Many of the posters presented in this session focussed on the use of legume forages, either annual or perennial, in cropping systems. Legumes contribute large amounts of N, which buffers forage-based systems against rising oil prices, which directly affect the cost of N fertilizer. Workers have identified tropical forage legumes, both herbaceous and woody species, which are well suited to fodder production in Africa's moist savannas (Muhr et al.). The point was made that there are many unexplored species which are suitable for fodder production in tropical agriculture. There were also several examples of energy crops, including the use of alfalfa in an integrated energy production/livestock production system, which would fit into mixed systems.

Despite the many benefits of forage crops, some environmental problems associated with their use need to be recognized:

1) Recent evidence is revealing groundwater contamination with nitrate where legumes have been used in cropping systems for several decades (Australia, Uruguay).

2) Nitrous oxide release to the atmosphere by both nitrification and denitrification may cause global warming and ozone depletion.

3) Soil acidification due to symbiotic nitrogen fixation, which may reduce land productivity.

4) Soil compaction by cattle.

In conclusion, the papers and discussion in this session provided compelling evidence for maintaining mixed grain/pasture cropping systems. However, the way we use forages in cropping systems may change in the future. For example, non-traditional plants (eg. annual legumes; dual use crop plants) are playing a more important role, and non-traditional uses of forage plants (eg. energy production) have already been adopted in some areas of the world. The constraints to adoption and maintenance of forage-based cropping systems require attention by both natural and social scientists, as well as extension workers and farmers. The critical importance of forages in sustainable agriculture needs to be emphasized in agricultural education and must be considered in agricultural and environmental policy decisions.