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Weed management
in millets

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Millets are 'nutri-cereals' traditionally grown in resource-poor agro-climatic regions of the country. Weeds are one of the major deterrents in sustaining the productivity of these crops. Weeds compete with millets for nutrients, soil moisture, solar radiation and space; and reduce the yield and quality of produce. Appropriate weed management would improve productivity and input use efficiency of these crops in semi-arid regions.

Key words: Millets, Weeds, Weed management



Pre-emergence application of atrazine in finger millet



Weedy check

Millets are small seeded grains, and are classified into major and small millets. Sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*) are considered as major millets, while finger millet (*Eleusine coracana*), kodo millet (*Paspalum scorbiculatum*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), proso millet (*Panicum miliaceum*) and barnyard millet (*Echinochloa frumentacea*) are grouped into small millets. Weeds are a major deterrent in increasing the productivity of these crops especially during rainy season.

Major weeds flora of millets

Weed flora in millets vary depending up on the season, agro-ecological condition and level of management. Major weeds associate with millets in different millets growing regions of country are classified, Table 1. Seedling of these crops are comparatively small and grow slowly for the first 20 to 25 days and consequently do not compare well with most weeds in early stage of crop growth, especially under the adverse condition. In addition, these crops wider rows spaced and do not have much canopy in terms of branching and leaf size during initial growth to stand up to weed competition.

Crop-weed competition and losses

Emergence of the weeds begins simultaneously with crops leading to the severe completion between weeds and crop right from early stage. Because, crops canopy forms slowly and provide little shading of weeds between rows until mid-season; by then most weeds are well established. Weeds compete with millets for nutrients, soil moisture, sunlight and space when they are limiting. The losses due to weeds in millets comprise: (*i*) direct yield losses from reduced crop quality, (*ii*) indirect losses from reduced crop quality, (*iii*) increase costs in harvesting, land preparation and similar operations, and (*iv*) harbours insects pest and diseases. Losses due to weeds are greater in rainy season than in post-

Table 1. Major weeds of millets

Groups of Weeds Scientific name	English name	Family
Grasses		
Cynodon dactylon	Bermuda grass	Poaceae
Brachiaria ramose	Brown top millet	Poaceae
Digitaria sanguinalis	Crab grass	Poaceae
Dactyloctenium aegyptiam	Crowfoot grass	Poaceae
Dinebra retroflexa	Viper grass	Poaceae
Chloris barbata	Peacock plume grass	Poaceae
Eleusine indica	Goose grass	Poaceae
Echinochoa colona	Jungle rice	Poaceae
Sorghum halepense	Johnson grass	Poaceae
Setaria glauca	Yellow foxtail	Poaceae
Setaria viridis	Green foxtail	Poaceae
Panicum repens	Tarpedo grass	Poaceae
Paspalum paspaloides	Hilo grass, Sour grass	Poaceae
Broad-leaved grass		
Convolvulus arvensis	Field bind weed	Convolvulaceae
Acanthospermum hispidum	Bristly starbur	Asteraceae
Achyranthes aspera	Prickly chaff flower	Amaranthaceae
Commelena benghalensis	Tropical sipder wort	Commelinaceae
Ageratum conyzoides	Bill goat weed	Compositae
Amaranthus Viridis	Pigweed	Amaranthaceae
Amaranthus palmeri	Palmar amaranth	Amaranthaceae
Amaranthus retroflexus	Redroot pigweed	Amaranthaceae
Boerhaavia diffusa	Hog weed	Nyctaginaceae
Celosia argentea	White cock's comb	Amaranthaceae
Cleome viscosa	Cleome	Capparridaeceae
Digera arvensis	False amaranth	Amaranthaceae
Portulaca olerecea	Common purslane	Portulacaceae
Euphorbia hirta	Pill pod spurge	Euphorbiaceae
Eclipta alba	False daisy	Compositae
Corchorus acutangulus	Jew's mellow	Tiliaceae
Ipomoea haderacea	Morning glory	Convolvulaceae
Trianthema portulacastrum	Horse puslane	Aizoaceae
Tridex procumbeans	Coat buttons, tridex	Compositae
Tribulus terrestris	Puncture vine	Zygophyllaceae
Xanthium strumarium	Common Cocklebur	Asclepiadaceae
Sedges		
Cyperus rotundus	Purple nut sedge	Cyperaceae
Parasitic		
Striga	Witch weed	Scrophulaceae

Table 2. Herbicides recommended for weed control in sorghum

Herbicide	Dose (kg/ha)	Time of application	Weeds controlled	Remarks
Atrazine	0.75-1.0	Pre-emergence/ early post-emergence	Broad-spectrum weed control. Some grasses are tolerant	For sole crop only. Does not control *Acrachne racemosa*, *Commelina benghalensis*
Metolachlor	1.0-1.5	Pre-emergence	Effective control of grasses	Suitable for intercropping
2,4-D	0.50-0.75	Post-emergence	Effective against broad-leaved weeds	For sole crop only. Apply between 4-6 weeks after planting. Good as sequential application to pre-emergence
Atrazine + pendimethalin	0.75 + 0.75	Pre-emergence	Broad-spectrum weed control	For sole crop only
Atrazine + metolachlor	0.75 + 0.50	Pre-emergence	Broad-spectrum weed control	For sole crop only

One supplementary weeding at 30 days after sowing following pre-emergence herbicides is required for broad-spectrum weed control and higher yields.

rainy season because of limited fieldwork days and heavy weed infestation. In most of millets, initial period of 4-6 weeks after seedling emergence was found as critical period and therefore, post-emergence cultivation or herbicide application should not be delayed beyond three weeks after planting. Uncontrolled weed infestation reduce crop yield between and 15 to 83% in sorghum 16 to 94% in pearl millet and 55 to 61% in finger millet depending on crop cultivars, nature and intensity of weeds, spacing, duration of weeds infestation, management practices and environmental conditions.

WEED MANAGEMENT

Mechanical and cultural practices

Hand weeding or inter-row cultivation are the most widely followed methods of weed control in millets. But during rainy season, there are not many clear days and as a result, inter-culture operations are delayed, due to which, weeds overtake the crops and cause severe reduction in yield. Also with rising labour wages and non-availability of adequate labour at times required, it is becoming a serious problem to control weeds manually on larger area at the optimum time. A good cover crop of cowpea, greengram or blackgram, narrow spacing between and within the rows smother the weed growth. Narrow rows (>30cm) are beneficial in reducing weed the competition and increasing yield of foxtail and proso-millets. Mulching soil surface between crop rows with crop residue materials like straw, many prevent germination of weed seeds and smother the established young weeds. The mulching practices also help in conserving soil moistures in semi-arid regions. Crop rotation with trap crop/catch crops i.e. soybean and cotton, intercropping of sorghum /pearl millet with groundnut, soybean and cowpea and green-manuring crops like *Sesbania* help in reducing the problem of parasitic weed *Striga* spp. in millets.

Use of herbicides

In no-till condition, herbicides are becoming a major component of



Sorghum Pigeonpea intercropping



Weed free plot of sorghum



Weed infested sorghum

Table 3. Herbicides recommended for millets

Millets	Herbicide	Dose (kg/ha)	Time of application	Weeds controlled	Remarks
Pearl millet	Atrazine	0.50	Pre-emergence/ early post-emergence	*Trianthema portulacastrum* and *E. colona*	For sole crop only
	2,4-D	0.50-0.75	Post-emergence	Effective against broad-leaved weeds	For sole crop only. Apply between 4-6 weeks after planting. Good as sequential application to pre-emergence
	Pendi-methalin	0.50-0.75	Pre-emergence	Broad-spectrum weed control	Each supplemented with one hand weeding at 45 days after supply
	Oxadiazone	1.0	Pre-emergence		
Finger millet	Oxadiazon	1.0	Pre-emergence	BLWs control	
	Isoproturon	0.50-0.75	Pre-emergence		
Kodo millet	Isoproturon	0.50	Pre-em.	BLWs control	

weed management in grain sorghum as they improve weed control and production efficiency. Several herbicides were evaluated in sorghum (Table 2). However, in other millets, the herbicide options are limited (Table 3). Most commonly atrazine is the only herbicide used for weed control in sorghum and pearl millet.

Intercropping

Growing of intercrops in widely spaced row not only reduces intensity of weeds but also gives additional yield. Although intercropping may reduces the weed infestation and growth, there is still a need for some degree of weed management in most cases. While second weeding may be needed in sole crop, this is often not required in intercropping since the canopy coverage is almost complete and weed growth after first weeding is minimal. Manual or mechanical weed control is the main method in intercropping systems. Most herbicides are crop specific and therefore all herbicides cannot be used in intercropping systems. Use of pendimethalin (0.75 to 1.0 kg/a), metolachlor (1.0 kg/ha), butachlor (0.75 to 1.0 kg/ha) was found safe and effective in intercropping systems.

Management of Striga

Striga also known as 'witch weed' is a major biotic constraint in the subsistence agriculture and causes considerable crop damage in maize, sorghum and millets in the semi-arid tropics. The yield reduction due to *Striga* infestation varies from 70 to 100% depending up on the level of infestation and management practices.

Hand pulling is the most common control measure used by the small holder farmers. Hand-pulling, however, is no solution to a dense infestation but it should be encouraged to prevent new or light infestations getting worse. Plants which are pulled, within 2-3 weeks of the start of flowering, should be taken out of the field and burnt to prevent seed production and further spread of seeds. Cattle should not be fed 'witch weed' plants as seeds pass through the cattle and are distributed in the manure.

Chemical control: There is no good selective herbicide to control *Striga* in field crops. Since *Striga* is a broad-leaved plant, use of pre-plant/pre-emergence herbicides such as atrazine, oxyfluorfen shows some effect. Post-emergence application of 2, 4–D is effective when sprayed on the *Striga* leaves.

SUMMARY

Due to slow initial growth and wider row spacing, millets are heavily infested with weeds especially during rainy season. In most of millets, initial period of 4-6 weeks after seedling emergence was found critical. Uncontrolled weed infestation reduce crop yield by 15 to 83% in sorghum, 16 to 94% in pearl millet, and 55 to 61% in finger millet. Crop rotation with trap crop/catch crops i.e. soybean and cotton, and intercropping of sorghum /pearl millet with groundnut, soybean and cowpea and green-manuring crops like *Sesbania* help in reducing the weed problem including parasitic weed *Striga* spp. Integration of pre-emergence herbicides and intercultural operations (hoeing and hand weeding) at 30 to 35 days after sowing provides effective and economical weed control in semi-arid regions.

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