**GUEST EDITORIAL**

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# Preventing the Entry of Exotic Weed Species and Problems Related to Herbicide Resistance[1]

This editorial addresses two major challenges of modern weed management: the necessity of preventing the introduction of exotic weeds into new environments by implementing weed risk assessment, and the need to prevent frequent evolution of herbicide-resistant biotypes in cultivated fields, including areas where genetically modified herbicide-resistant crops are grown. This paper provides information about FAO initiatives and the Organization's response to these important issues.

Prevention as part of the management of these phenomena becomes crucial although initially it may cost more due to the need for certain infrastructures, which are not always readily available in developing countries. More than a decade ago, FAO began work on the development of new methods and regulations to enable countries to implement measures for preventing the introduction of potentially invasive organisms and resistant pest biotypes that could harm biodiversity, agriculture and the economy in general.

**Weed Risk Assessment** The social and economic cost of the introduction of exotic weeds is very high, and prevention of their entry and/or spread is essential. In this context, countries should formulate a list of exotic plants absent from their territory, and should also try to determine whether these plants can adapt to the new environment after introduction.

[1]The present paper does not necessarily reflect the views of the FAO.

Procedures are required to assess properly the likelihood of plant adaptation. Weed risk assessment enables the concerned authorities to identify high-risk invasive species and, subsequently, to make informed decisions that will reduce the economic and ecological damage caused by these plants.

The new FAO procedures for weed risk assessment (7) have been modelled after systems that were developed in Australia and New Zealand, where quarantine protocols for preventing the entry and spread of weeds have proven to be effective. They are also based on the approved guidelines for pest risk analysis of quarantine pests (8) and include information on primary pathways of entry of plants for horticultural or forestry purposes; through weed seeds contaminating agricultural products for direct consumption by humans or livestock; or, the less common, *i.e.*, seeds on shoes or adhering to the clothes of passengers. National plant protection authorities and associated scientific personnel should analyze the most important pathways for possible entry of such plants and, based on their findings, establish the required monitoring and inspection procedures.

This assessment should produce a list of those plants likely to pose a threat if introduced into a new territory and that should be combated in order to avoid their spread. This procedure will help the national authorities to comply with the requirements of the International Plant Protection Convention, as well as the recommendations of the Convention on Biological Diversity on the development and implementation of exotic invasive species strategies and action plans (1).

**Preventing Herbicide Resistance** Another important weed issue is herbicide resistance. Various factors intervene in the process of resistance evolution, which have been described in detail in many scientific publications (2–4). Resistance evolves in those cultivated fields where control relies solely on the use of one or a few herbicides with similar modes of action. Any management action to prevent herbicide resistance should try to reduce the selection pressure of the herbicide through rotation with crops using herbicides with different target sites, slightly changing planting time, increasing crop competitiveness, or other methods.

The information available on problems of resistance increases every year and this enables technicians to determine, with some degree of certainty, the time necessary for resistance to evolve (the number of applications of an herbicide and years it takes to bring about the resistance in a particular weed species).

Currently an FAO group of experts is developing databases and tables indicating the number of applications (and years of use of a single herbicide) that will potentially cause resistance in some weed species. When complete, the databases will be valuable resources for use by agricultural extension workers and land managers. The work was started on problems of resistance in rice and will then turn to other crops, such as wheat and maize. This information will help to facilitate the prevention of resistance.

Another technological advance in agriculture is the use of genetically modified crops, among them the herbicide-resistant crops (HRC). The benefits of this technology are evident, such as minimizing labor for land preparation, early weed control, and reducing production costs. However, it may be asserted that the use of HRCs raises some serious concerns (6), such as the potential for gene transfer from HRC to genetically related wild species, the possible appearance of HRC volunteers in subsequent or neighboring crops, and adverse effects on ecological processes and on non-target organisms.

**Ecological risk assessment of HRCs: Focus on weed aspects** Another FAO group of experts has prepared procedures (5) as guidance for authorities in assessing the potential ecological effects of HRCs in order to facilitate decisions as to whether to use or reject these crops. The risk assessment should be conducted on a case-by-case basis and adapted to local conditions. First it is necessary to identify the hazards, such as possible contamination of the gene pool of non-target relatives; possible hybridization of the HRC with botanically identical or closely related populations/species, in both cases either in the agricultural field or in the adjacent ecosystems; changes of weed flora due to the continuous use of herbicides associated with HRCs over large areas for several years; and a detrimental effect on the populations of non-target organisms (*i.e.*, birds, beneficial insects, soil-inhabiting living organisms and microflora) due to the intensive use of HRC and its associated practices.

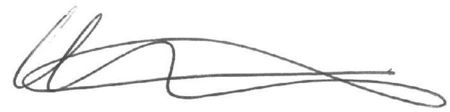
Once the hazards are identified, the risks will be characterized. The risk assessment adopted was the qualitative one due to the complexity of the biological processes involved. This process continued with the identification of the agricultural scenarios and environmental conditions under which the crop will be released. There are two possible scenarios: the HRC will be released into an agricultural system either where (i) there are compatible wild relatives/weed species or (ii) the risk of gene flow is minimal. Based on these, the likelihoods (keys) were defined, giving rise to the following probabilities:
<u>For the first scenario:</u>

- The competitive abilities of wild relatives occurring in undisturbed, uncultivated land will be altered by hybridization with HRC.
- A new type of arable weed will be produced by gene flow between the HRC and its relatives.
- Contamination of non-target crops or areas will take place through pollen or seed dispersal.

<u>For the second scenario:</u>

- HRC will become a volunteer problem on arable land or uncultivated areas.
- Build-up of HR-resistant weeds will occur.

In summary, FAO is in the process of developing guidelines for plant quarantine authorities and associated scientists, to help prevent the introduction of exotic plants that have a high potential for becoming invasive species. FAO is also developing guidelines for extension workers and land managers to help minimize the development of herbicide resistance in agricultural crop weeds. Finally, FAO has developed procedures to help ensure that genetically modified herbicide-resistant crops do not increase weed problems by hybridizing with wild relatives. The implementation of these procedures requires the establishment of national capacities to deal with such tasks. Therefore, FAO in close cooperation with scientists and institutions from different countries, is committed to providing assistance for the training of technical personnel in developing countries in these areas.



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