REVIEW ARTICLE

Crop Weed Competition in Sugarcane–A Review

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Abstract

Sugarcane (*Saccharum officinarum* L.) is the most adaptable plant under sub-tropical and tropical conditions. Among the C_4 group of plants, sugarcane is one of the most efficient crops. Converting the efficiency of solar radiation into photosynthates is relatively higher in sugarcane than any other crops evolved. But there is a wide yield gap between the potential and actual yield. Weeds are the important major threat in a yield reduction of sugarcane crop. Hence knowledge about weed flora, a critical period of crop weed competition, the competition of weeds, the effect of weed on crop growth is helpful in deciding the method of weed management in particular crop. Reviewing these parameters is helpful, and it is carried out in this paper.

Keywords: Chemical weed management. Sugarcane, Weeds, Weed flora

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Introduction

Sugarcane (*Saccharum officinarum*. L.) crop occupies an essential position in Indian agriculture. It is the most important and celebrated crop cultivated widely in India since time immemorial. It is the second-largest organized cane-based agro-industry in the country next to textile. It employs over 40 million cane growers and about 3.5 lakh skilled and unskilled workers. Sugarcane is grown in not less than 105 countries, and presently it covers a total acreage of about 19 million hectares for world production of approximately 1.3 billion tonnes of cane and 127 million tonnes of sugar. Today, India maintains the second position, next to Brazil in terms of production.

The reasons for low yield of sugarcane includes improper land preparation, conventional planting methods, less than recommended seed rate, heavy weed infestation, shortage of irrigation water, imbalanced fertilizer application, less support price, lack of coordination between growers and mill owners, natural calamities, delayed harvesting, pests and disease incidence, poor management of ratoon crop and salinity. Among the various factors limiting cane production, weed infestation is one of the significant biotic constraints in sugarcane production (Malik and Gurmani, 2005).

Weed flora of sugarcane

The type and number of weed species vary from country to country due to varied climatic, edaphic, and biotic factors. Different types of weed population have reported losses up to 40% of cane yield. Johnsongrass and tall perennial grasses decreased cane yield by 36% and sugar yield by 31% compared to weed-free sugarcane fields (El-Shafai *et al*., 2010).

The typical weed flora observed in the ratoon sugarcane crop was *Cyperus rotundus, Cynadon dactylon, Sporobolus* sp., *Digitaria sanguinalis, Trianthema portulacastrum, Amaranthus viridis, Gyanandropsis pentaphylla, Cleome viscosa, Euphobia hirta* and *Tridax procumbens. Cyperus rotundus* among sedges and *Trianthema portulocastrum* and *Cleome viscosa* among dicots were predominant and these species occupied about 70% of the total weed density (Chitkaladevi *et al*., 2010).

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Cyperus rotundus, Dactyloctenium aegyptium, and *Trianthema portulacastrum* were the major weeds observed in Karnal (Singh *et al*., 2011). At Coimbatore, the major weed flora of the sugarcane field included *Trianthema portulacastrum, Portulaca quadrifida, Corchorus olitorius, Datura fastuosa, Digera arvensis Cyperus rotundus, Cynodon dactylon, Dactyloctenium aegyptium, Chloris barbata* and *Setaria verticillata* (Kalaiyarasi, 2012).

Critical period of weed competition

Weeds compete with cultivated crops for growth factors (water, light, nutrients and space), and harbor pests and plant pathogens. Knowledge and understanding of a critical period of the crop weed competition is essential to formulate the suitable weed management practices for enhancing the productivity of sugarcane. The competition depends upon the crops stand and weed population as well as the competition period. The critical period of weed competition in the shortest time span during the crop growth

When weeding results in the highest yield and economic returns. The initial period of weed competition starts with the beginning of interference from weeds and ends when the crop covers 80% of soil. Singh and Singh (1979) concluded that weed crop competition is effective for 120 days of crop growth in sugarcane and zero weed crop competition for the first 120 days of growth period enhanced cane yield

by 45%. However, after 120 days, zero competition was not advantageous. However, Srivastava (2003) reported that in India, the critical period of weed- crop competition in sugarcane ranged between 27 and 50 days. The length of the critical period of weed competition depends on the nature of crops, its competitive ability, variety, growth habit, field conditions, and planting techniques. As the plant grows, leaf area index and root density increase, leading to mutual interference in the absorption of one or more growth factors (Reddy and Reddi, 2002).

In a sugarcane field, where the purple nutsedge (*Cyperus rotundus*) was predominant weed species, weed crop competition started even at the initial sugarcane sprouting stage. However, the purple nutsedge is very sensitive to sugarcane canopy shading and low temperature. Hence, competitions ended at 22 days after planting (Kuva *et al*., 2000).

Patel *et al*. (2007) reported that when sugarcane field that was kept weed-free up to 150 DAP. It gave higher cane height, many millable canes ha^{-1}, cane yield, commercial cane sugar (C.C.S) as well as higher economic returns. Weeds compete throughout the life cycle of the main crop, but it is more sensitive to the presence of weeds at a specific period during which it causes maximum yield losses while Zafar *et al*., (2010) have reported that the critical period of weed crop competition in sugarcane ranged between 100 to 105 days.

Competition of weeds for moisture

Weeds absorb more soil moisture and remove as much as 750 to 1250 tonnes of water in one hectare of land (Srivastava and Chauhan, 2002). On average sugarcane required about 30–40 irrigations. In the early stage of crop growth (45 DAP) frequent irrigation increased the weed density, weed dry weight, and the optimum moisture level for weed growth is 50%. Actual soil moisture (ASM) (Jeyaraman *et al*., 2002). Since weeds remove more amount of moisture from the soil, many irrigations need to be increased. For conservation of the moisture, advanced irrigation methods need to be adopted (Nair, 2011).

Competition of weeds for nutrients

Nitrogen removal by weeds in sugarcane field is to the tune of about 40kg ha^{-1} in the unweeded control plot. Honyal and Raddar (1994), Peeples (1995) and Gouthaman (1997) reported that the application of herbicides reduced the nutrient uptake by weeds in sugarcane. Amount of major nutrients removed by the weeds has a direct influence on their availability to the main crop and in turn to the cane yield. Management practices that would minimize the nutrient losses through weeds have got added advantage in obtaining better returns. At all stages of crop growth, unweeded control has registered the highest NPK removal (Janagarathinam, 2004). The unweeded control treatment recorded higher NPK removal as compared to herbicidal weed control method (Vasuki, 2005). Kalaiyarasi (2012) also reported that nutrient removal by weeds in unweeded control was 47.4% higher than the herbicide treated plot.

Competition of weeds for light and space

The weeds especially, those with large and coarse (rough leaf surface) leaves restrict the photosynthetic activity of the crop by shading (Crafts and Robbin, 1973). Since sugarcane is having initial slow growth and germination phase took about 30 days and then 2 months period to cover the ground by foliage and during this period the soil nutrient, space and light left as unutilized by the crop were utilized effectively by the weeds (Rao *et al*., 1995).

In unweeded control, growth parameters were lower, and it was due to the competition for light and space between the crop and weeds (Sharma and Gupta, 2010). Weeds compete with the crop more efficiently for light, moisture, and nutrients at the initial stage of the crop compared to the later stage. It is due to the initial slow growth of sugarcane crop (Kadam *et al*., 2011).

Weed competition and crop growth

The competitive ability of weeds can be understood clearly by studying the growth pattern of crop and weeds under cropped conditions. Mehra *et al*. (1989) reported that the sugarcane crop suffered more from weed competition during the initial stages of growth because of the slow emergence and growth of the cane shoot during the early stage. Control of weeds is an important component of its management. In its early stages, sugarcane germinated and grown very slowly, while weeds show rapid growth due to the lack of competition from the crop (Cheema *et al*., 2010)

A significant reduction in the germination of sugarcane due to the weed infestation was reported by Chinnusamy (1982). Umarhatha (1997) reported that the heavy infestation of weeds was found to reduce the germination of buds by 26%. Germination percentage was slightly lesser in the unweeded control plot compared to herbicide applied plot (Kalaiyarasi, 2012).

In north Indian conditions (Punjab) there was a reduction of tillers (63%) in unweeded control compared with the best treatment of atrazine @ 2.0 kg ha^{-1} (Singh *et al*., 2001). Likewise, the number of millable canes were also higher in herbicide treated plots compared with unweeded control (Singh *et al*., 2001). Many millable canes were lower (90/m^2) in the control plot, whereas it was higher in hand weeded plot (136/m^2) (Sharma and Gupta, 2010). There was a loss of 40% in the number of millable cane population due to weed infestation (Sathyavelu *et al*., 2002). Chauhan and Srivastava (2002) observed in the reduction of several millable canes and cane yield, where weeds were allowed to compete with the crop beyond the initial 30 days in sugarcane.

Weed infestation affected the production of leaves, the length, and width of leaf blades, the formation, and elongation of the internodes ultimately resulting in stunted growth and lesser dry matter production (Chitkala and Rao, 1990). Vasuki (2005) revealed that leaf area index (LAX) and crop growth rate (CGR) were lower under unweeded control whereas, application of metribuzin at 1.0 kg ha^{-1} as pre-

emergence along with 2,4-D at 1.0 kg ha^{-1} as post-emergence recorded higher growth parameters due to complete weed control at early stages of sugarcane cultivation. Patel *et al*. (2007) reported lower plant height and leaf area index were in weedy check during different weed-crop competition periods. The lowest plant height (2.14 m) was recorded in weedy check (full season weed-crop competition) in both the seasons, whereas maximum plant height of sugarcane (3.48 m) was recorded under zero weed competition. A decrease in LAI and CGR with an increase in weed-crop competition period was also observed (Zafar *et al*., 2010).

A galaxy of researchers reported that the yield loss was ranging from 12 to 83% due to the weeds in sugarcane field (Jha *et al*., 1992; Sandhu and Walia, 1993; Hossain *et al*., 2001; Pechiappen, 2001 and Veeranna *et al*., 2001). The yield reduction in cane was noticed to the tune of 50% due to weeds at Cuddalore (Marimuthu *et al*., 2002). According to Chauhan and Srivastava (2002), the reduction in cane yield due to weeds was 53%. While Tomar *et al*. (2003) reported 43% reduction in the first crop and 44%% in the second crop. In Tamil Nadu, the herbicide treated plot recorded the yield of 134 t ha^{-1}, whereas unweeded control recorded 67 t ha^{-1}, which was 50% lower (Ramesh and Sundari, 2006). In Karnal, 38% yield reduction due to weeds was observed (Singh *et al*., 2011).

Weeds on quality of cane

Various weed control methods did not result in any significant difference in brix content, sucrose percent, purity%, polarity percent and commercial cane sugar percent (Singh *et al*., 2002; Sharma and Gupta, 2010). Sathyavelu *et al*. (2002) reported that the quality of the cane was not affected significantly by the weed infestation. Singh *et al*. (1995) reported that different weed control treatments had little effect on sucrose percentage in juice, but commercial cane sugar was 53% lesser in weedy check compared with mechanical weed control.

Conclusion

The foregoing review revealed the importance of weeds it competition effect on moisture nutrient, light and space, crop germination, crop growth and quality parameters, and yield of crops. It can be concluded that to obtain the potential yield, timely weed control is essential.

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