Weeds: the climate-smart solution

Introduction

Weeds are characterised by their ability to grow and spread rapidly. In the right conditions they can outcompete crops in the battle for resources such as water, nutrition and light. As a result, weeds remain a major problem in agriculture. Without effective weed management, crop losses can reach 20-40% or more. Losses in wheat and maize yields can exceed 80%.

In the past, weed control has relied heavily on the use of herbicides which account for the majority of pesticide use in countries such as the US. However, herbicides suffer from a number of disadvantages, including residues in food and the environment and growing herbicide resistance among weed species. As a result, governments (e.g. in EU) are seeking to reduce overall pesticide use. There are now over 450 confirmed cases of weed species showing resistance to herbicides with particular problems in wheat, maize, rice and soybean. This has resulted in growing pressure to reduce the high levels of herbicide use which enable resistance to emerge. The use of alternative techniques is of obvious importance in organic agriculture where herbicides are prohibited.

This is the challenge addressed by integrated weed management (IWM). A simple definition of IWM is 'the use of more than one weed management tactic (biological, chemical, cultural or physical)' (Harker and O'Donovan 2013). IWM includes herbicides as one part of a broader array of cultural, mechanical and biological methods of control. The basic goal of IWM is to restrict weed growth until a crop is sufficiently well-established (e.g. in the development of crop canopy cover) that it can outcompete weeds.

Cultural IWM techniques include:

- Use of more competitive varieties, mixing cultivars, the use of pest or herbicide-resistant varieties
- Use of clean or herbicide-coated seed to help prevent the introduction of weeds as well as their spread
- Cultivation techniques such as: different tillage practices, the use of stale seedbeds, changing planting timing and density, the use of mulching
- Selective promotion of crop root health such as better fertiliser use and application (e.g. in timing and more targeted application) which benefits crops rather than weeds
- Use of rotations, intercropping and cover crops

Physical methods include:

- Mechanical weeding (e.g. inter-row weeding machines)
- Flame weeding

- Soil solarisation (heating the soil to supress weeds using mulches and plastic sheeting) Biological tools include:
- Exploiting the allelopathic properties of plants (in preventing or slowing weed seed germination and growth)
- Bio-herbicides, use of fungi and bacteria or insects

Chemical techniques (sometimes known as integrated herbicide management) involving using different types of herbicide in different ways at different points: pre-plant incorporated, pre-emergence, post-emergence, tank mixtures or sequential applications.

An example of IWM in practice is the control of *Striga* (also known as witchweed), a parasitic weed attacking cereal crops such as maize, sorghum and millet which has infested an estimated 50 million hectares of land in sub-Saharan Africa (see: http://www.cabi.org/isc/datasheet/51849). Techniques to control *Striga* include:

- The development of Striga-resistant maize varieties by international research groups such as IITA and CIMMYT and national research organisations such as Kenya Agricultural Research Institute
- Herbicide-dressed seeds
- Crop rotation or intercropping e.g. with legumes or soybean
- Use of fungi for biological control

The success of IWM can be seen in trials in Northern Nigeria using a combination of Striga-resistant varieties in rotation with legumes (with allelopathic properties) which has reduced weed density by up to 50% and increased overall crop productivity by over 90%.

Burleigh Dodds Science Publishing is supporting IWM by:

- Commissioning and publishing individual chapters on IWM for particular crops such as wheat and maize
- Developing a comprehensive review of principles and techniques in IWM: *Integrated weed management for sustainable agriculture*, edited by Emeritus Professor Robert Zimdahl of Colorado State University, USA

In this way we are building a rich resource of reference material on IWM for the benefit of the research community.

To preview what we are developing, click here to read an excerpt of our chapter on **Integrated weed management in wheat cultivation** by *K. Neil Harker and John O ' Donovan, Agriculture & Agri-Food Canada; and Breanne Tidemann, University of Alberta, Canada.*

References and further reading

Harker, K. N. and O'Donovan, J. (2013), 'Recent weed control, weed management and integrated weed management, *Weed Technol*. 27: 1-11.

Harker, K. N. and O'Donovan, J. (2016), 'Integrated weed management in wheat cultivation', in P. Langridge (ed.), *Achieving sustainable cultivation of wheat Volume 2: Cultivation techniques*, Burleigh Dodds Science Publishing, Cambridge, UK

IITA Integrated Striga Management in Africa (ISMA) Project : http://www.iita.org/web/isma/home

Liebman, M. et al. (2007), *Ecological management of agricultural weeds*, Cambridge University Press, Cambridge, UK.