

Management of problematic weeds in sugarcane

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Timely and effective weed management is one of the major challenges for increasing the productivity of sugarcane. The emergences of weeds in different flushes further aggravate the problems. The initial 60 to 120 days period of crop growth is considered as most critical for weed competition, thus a weed free period of 2-4 months is essential for better yield realization. Uncontrolled weeds in sugarcane field may cause a yield reduction to the extent of up to 76 %. An integrated weed management technology using cultural + mechanical + chemical was developed which can effectively manage these problematic weeds in sugarcane field.

Key words: Herbicides, Sugarcane, Trash mulching, Weeds

Sugarcane (*Saccharum officinarum*) is the most important sugar crop in India occupying an area of 5.03 m ha with an average productivity of 70.86 tonne/ha. The crop is grown as main crop as well as a ratoon crop (about 50% of total sugarcane area with an average productivity of 45 tonne/ha). There are total 527 sugar factories operating with production of 32.15 million tonne of sugar. Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu are the major sugarcane growing states contribute about 81% of the total production in India. There are many challenges for increasing the productivity, among which the timely and effective weed management is one of them.

Losses caused by weeds in sugarcane

Weeds poses tough competition to sugarcane crop because of wide spacing, slow germination and growth at initial stages, heavy fertilization and frequent irrigations. It

severely reduces tonnage in the field, sucrose recovery in plant and ratoon crop. Depending upon the season, growing condition, soil types, regions and intensity and diversity of weed flora etc., the losses due to weed infestation may vary from 38 to 76%. The total cane yield loss in the country per annum is around 25 million tonne (equivalent to 2.5 million tonne of sugar) valued around ₹ 1,500 crore. Further, weeds harbour certain disease and insect pests that attack sugarcane and thus lead to indirect losses. For example, Bermuda grass (*Cynodon dactylon*),

the cogon grass (*Imperata cylindrica*) and other graminaceous weeds are known to be alternate hosts to Ratoon Stunting Disease of sugarcane. Twining weeds (*Ipomoea* spp.) which sprout at later stages and twine around clumps affect cane growth and cause around 25% loss in yield. In some sugarcane growing districts of tropical zone, *Striga* a parasitic weed is also creating a great problem and threatening cane cultivation in these areas.

Critical period of crop-weed competition

The nature of weed problem in sugarcane cultivation is quite different from other field crops because sugarcane is planted with relatively wider row spacing and crop growth is very slow in the initial stages. It takes about 30 to 45 days to complete germination and another 60 to 75 days for developing full canopy cover. The initial 60 to 120 days period of crop growth is considered as most critical period of weed competition.



(A) A view of heavy infestation of weeds in sugarcane crop (above) and (B) manually weeded out (below).



Inter-row cultivation through rotary weeder needs manual weeding in intra-row in sugarcane

Therefore, the weed management practice adopted should ensure a weed-free field condition for the first 3-4 months period.

Common weed flora

Sugarcane crop being grown in different season under different agro-climatic conditions with variable management practices, the crop is infested with almost all types of weeds viz, grassy, broad leaved weeds and sedges. Besides twining and parasitic weeds are also threatening. Nearly 63 weed species belonging to 58 genera and 26 families affecting the sugarcane crop, out of these 63 species, 52 belongs to dicot families and 10 monocot families. Most common weeds of sugarcane in India are *Cyperus rotundus* (sedge); *Cynodon dactylon*, *Digitaria sanguinalis*, *Dinebra retroflexa*,

Eleusine indica, *Panicum* spp., *Dactyloctenium aegyptium*, *Sorghum helepens* (among grasses); *Chenopodium album*, *Trianthema portulacastrum*, *T. monogyna*, *Convolvulus arvensis*, *Amaranthus viridis*, *Digera arvensis*, *Portulaca oleracea*, *Lactuca runcinata*, *Euphorbia hirta*, *Euphorbia geniculata*, *Eclipta alba*, *Commelina benghalensis*, *Phyllanthus niruri*, *Cleome viscosa*, *Cannabis sativa*, *Luffa graveolans*, *Trichosanthes cucumerina* and *Ipomoea* spp. (among broad leaved weeds).

Weed management approaches

Tillage: Tillage operation is quite effective in controlling weeds through the means of ploughing, discing, harrowing and leveling which enhances the germination of weeds through soil tilling and exposure to sunlight. Tillage

operations control annual as well as perennial weeds by physically damaging them on both above ground part and below ground. Blind hoeing before the sprouting of sugarcane followed by 2 to 3 manual or mechanical inter-row cultivation during tillering stage of crop growth is essential. Afterwards, the grand growth stage of the cane takes care of the weeds by smothering effect. Double pass of rotary weeder/tiller was found effective in managing the weeds in sugarcane.

Intercropping: Intercropping plays significant role in covering soil quickly and efficient utilization of resources/input and minimize the crop-weed competition. Among intercropping systems, sugarcane + cowpea/ greengram/blackgram can effectively reduce the weed density and dry weight of weeds as compared to sole crop up to 120 days after planting, with corresponding weed control efficiency ranges from 37 to 42%.

Trash mulching: It is highly useful in sugarcane for moisture conservation and suppression of weeds. Mulching the inter-row spaces with 5 to 10 cm thick-layer of dry leaves of sugarcane (trash) or any other organic source is quite effective. About 10 to 12 tonne of sugarcane trash per hectare is enough to provide the desired thickness of mulching. To increase the efficiency of mulching, a thorough hoeing and weeding in the field before spreading the trash is required. Besides, the trash on decomposition release nutrients which improves the soil health. Due to in *in-situ* availability of trashes,



Profitable vegetables-based intercropping with autumn planted sugarcane smother the weeds



Role of trash-mulching for effective control of weeds in sugarcane

mulching in ratoon is more convenient than in the plant crop. Bagasse, paddy husk, hay, straw etc. can also be used as mulching material.

Chemical method: Several herbicides were found effective in controlling weeds. Pre-emergence application of atrazine, metribuzin, ametryn, sulfentrazone, flumioxazin either alone or in tank mix can effectively control the weeds for initial 35 to 45 days and thereafter post-emergence application of herbicides like 2,4-D, ethoxysulfuron, halosulfuron, ametryn, chlorimuron further manage the weeds for another 35 to 45 days. Recommended herbicides for the management of weeds in sugarcane are mentioned in Table 1.

Integrated weed management

It is the integration of two or

more weed-control methods at low input levels for reducing weed competition below an economical threshold level in the crop. It is basically a combination of effective, dependable and workable weed management practices that can be used economically by the producers as a part of sound farm management system. Hence, to get effective control of composite weed flora in sugarcane, a logical combination of several weed control methods will certainly prove the most effective approach for season-long weed management. Pre-emergence application of atrazine@2.0 kg/ha followed by 2, 4-D @ 1.0 kg /ha at 60 days after planting added with one hoeing at 90 days after planting provided season- long weed control and the highest productivity of sugarcane and monetary returns. Post-emergence application of

glyphosate @ 1.0 kg a.i. at 25 days after planting + one hoeing at 60 days after planting proved efficient in controlling the weed problems and proved to be economical compared to 3 manual hoeings at 30, 60 and 90 days after planting.

The herbicides recommended for plant cane and ratoon cane may not be suitable under sugarcane based intercropping systems. Pre-emergence application of oxyfluorfen@ 0.23 kg/ha or pendimethalin@ 0.75-1.0 kg/ha proved effective in reducing weed growth and provided highest monetary net returns in sugarcane-garlic/cabbage/pea/green gram/blackgram intercropping systems. Similarly, pre-emergence or early post-emergence application of metribuzin @ 0.75 to 1.25 kg/ha could be used in sugarcane + potato inter-cropping. Post-emergence application of metsulfuron @ 4-6 g/



Ametryn+2,4-D+ Halosulfuron @ 1500+725+60 g/ha (PO)



Ametryn @ 1500 g/ha (PE) fb Flazasulfuron (SL 160) at 50 g/ha (PO)

Table 1. Recommendation of herbicides in sugarcane

Herbicides	Dose (a.i) (g/ha)	Product (g/ml/ha)	Application time	Remarks
Pendimethalin	1,000-1,250	3,000-4,000	Pre-emergence	Apply within 2-3 days after planting/sowing at appropriate soil moisture. Controls many annual grasses and some BLWs. Suitable for sugarcane-based intercropping systems.
Oxyfluorfen	250	1,050	Pre-emergence	Apply within 2-3 days after planting/sowing at appropriate soil moisture. Controls many annual grasses and some BLWs. Suitable for sugarcane-based intercropping systems.
Atrazine	2,000	4,000	Pre-emergence/ PO	Apply early within 2-3 days after planting at appropriate soil moisture. Controls many annual grasses and some BLWs. It can also be applied as early post-emergence or as lay by application.
Metribuzin	1,000-1,250	1,400-1,800	Pre-emergence/ PO	Apply within 2-3 days after planting at appropriate soil moisture. Controls many annual grasses and BLWs. It can also be applied as post-emergence (60-75 DAP). Its also effective against binding weeds. It can be tank mixed with 2,4-D for broad-spectrum control.
Ametryn	1,500-2,000	1,875-2,500	Pre-emergence/ PO	Apply within 2-3 days after planting at appropriate soil moisture. Controls many annual grasses and BLWs. It can also be applied as post-emergence (60-75 DAP). Its also effective against binding weeds. It can be tank mixed with 2,4-D for broad-spectrum control.
Sulfentrazone	1,000-1,200	2,500-3,000	Pre-emergence/ Early PO	Apply within 2-3 days after planting at appropriate soil moisture. Controls many annual grasses and some BLWs. Also effective against <i>Cyperus</i> .
Flumioxazin	150	300	Pre-emergence	Apply within 2-3 days after planting at appropriate soil moisture. Controls many annual grasses and some BLWs.
2,4-D	1,500		Post-emergence	Apply as post-emergence (45-90 DAP). Controls BLWs including binding weeds and sedges.
Halosulfuron	67.5-78.75	90-105	Post-emergence	Apply as post-emergence (25-45 DAP at 2-3 leaf stage of <i>Cyperus</i> sp). Controls only sedges. It can be tank mixed with metribuzin/atrazine/ ametryn.
Metsulfuron	6 to 8	30 to 40	Post-emergence	Apply as post-emergence (25-45 DAP Controls only BLWs, binding weeds and some <i>Cyperus</i> sp.
Ethoxysulfuron	60	400	Post-emergence	Apply as post-emergence (25-45 DAP Controls only BLWs and some <i>Cyperus</i> sp.
Flaxasulfuron	50-60	500-600	Post-emergence	Apply as post-emergence (25-45 DAP Controls grasses, BLWs and <i>Cyperus</i> sp.

DAP, Diammonicune Phosphate

ha can be used for effective control of weeds in sugarcane + wheat inter cropping system.

Management of weeds

It is difficult to control some weeds. As to how they are managed is discussed here.

Sorghum halepense

Sorghum halepense is classified as obnoxious weed due its greater difficulty to control ranked as the world's sixth worst and most obnoxious and persistent weed species. It is infesting sugarcane almost in whole sugarcane growing area *kharif* during and reduces the yield potential by 40 to 70 %. The weed can be mechanically controlled through hoeing at early stage. Frequent mowing leads to arrest in seed formation, rhizome production, and shoot re-growth, which ultimately affect the growth and development of established plant. Summer deep tillage is also helpful in controlling its population. Several herbicide pre-metribuzin, ametryn and atrazine as well as post-emergence trifloxysulfuron, asulam and glyphosate are available to control this weed.

Cyperus rotundus

Purple nutsedge (*Cyperus rotundus*), is a most troublesome and economically damaging weed, which is widely spread in the tropical and subtropical regions of the world. This weed is reported to cause 20 to 90% yield losses in various agricultural crops throughout the world. Sugarcane growers in India experienced an increase infestation of purple (*C. rotundus*) and yellow nutsedge (*C. esculentus*) to the tune of 60 to 80% of the total weed flora in sugarcane fields in India.

Deep tillage helped in lifting and bringing the tubers from 35 to 40 cm depth to closer to ground surface that invariably causes 70 to 100% reduction in tuber sprouting through exposing to heat and dehydration.

Application of post-emergence herbicides, including haloxyfop-*R*-methyl, halosulfuron, and glyphosate, is promising for the control *C. rotundus*, as these herbicides



Herbicides (halosulfuron and flazasulfuron) found effective against *Cyperus rotundus*

translocate into the tubers and reduce their viability. There are number of new molecules to control this weed species, among that best is ethoxysulfuron at 60 g/ha provide excellent control of *Cyperus rotundus*. Halosulfuron- methyl at 90-120 g a.i./ha applied 3-4 leaf stage of weed (45 day after planting) provides effective control (97.8 to 97.9 %) of *C. rotundus* without any adverse carry over effect on the follow up crops (black gram, maize and cucumber) even up to the dose of 150.0 g/ha. Sulfentrazone (1,200 g a.i./ha) a pre-emergence provides greater mortality rate of *C. rotundus* tubers and consequent reductions in the numbers of viable tubers. Flazasulfuron, a sulfonyl urea herbicide is selective and systemic herbicide for the broadspectrum control of weeds in sugarcane. Its application either pre- or post-

emergence provides season-long control of *C. rotundus* in sugarcane.

Cynodon dactylon

Legumes or other cover crops are sometimes used for smothering *C. dactylon* since the weed does not tolerate deep shade. Vigorous crops and higher crop density may be important in reducing weed competition. Intercropping systems in sugarcane helps in checking the growth of *C. dactylon*. Minimum tillage using glyphosate for sugarcane eradication before replanting is preferred to ploughing out stools and *C. dactylon*. Deep summer ploughing three times at 3 to 4-week interval reduced its infestations in the newly planted crop from 44 to 51%. Application of glyphosate as a post-emergence at either 2.24 or 3.36 kg ai/ha with special hood applicator in late

August, *C. dactylon* infestation was found to reduce to the level below 20%.

Striga spp.

Striga is a parasitic weed, adversely affecting sugarcane productivity in semi-arid regions. Hand weeding/pulling is the simplest and easiest control method recommended to prevent seed setting and seed dispersal. Due to high labour costs, repeated hand-pulling should not begin until 2 to 3 weeks after begins to flower to prevent seed rain/setting.

Trap-crops cause to stimulate suicidal germination of the weed, which reduces the seed number in the soil. Some crops suitable for intercropping in sugarcane such as cowpea, groundnut and soybean have potential to cause suicidal germination of *Striga* and it also improves soil fertility. Incorporation



IWM consisting of pre-emergence application of atrazine fb trash mulching fb post-emergence application of 2,4-D at 75 DAP



Protected application of glyphosate@1.5-2.0% in interrow of sugarcane controls Doob grass effectively



Adverse effect on sugarcane due to heavy transpiration loss of water by *Striga* sp.

of organic manure such as composts, manures and inorganic fertilizers helps in increases the competitive ability of the crop over the weed. Application of higher doses of N fertilizers and frequent irrigations are highly recommended especially in the *Striga* infested patches. To control striga in sugarcane, integrated nutrient management through organic manure and fertilizer application, a fertility augmented soil strategy need to be adopted to reduce the infestation of *Striga*.

40 days can effectively control this parasitic weed.

Ipomoea spp.

Ipomoea is a climbing weed that entangle themselves with and climb up the cane plant. They generally tend to germinate later in the season when the cane is more advanced. Vines are relatively easy to kill but can be difficult to manage. They germinate over a long time and even under a closed canopy. It germinates readily through a trash blanket and grow prolifically.

It is difficult to apply pre-emergent herbicides to a trash blanket and so only knockdown herbicides can be used for control. The creeper weeds (*Ipomoea hederacea*) cause damage to crops not only by below ground competition but

also by disturbing the crop canopy by closely adhering to the crop plants (sugarcane). Twining weeds which sprout at later stages and twine around clumps affect cane growth and cause around 25% loss in yield. Beside severely hindering the harvesting of the crop.

At early stage of weed, it can be easily uprooted manually but due to its emergence in later stages of the crop which coincide with the early grand growth period of the sugarcane, it is very difficult to enter in the field and uproot this weed. Preliminary studies at India Institute of Sugarcane Research, Lucknow showed that tank mix application of metribuzin + 2,4-D @ 1.25 + 1.50 kg/ha at about 1.5 feet height of this weed was found effective to get rid of this weed.

SUMMARY

Weeds are one of the major challenges in increasing the productivity of sugarcane. They cause 38 to 76% yield loss depending on the nature of weed flora and duration of crop-weed competition. The total cane yield loss in the country per annum due to weeds is around 25 million tonne (equivalent to 2.5 million tonne of sugar) valued around ₹ 1,500 crore. *Sorghum halepense*, *Cyperus rotundus*, *Cunodon dactylon*, *Ipomoea* spp., and *Striga* spp. are the major weeds in sugarcane. Integrated weed management involving pre-emergence application of atrazine@2.0 kg/ha fb trash mulching fb post-emergence application of 2,4-D at 75 day after planting added with one hoeing at 90 day after planting provided season-long weed control and the highest productivity of sugarcane and monetary returns.



Sugarcane field infested with *Ipomoea*

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