5. Major weeds of legumes and cereals and control measures

F. Ekeleme
International Institute of Tropical Agriculture
PROSAB, Maiduguri, Borno State

Introduction

Legumes and cereals are important food and cash crops in sub-Saharan Africa. Weed competition is a major constraint in Nigeria. In recent years, the production of these crops has continued to increase, largely due to the increase in food demand arising from population expansion and higher consumer incomes. The highest costs in the production of these crops are for labor and weeding operations that amount to about 25 to 55% of the total costs.

Weed problems

Cereals and legumes are most sensitive to weed competition during their early growth periods. The growth of most legumes and cereals in the first week is rather slow and it is during this period that weeds establish rapidly and become competitive. Maximum weed competition in legumes and cereals occurs during the period of 2 to 6 weeks after sowing. This suggests the importance of maintaining fields weed-free during this critical period. Fields that are kept free of weeds for the first 4 to 6 weeks after planting give the crop a “head start” which enables it to shade out or otherwise out-compete the weeds that emerge later in the season. Uncontrolled weed growth in legumes and cereals causes a grain yield reduction of about 50–70%. A severe weed infestation may not only reduce stands but could lead to the abandonment of the entire farm, especially if it is infested with parasitic weeds, such as *Striga* spp., or perennial grass weeds, such as *Imperata cylindrica.* Apart from causing yield reduction through competition for light, space, and soil nutrients, weeds can produce allelopathic substances that are toxic to these crops. Weeds also often serve as hosts for most insect pests that attack legumes.

Depending on agroecological zones, weeds found in legumes and cereals are essentially the same as those in other arable crops in the same zone. However, parasitic weeds, such as *Striga* spp., infest legumes and cereals mainly in the dry savannas where *I. cylindrica* that infests crops in the moist savanna does not constitute a major production constraint. Some of the major weeds found in legumes and cereals are *Striga hermonthica*, *S. gesnerioides*, *Imperata cylindrica*, *Sporobolus pyramidalis*, *Rottboellia cochinchinensis*, *Chrysanthellum indicum*, *Hackelochloa granularis*, *Thelepogon elegans*, *Boerhavia erecta*, *Vernonia galamensis, Setaria pallide-fusca, Acanthospermum hispidum*, *Eleusine indica*, *Ludwigia abyssinica*, *Commelina nigritana*, *Mariscus alternifolius*, *Fimbristylis hispidula*, *Kyllinga squamulata*, *Mitracarpus villosus*, *Schwenckia americana*, *Cyperus rotundus*, *Ageratum conyzoides*, *Digitaria horizontalis*, *Oldenlandia corymbosa*, *Leucas martinicensis*, *Oldenlandia herbacea*, *Portulaca oleracea, Dactyloctenum aegyptium*, *Solanum nigrum*, *Euphorbia hirta*, *Euphorbia heterophylla*, *Physalis peruviana*, *Cynodon dactylon,* and *Panicum maximum.*

Weed control principles

Weed control is an essential part of all crop production systems. The effectiveness of any weed control program in legumes and cereals depends largely on how timely is the application of control. Most weed control measures (cultural, mechanical, and chemical methods) are effective if applied at the correct time. To plan an effective weed management program, farmers must be able to identify those weeds present in their farms because different weeds vary greatly in their ability to compete with crops and reduce yields. Broadleaf and grass weeds have been reported to compete at different levels of intensity, depending upon the competitiveness of the crop, the tillage system, the environmental conditions, and the other weeds present. In general, broadleaf weeds are more damaging to a broadleaf crop; grass weeds are more competitive in a grass-leaf crop (Anon 2007). Broadleaf weeds are generally more competitive against legumes than grass weeds. Weed control measures should be matched to the specific weed problem.

The use of herbicides is perhaps the most economically viable option for weed control in legumes and cereals planted in large areas. The use of herbicides in legume and cereal production, however, must be combined with agronomic or management practices that would enhance the ability of the crops to compete with weeds. Some of the management practices are (1) suitable and properly timed land preparation, (2) the planting of a competitive crop cultivar, (3) appropriate crop population and spacing, (4) the best time and method of planting, (5) the right method of fertilizer placement (6) rotation, and (7) intercropping. The most effective herbicide on weeds may fail to achieve the desired goal if these management practices are neglected. It is important to note that these practices usually result in little addition to production costs or none. I will discuss briefly some of these methods.

Land preparation

Tillage is an important and practical method of controlling weeds. Suitable land preparation depends on having a good knowledge of the weed species prevalent in the field. I don't mean here that farmers must begin to learn or memorize names of weed species written in Latin but they should be able to recognize a perennial or an annual weed species. An annual weed flowers and produces seeds and dies within a growing season. Perennial weed species tend to grow for more than one growing season before producing seeds. For example, when perennial grass weeds, such as *I. cylindrical,* are predominant in the farm, it is best to plow and harrow in such a way that the roots and rhizomes are fragmented and exposed on the soil surface, facilitating desiccation by wind and sun. Deep plowing is needed when perennial weeds dominate the weed spectrum. Deep plowing buries the weed seeds, generally delays their germination, and distributes them throughout the work soil zone where they remain viable but dormant, until returned to the soil surface by further cultivation. When annual weeds are predominant, shallow cultivation of the soil surface is desirable, as this helps to keep seeds near the surface and often stimulates early germination. *Cynodon dactylon* (bermuda grass) and *Panicum maximum* (guinea grass) can be effectively controlled by frequent shallow cultivation and by subsequently removing the plant parts to prevent reestablishment.

Planting method and time

Depending on the agroecological zone and farm location, legumes may be planted on ridges or on the flat. However, whether on ridges or on the flat, planting in rows

is recommended as this makes the management of farm practices easier. When legumes and cereals are planted in rows, it is easier to achieve the recommended plant population and spacing. The application of herbicide in the form of a directed spray is also easier. Planting should be done soon after land preparation to reduce the risk of weeds germinating before the crop. Weeds that emerge with the crop are generally more destructive. Legumes and cereals should be planted at a time when there would be adequate moisture during the first few weeks after planting to ensure good germination and establishment as these lead to rapid canopy closure and minimize weed growth. Once the full canopy is formed, further weed removal may no longer be necessary as the density of the weeds may fall below the economic threshold. An economic threshold for weeds is the density of a weed population at which control is economically justified because of the potential for yield reduction, quality loss, harvesting difficulties, or other problems that weeds may cause.

Competitive cultivar/appropriate stand population

An optimum plant population of a competitive legume or cereal cultivar is important in maintaining a relatively weed-free farm after the crop has developed a full canopy. Standard spacings are available for rows and interrows for optimum populations for most legumes and cereals. Improved cultivars of legumes and cereals for different agroecological zones in Nigeria are also available. For example, farmers in southern Borno State have adopted several *Striga* resistant/tolerant cultivars of legumes and cereals. Only cultivars that can develop a full canopy cover within few weeks after planting to shade the ground can compete effectively with weeds, provided that these cultivars are planted at a high enough population. Farmers must take the extra pains to replace dead plants as soon as any are noticed to maintain an optimum plant population. Any practice that provides optimum conditions for early and vigorous growth of crops helps to give them a competitive edge over weeds.

Crop rotation

Crop rotation is the practice of growing a series of crops of dissimilar types in the same piece of land in sequential seasons for various benefits, such as to avoid the buildup of weeds, pathogens, and pests that often occurs when one species is continuously cropped on the same field (Anon 2007). Planting different crops over time on the same field is a well-known primary means of preventive weed control (Bàrberi 2003). Different crops bring about different cultural practices, which act as a factor in disrupting the growing cycle of weeds and, as such, preventing the selection of the flora towards an increased abundance of problem species (Karlen 1994; Barberi 2003). In contrast, continuous cropping selects the weed flora by favoring those species that are more similar to the crop and tolerant to the direct weed control methods used (e.g., herbicides) via repeated application of the same cultural practices year after year (Bàrberi 2003).

Chemical weed control

The use of herbicides is probably the most economically viable option for weed control in large-scale legume and cereal production. It is less expensive to use herbicides in such large-scale production than to use other weed control methods, which may require a large amount of paid labor. With herbicides, weeds are controlled early, during the critical period of crop growth when other methods may not be effective or applicable. Less labor is required, compared with other methods. Herbicides can also be combined with other weed control methods. It is important to select herbicides based on the weeds

present in a field, since no single herbicide will control all species of weeds. Herbicides usually control weeds selectively. In most cases, herbicides are often combined to control more species, reduce carryover, or crop injury. Using them effectively requires specific conditions to be met. For example, the correct herbicide for the weed spectrum in legumes and cereals must be selected. It must be applied uniformly at the correct rate at the right time under specific environmental conditions. Soil type, soil organic matter content, soil moisture, rainfall, temperature, and air movement are some of the environmental conditions that can affect the performance of herbicides.

Preemergence herbicides have the advantage of eliminating early competition between crops and weeds. A number of broad-spectrum preemergence (PRE) and postemergence (POST) herbicides are available for use in legumes and cereals (Annex 4). These herbicides are active against most annual grasses and annual broad-leaf weeds. Note that the preemergence herbicides are soil-active and will not kill established vegetation. The preemergence herbicides also will not kill or stop shoots emerging from fragments of rhizomes and stolons of *I. cylindrica* and *Cynodon dactylon,* and from the remains of the basal rootstock of *Panicum maximum* left in the soil after plowing.

In the case of a large field infested with a weed such as *I. cylindrica*, the appropriate approach would be to slash the field mechanically and allow regrowth for 2 weeks. Alternatively, the area needed for cultivation should be burned (controlled burning) and the shoots allowed to grow for 2 weeks. Apply glyphosate (Roundup or Touch down) at the rate of 6–8 L/ha to the young shoot regrowth. Allow 2 weeks or 14 days before plowing and harrowing. Apply Primextra at the recommended rate soon after planting. It is very important that the desired preemergence herbicide is applied immediately after planting with some measure of precision to meet the objective. Excess use of herbicide is wasteful, and may also damage the crop. Too little will result in poor weed control. In either situation, the farmer will sustain economic loss. The key to successful herbicide spraying is the proper calibration of the sprayer. Before herbicide is applied in the field, the amount of water required to give an even coverage to the plot should be determined. The National Advisory Committee on Weed Control (NACWC 1994) recommends the following procedure for calibrating a knapsack sprayer.

- Check all parts of the sprayer to ensure that they are functioning properly.
- Calibrate the sprayer in the field shortly before spraying to simulate the conditions usually encountered during actual operations.

1. Measure and mark off an area of 100 m^2 (2 m × 50 m).
2. Fill the sprayer with water to the desired level.
3. Spray the marked area, walking at a normal and comfortable pace and using a constant pumping speed.
4. Determine the time it takes to spray the area.
5. Repeat the procedure at least three times and determine the average time.
6. Determine the nozzle discharge rate.

The nozzle discharge rate refers to the volume unit area of spray solution discharged. To determine the nozzle discharge rate, fill the spray tank either to the top or to a known level. Following step 3, spray the marked area and measure the amount of liquid required to refill the tank to the original level after the spraying. In each of the above methods, repeat the procedure at least three times to ensure a constant discharge and determine the average volume used to cover the 100 m^2.

Example: Assuming that, in the above calibration exercise, a knapsack sprayer delivers 2.5 L of water over the 100 m^2 test area. Delivery rate is:

$$\frac{2.5 \text{ litres}}{100 \text{ m}^2} \times \frac{10000 \text{ m}^2}{1 \text{ ha}} = 250 \text{ L/ha}$$

The quantity of water delivered in 1 ha = 250 L. Therefore in 5 ha, the quantity of water delivered will be 1250 L. Assuming the farmer has a 20 L capacity knapsack, the sprayer will carry approximately 63 loads of the knapsack to spray a 5 ha maize plot. Assuming that a farmer is to apply Primextra 500 FW at the rate of 6 L/ha, he would need to add 480 ml of the herbicide to his 20 L capacity knapsack. Note that delivery rates can be increased or decreased by changing the sprayer nozzle, sprayer speed, and nozzle pressure.

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