Integrated Weed Management: A Possible Solution to Weed Problems in Zimbabwe

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Abstract

Weed pressure is becoming more severe in New Farms due to over reliance on chemical and mechanical weed control methods. Increasing weed population is caused by lack of availability of herbicides on the market, skill in weed identification and correct matching of herbicide to weed. Availability of draught power makes mechanical method ineffective. In addition, over reliance on the two methods can damage soil structure and the environment. A safe, cheap and effective option for farmers could be integrating all methods available, ranging from biological, cultural, mechanical and finally chemicals in that order of preference. This ensures a limit to the introduction and spread of weeds, help the crop to compete with weeds and finally make it difficult for weeds to adapt. The overall benefits to the farmer will include cost minimisation, crop yield and quality improvement and safe environment for useful organism in the crop-soil ecosystem.

Introduction

Above average rainfall experienced during the 2005-2006 season made farmers experience a serious weed problem in Zimbabwe. Weeds are any undesirable plants that can be both a nuisance and a hazard in agriculture. They can cause injury to man and animals. Weeds compete with field crops for soil nutrients, light and water. They harbour insect and disease pests. Weeds interfere with agronomic operations such as fertiliser application and harvesting. Overall weeds increase the cost of crop production.

In Zimbabwe most maize farmers rely on mechanical and chemical methods (Parsons, 1988; King, 1987). Reliance on only one or a limited number of methods in maize production is dangerous because it gives weeds a chance to adapt. Perennial weeds like the Shamva grass (*Rottboelia cochinchinensis*), couch grass (*Cynodon dactylon*) can make mechanical cultivators slip away, while weeds with a watery stem and those with a vegetative mode of reproduction like common purselane (*Portulaca oleracea*) and purple garden sorrel (*Oxalis latifolia*) can re-establish after being shredded into smaller parts. Over reliance on chemicals with the same mode of action results in weeds that are resistant to herbicides. Chemicals cause harm to the user and to millions of micro organisms in the soil crop ecosystem. Herbicides are expensive and in some cases, they are not available on the market. Some farmers
may also fail to match weed type to appropriate chemical control method and end up incurring loss when the weed has not been killed by the wrongly applied chemical.

With problems as those cited above, it becomes essential to broaden and diversify control methods. Research indicates that there is good potential to reduce the number of herbicide applications and utilize lower herbicide doses within competitive cropping systems to ensure a safe environment for all life on the farm (Pannell, 2004).

**Integrated Weed Management**

Weed management requires an integrated approach which is referred to as Integrated Weed Management (IWM). IWM requires the incorporation of all appropriate management techniques including chemical, mechanical, and cultural practices in a weed control program. The approach employs strategies ranging from simple monitoring of pests, through cultural and mechanical to proper timing of application of pesticides with the aim of preventing economically damaging weed out breaks, while reducing risks to human health and the environment.

**Strategies**

**Scouting**

The first process is scouting. Scouting involves walking in the fields and evaluating population of key weed species in the field. Scouting defines the scope of the problem and allows the best management practices to be selected. Number of weeds, species present, and their locations are important. Farmers must take note of the dominant species along with uncommon or perennial weeds. The management strategies to be adopted must control the dominant species, while preventing the spread of uncommon weeds. With proper scouting and weed identification the right chemical, dilution and timing can be determined, and thus reducing the quantities of pesticides as well as mechanical effort required to control weeds.
During scouting the farmers must differentiate weeds by their life cycles into winter annuals, summer annuals, biennials, simple perennials and spreading perennials. Each of these have characteristic well detailed in any standard weed science textbook and farmers should refer to these for clear understanding of weeds in their fields. Also differentiate weeds into broadleaved (Amaranthus hybridus) and grasses types (Echinochloa colona).

Both life cycle and the classes help to determine timing of control and the best combination of strategies to adopt. Annuals and biennials for example are best controlled before they seed so as to reduce next season infestation, while spreading perennials propagate by seed and underground reproductive structures which make their control. Weed population and density helps in determining economic threshold, the density at which control measures can be implemented.

Cultural methods

Cultural weed control is the management of the crop to make it more competitive against weeds. If properly employed cultural techniques reduce weed numbers in the crop field and the few weeds that appear can easily be controlled using reduced levels of chemicals and limited mechanical effort. Cultural control measures include winter tillage and good seed bed preparation, optimising planting date, seeding rate and depth, fertility management, understanding of the crop, field sanitation and the use of adapted varieties (Blackshaw et al, 2006).

Deep winter tillage ensures that weeds are buried to deep levels that have a high carbon dioxide to oxygen ratio where they die from lack of oxygen (Gardner et al, 1985). In addition, early land preparation allows the farmers to plant their crops early enough to ensure fast canopy development before the weeds emerge. Proper seed bed preparation also ensures that the crop, and not the weed, is placed on an ideal environment which gives the latter competitive edge. Practices of minimum and conservation tillage should also be part of an integrated weed management programme, as they leave crop residue in between rows, shading the soil and suppressing weed emergence. With few weeds in the field spot treatment of weeds becomes possible, thus achieving the goal of cost minimisation and environmental protection.

High seeding rates help in shading the weeds and make it difficult for them to take water and nutrients. This weakening gives herbicides in spot treatment a boost. in small holder systems low seeding rates allow light to penetrate into the wide spaces in the canopy and stimulate weed growth (Cralle, 1986). Farmers should also calibrate their equipment in order to ensure uniform seeding at correct depth, for fast crop emergence and good establishment, thus making the crop more competitive.

Fertiliser application methods like broadcasting benefit the weed as well, while placing the fertiliser where the crop only has access allows the crop to outcompete and suppress weeds. After banding nitrogenous fertiliser for four consecutive years, the density of Eulesine indica in maize under both conventional and reduced tillage systems was found reduced by 95 % by Kelner, and Derksen (1996).

Recommended planting dates are important in IWM and must be adhered to. Weeds that emerge after the crop has emerged cause less yield loss than those that emerge before (Liphadzi and Dille, 2005). Late planting makes the need for pre-emergence herbicides, post emergence herbicides and early cultivation to control germinating weeds a necessity. Winter annuals like the wild oats (Avena fatua) and wild mustard (Sinapsis arvensis, aka
Brassica kaber) are a problem in early sown crop, while summer annuals like upright starbur (Acanthospermum hispidum) and black jack (Bidens pilosa) are of concern with late crop. Choice of the correct weed control programme becomes easy if the planting time is planned and well distributed across the season within recommended range.

Farmers should have a clear understand their crop. Maize grows slowly and develop a full canopy after 6-8 weeks and weed control effort should be strong during this period. IWM technique would also require that correct hybrids adapted to the agroecological zone are planted so that the crops grow vigorous to out compete weeds.

Field sanitation prevents weeds from spreading into the field. Practices such as use of clean seed, clean equipment are examples of good field sanitation. Controlling weeds on the edges of the filed, patches of new invading weeds and herbicide resistant weeds should also be done. Weeds should be removed before they seed.

Mechanical methods
Mechanical weed control methods can be employed right from the period before crop establishment. Incorporation of mechanical weed control strategies ensures a reduction of weed pressure late in the season and the few remaining weeds that escape destruction can be controlled using chemical spot spraying. Mechanical weed control methods include, hand weeding, hand hoeing, interrow ploughing and interrow cultivation.

Hand weeding is important for removing weeds within crop rows and too near crop plants for them to be controlled. Hand-weeding is often used as a supplement and in combination with other control techniques. Success with hand-weeding depends on the proper timing of removal, size of the weeds, size of the field and the thoroughness of the people doing the weeding. It is most effective when the weeds are small and not well-established.

However, hand weeding does not control large or perennial weeds like shamva grass (Rottboellia cochinchinensis), those with mechanical strength like cats tail (Sporobolus pyramidalis) and rapoko grass (Eleusine indica). Most importantly, hand-weeding is very labour intensive, thus potentially expensive.

The hoe is used to cultivate the interrow space, digging out, cutting and burying weeds, thus leaving the crop field clean. In large scale commercial farms it is used as supplement in combination with other control techniques. As with hand weeding, success with hoeing depends on the proper timing for removal, size of the weeds, size of the field and the thoroughness of the people doing the weeding. It is also most effective when the weeds are small and not well-established.

Mouldboard ploughing, chisel ploughing, discing or harrowing are commonly used before planting to eliminate emerged annual weeds and to suppress perennial weeds. Use of plough to till the interrow space is not uncommon in communal and small scale commercial farming areas in Zimbabwe. Ploughing can bring the rhizomes of perennial weeds to the soil surface where they are killed by desiccation and freezing depending on the season and location.

Row cultivators are widely used in the production of crops established in rows. Cultivators dislodge or cover many weed seedlings and they work best when weeds are small, before they reach the 3 to 4 leaf stage. A layer of dry soil placed in the crop row by cultivation can also assist in weed control by preventing germination.

However large weeds with extensive root systems require deep tillage for adequate kill, a practice that is now discouraged for its damaging effect on soil structure. Deep tillage also increases the potential for damaging crop
root systems. Effective mechanical control requires precise row spacing, a practice which most farmers are failing to achieve due to shortage of equipment. Weather conditions influence the effectiveness of tillage, with wet conditions causing delays and allowing weeds to proliferate. Rainfall or irrigation soon after mechanical control allows weeds to re-root.

**Chemical methods**

Herbicides kill weeds by inhibiting biochemical processes necessary for growth. Herbicides should be selected based on: crop being grown, crop rotations being used, weed species present, costs, and ease of application and farmers should work closely with extension staff for specific details on herbicide compatibility with their crops. The chemical management of weeds should be minimal due the elevated costs of herbicides and negative impact of chemicals to the environment. Farmers should only resort to this method in dealing with spot problems.

Herbicides can be divided into classes that are well detailed in standard crop protection textbook. For example, selective herbicides like atrazine can be directly applied to maize and other crops listed on their labels without causing injury, while nonselective herbicides such as glyphosate must be applied without coming into contact with the crop. Other classes include preemergence and postemergence. Farmers should always read instructions and understand the class of the chemicals before they use these.

Calibrating crop protection equipment correctly does not only save money, but also helps the farmer to reduce environmental damage and harm to the person applying the herbicide. Herbicides can alter soil chemical properties and affect microbial life in the soil, therefore proper amount of herbicide should be applied evenly on target areas.

**Conclusion**

Integrated weed management in maize and other field crops identifies the weed problem through scouting and combines preventative, cultural, mechanical, biological, and chemical control methods in a compatible manner to solve it. Integrated weed management avoids relying solely on one management tool and helps reduce the need for chemical weed management. The approach combines a series of strategies to profitably produce a marketable maize and other crops without harming the environment. The overall benefits include, clean weed free crop, high quality crop produce, high yield, reduced costs of production, high profit and environmental safety.

**References**


