GUEST EDITORIAL

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Pesticides, IPM and Training

Many farmers and others perceive chemical control to be a simple option – you buy a pesticide, mix it and apply it – but environmental and safety concerns have increased as considerable numbers of farmers use highly toxic chemicals which adversely affect their health (9) and non-target organisms. One alternative seen by many is organic crop production (*see* 5) with a return to traditional pest control measures such as crop rotation, host plant resistance and biological controls. To many people this approach is synonymous with integrated pest management (IPM), because they have ignored the role of chemical control in IPM. Meanwhile, the agrochemical industry is expanding by taking over major seed companies and has moved towards the use of genetic engineering to develop transgenic crops.

In reality, relying purely on biological and cultural controls generally will not maintain the high levels of crop production needed to feed the growing world population. Public concern about transgenic crops has already been voiced, especially in Europe: Will genes imparting resistance to herbicides increase weed problems if genes transfer to wild populations? Will the quality of food be affected? As crops are often subject to several types of pests, transgenic crops – such as those with the *Bacillus thuringiensis* toxin gene effective against certain insect groups – will still require protection from sucking pests (4). Therefore, chemical control will continue to play a major role in the future protection of crops. New chemistry is providing different pesticides, some of which are more selective than previous ones, and are active at very low dosages. Their effective use in IPM programs emphasizes the need for more precise integration of applications, both in space (*e.g.* 'patch spraying' using GPS [global positioning system] technology) and time. Such improved application requires crop monitoring to provide relevant in-field information.

Unfortunately it is the application aspects of chemical control that are largely ignored. Despite enormous investment in the chemicals and registration procedures, the final delivery of the chemical is dependent on the farmer using spray technology, much of which has not changed significantly during this Century. Sprays are still applied almost entirely by pressure through hydraulic nozzles. However, there have been major improvements in developed countries to reduce exposure of farmers to the chemical by improved packaging, closed transfer systems (2) and changes in equipment to allow nozzle selection in terms of spray quality and drift reduction (8), but the vast majority of small-scale farmers in the developing countries have to use the least expensive manually operated equipment and are overexposed to the more toxic, less expensive pesticides.

Major efforts have been made and are being continued by FAO to train farmers through Farmer Field Schools (FFS) to recognize natural enemies of insect pests and rely more on biological control. While this approach has met with some success particularly in tropical lowland irrigated rice (*see* 6), more research is needed on vegetable and other crops, especially to establish ways of improving the survival of natural enemies between seasons in the rainfed semi-arid areas. Farmers use pesticides not only due to the sales pressure by agrochemical companies, but also because they envision severe damage to their crops, and a benefit of the rapid action of a pesticide, when pests are noted in their fields (3). Clearly, to obtain a benefit from spending money on pesticides, the yield potential of a crop must be high, but lack of relevant local advice due to the poorly financed extension services has resulted in many farmers using pesticides when there can be no economic benefit. Thus, advice on pest management must be interrelated with sound agronomic recommendations, especially as regards sustaining soil fertility. Improved cultivars, including transgenic crops, can raise the potential yield, but they also succumb easily to pest infestations. Therefore, insect pest, pathogen and natural enemy identification must be teamed up with better farming practices that include judicious use of pesticides.

There are many factors affecting yield potential, but in terms of application technology the key areas that require more attention are weed management and soil conservation. Few farmers in the tropics use herbicides, yet yields are significantly depressed by weed competition, especially in the early stages of plant growth. Yields of maize can be reduced by more than 30% if farmers neglect early weeding. Hoeing weeds disturbs the soil and may damage the crop but is often ineffective in reducing the amount of weeds and therefore has to be repeated several times. This ties up the limited farm labor, leads to soil loss by erosion, and often a failure to weed the whole area that has been sown. Clearly much needs to be done to develop simple techniques of herbicide delivery that are cost effective and appropriate to the small-scale farmer.

Critics of pesticides still refer frequently to the persistent organochlorine insecticides of the 1950s, but new combinations of technology involving pheromones and biopesticides as well as new, often more selective, chemical pesticides offer exciting ways of limiting the number of interventions needed to control a pest. However, this may require much better application to deliver the new products more precisely to the target pest. Too often pesticides have been wasted by dilution in large volumes of water – frequently much more than 200 liters per hectare – applied like rain over the crop, while umbrellas of leaves have protected the pests on the undersides of leaves within the crop canopy. The lack of control of whiteflies (*Bemisia tabaci*) is a good example of poorly targeted application. In consequence farmers, seeing pests continue to survive, have frequently repeated sprays, further encouraging the selection of resistant pests (7). Such inefficient sprays waste a high proportion of the chemical and add to the environmental pollution. Better targeting of a spray can be achieved, albeit with adjustments to equipment, *e.g.* use of droplegs, or by selecting different nozzles. The recent development of the biopesticide *Metarhizium anisopliae* var. *acridum* to control locusts and grasshoppers is one example which illustrates the importance of appropriate application and formulation for efficient dose transfer by optimizing the droplet size and concentration of spores (1).

In developed countries where pesticides are a recognized component of integrated crop management, governments are now introducing regular inspection of sprayers to ensure they are safe and effective, and some countries require mandatory training for those applying pesticides. This contrasts with the developing world, where there is very little training provided for the vast numbers of farmers. More countries need to emulate the experience in Zimbabwe, where a school was set up especially to train cotton farmers in pest identification and control methods. Clearly the knowledge gap between scientists and farmers has to be addressed if crops are to be protected effectively by more judicious use of pesticides, applied more accurately with IPM systems. It is a formidable problem, and one that requires significantly more attention than given it to date. Scientific research may ultimately develop techniques that avoid the use of pesticides, but for the foreseeable future pesticides remain an important tool in IPM, the utilization of which must be improved on a global scale. Technologies such as the employment of computers have expanded rapidly on a global scale. Similar emphasis should be given to the safe and effective application of pesticides. Pesticide use is *not* a simple option: it necessitates *training* with *improved application.* If this is to be achieved it will require industry, governments and farming communities to work together, use more modern media technology, including television, illustrated booklets, cartoons, etc., and provide information in an easy-to-understand format.

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