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INFLUENCE OF ROW SPACING ON WEED DENSITY, BIOMASS AND YIELD OF CHIP BUD SETTLING OF SUGARCANE

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ABSTRACT

Sowing method is one of the pre-basic factor for production technology of a crop therefore suitable row spacing in field is very crucial for making the best use of available resources. The Impact of planting geometry on weeds and yield potential of spring planted sugarcane bud chips variety CP77/400 was studied at Sugar Crops Research Institute, Mardan during 2012-13. The study was comprised of 60, 90, and 120 cm row to row distance and the plant to plant distance was kept at 60 cm for all the treatments. Experiment was laid out in randomized complete block design with three replications. Results revealed that densities of Cynodon dactylon, Sorghum halepense, Cyperus rotundus and Digeria arvensis were significantly higher in 120 cm row spacing and were remained lower in 60 row spacing. Significantly highest weed fresh and dry weights were recorded in 120 cm row spacing plots and lower at 60 cm row spacing. Highest cane yield was achieved by 120 cm row spacing as compared to 60 cm row spacing. It is concluded that row spacing of 120cm had the highest can and sugar yield despite of greatest infestation of weed densities and fresh and dry biomass; therefore an integrated weed management should be applied for the reduction of weeds control in wider row spacing for enhancing cane and sugar yield.

Keywords: Cane yield, chip bud sugarcane, row spacing, weed density, weed biomass.

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INTRODUCTION

Sugarcane *(Saccharum officinarum* L.) is an important commercial crop of Pakistan next only to cotton and it is one crop that spreads across both in the tropics and the subtropics. In Pakistan, it is cultivated over an area of 1058 thousand hectares with an annual production 58396 tons and yield of 55.2 tons ha^{-1}, while in Khyber Pakhtunkhwa, it was grown on 105.9 thousand hectares and annual production 4684.3 tons having an average yield of 44.2 tons ha^{-1} (Anonymous, 2013). It has been observed that the major problem in the way of increasing yield at farmer's fields is improper row spacing (Bashir *et al*., 2000; Mahmood *et al*., 2005), being slow growing crop at initial stage, weed infestation is a major cause of low sugarcane yield (Hussain and Afghan, 2001; Baloch *et al*., 2002; Malik and Gurmani, 2005).

Being a long duration crop, yield potential of sugarcane can be reduced from 20-25% due to weeds (Khan *et al*., 2004).Weeds compete with cultivated crops for growth factors (water, light, nutrients, and spaces) and harbour pests and plant pathogens (Qasem and Foy, 2001). The competition depends upon the crop stand and weed population as well as competition period. The initial period of weeds competition starts with beginning of interference from weeds and ends when crop covers 80% of soil. Sugarcane initial growth is slow and crop is widely spaced so it takes longer period to cover the soil, critical period of weeds is therefore longer (Reddy and Reddi, 2002). The length of critical period of weed competition depends on the nature of crops, its competitive ability, variety, growth habit, field conditions and sowing technique (Reddy and Reddi, 2002). Singh and Tomar (2003) stated that when weeds were removed after competition of 30, 45, 60, and 75 days, a reduction of 17.5, 23.8, 59.7, and 74.7%, respectively in cane yield was recorded. The respective losses were 20.5, 21.9, 49.7, and 74.5% in each year. Durigan (2005) revealed that purple nut sedge population of 58 to 246 shoots per m2 reduced sugarcane yield by 14% and shoot populations of 675 to 1198 per m2 reduced sugarcane yield by 45%. In Pakistan the average requirement of seed material per year is approximately 40 million tones. With the adoption of chip bud technology, there is a possibility of savings of about 20 million tones of seed cane that could be sent for milling, thus benefiting both the farmers and the millers. Well-nurtured seed cane can lead to the establishment of good plant and ratoon crops. The present study was therefore initiated to attempt the effect of row spacing on weed population, its biomass and consequently yield of chip budded sugar can an agro-climatic condition of District Mardan.

MATERIALS AND METHODS

Site and soil

The proposed study was conducted at Sugar Crops Research Institute, Mardan during 2012-13. The site lies at 34^0 N latitude, 72^0 E longitude and Altitude of 354 m above the sea level and climate is subtropical. The mean maximum and minimum temperature in summer are 45^0C and 27^0C, respectively.

Experimental design and experimental material

The experiment was laid out in randomized complete block design with three replications comprised on 60, 90, and 120 cm row to row spacing. The plant to plant distance was kept 60 cm or all the treatments. Chip buds were chipped from healthy, 7 month old seed cane of variety CP 77/400 and planted in plastic trays during the year 2012. The seedling was transplanted in February 2013 in plot size of 5 m by 6.6 m (33 m^2). The seed bed was prepared by two to four ploughing followed by planking and other cultural practices like hoeing, earthing up and irrigation were kept uniform for all treatments. NPK were applied as per the recommended rate by using Urea, DAP and SOP sources respectively. Settlings were carefully transplanted after the field preparation in each plot and given a light irrigation soon after transplantation. All agronomic practices were carried out uniformly in each treatment. The data were recorded on weed density by throwing one square meter quadrate in the centre of the each plot and the weeds fallen under the quadrate was uprooted, identified and separated in each plot with the help of literature of weed science. Weed fresh and dry weight data were by weighing the uprooted weeds using electrical balance and dried in oven at 70 ^{0}c for 48 hours. The strip cane weight was taken by actual weighing the can without trash and then converted to tone of cane.

Statistical analysis of the data

The collected data were analysed statistically using Fisher's analysis of variance technique and treatment means were compared using least significant difference (LSD) at 5 % probability level (Jan *et al*., 2009).

RESULTS AND DISCUSSION

Weed flora, weed density m^{-2}, weed fresh and dry biomass (g m^{-2})

The weeds flora and its density m^{-2} recorded in various row spacing are reported in Table 1. Statistical analysis of the data showed that densities of *Cynodon dactylon, Sorghum halepense, Cyperus rotundus* and *Digeria arvensis* were significantly influenced by row spacing. The higher density of *C. Dactylon, Sorghum halepense,* and *Digeria arvensis* (31, 24.67and 16.67, respectively) was recorded in

120 cm row spacing however it was at par with row spacing of 90 cm (25, 22.7, 17.33 and 14, respectively) whereas row spacing of 60 cm had the lower density of *C. Dactylon, Sorghum halepense,* and *Digeria arvensis* (20.3, 17.0 and 8.67, respectively). The density of *C. rotundus* was higher (24.67) in plots where the row to row distance was maintained at 120 cm followed by 90 cm row spacing (17.33) whereas row spacing maintained at 60 cm spacing had the lower *C. rotundus* density (15.33). Row spacing of 120 cm had the highest weeds density m^{-2} (97) followed by 90 cm row spacing (79) and lower weed density m^{-2} (61.3) were recorded in 60 cm row spacing.

The effect of row spacing on individual and overall weeds fresh weight was found significant except fresh weight of *D. arvensis* (Table 2). The highest overall weeds fresh weight and the fresh weight of *D. arvensis, C. Rotundus, S. Halepense and C. dactylon* (776.0, 207.0, 209.0 and 101.3 g m^{-2}, respectively) were recorded in 120 cm row spacing however it was at par with 90 cm row spacing for all weed densities except *S. halepense* and also with 60 cm only for *C. dactylon* whereas the lowest fresh weight of overall weeds and the fresh weight of *C. rotundus* and *S. halepense* (641.3, 167.7, 175.7 g m^{-2}, respectively) in 60 cm row spacing.

Total weed dry weight and dry weight of *Cynodon dactylan*, *Sorghum halepense, Cyperus rotundus and Digeria arvensis*was significantly influence by row spacing (Table 3). Mean values of the data showed that highest overall weed dry weight and individual highest dry weight of *Cynodon dactylon, Sorghum halepens* , *Cyperus rotundus and Digeria arvensis* (187.3, 31.0, 24.7, 24.67 and 16.67 g m^{-2} respectively) was recorded in 120 cm row spacing followed by 90 cm row spacing which was not significantly different from row spacing of 120 cm whereas the lower overall dry weight and that of *C. dactylon, S. halepens* , *C. rotundus and D. arvensis* (153.3, 20.3, 17.0, 15.33 and 8.67 g m^{-2} , respectively).

Weeds present in rows i.e. along the cane rows leads to more damage as compared to the inter-row spaces in the early crop growth stages therefore the early 90-120 days growth period might be the most vital period of competition consequently, a weed-free condition during initial 3-4 months period must be insured for the reduction in major losses. Weeds flora in sugarcane field can also eliminate N and P four times and twice and half times of potash as compared to other crop during initial few months. *Cynodon dactylon* can also play its role as alternate hosts to ratoon stunting disease of sugarcane. Thus weeds essentially harm young sugarcane sprouts by depriving them of moisture, nutrients and sunlight. Retarded growth of cane due to weed invasion may also affect the quality of cane and sugar (Qasem and Foy, 2001). Spatial arrangement can also influence agronomic characteristics of cane and the narrow row spacing might leads to greater crop growth and suppressed weed growth than wider spacing (Dwyer *et al.*, 1991). The individual weed weight and overall weed biomass reduces under narrow row spacing (Olsen *et al*., 2002). The results are in line with Alford *et al*. (2004) who reported that closer rows spacing decline the biomass of weeds. Similar results were also evaluated by Dwyer *et al*. (1991) who found lesser planting rows reduced prolific weed growth than wider row spacing

Cane yield (tones ha^{-1})

Planting geometry significantly affected the sugarcane yield .The highest cane yield (80.9 t ha^{-1}) was obtained in row spacing of 120 cm apart followed by 90 cm (80.2 t ha^{-1}) whereas the lower yield was recorded in plots where 60 cm row to row distance was maintained. The highest yield at planting geometry of triple rows 120 cm apart may be due to reduced competition for nutrients, moisture and space from the weed population on account of wider space available. Another reason for high yield may be reduced root interference of the weed roots with sugarcane plants because of enough space for the two at early growth stage as compared to the space in the narrow spacing. Widening the rows definitely provides enough space for weeds to infest the vacant spaces and thus start competition for resources with the crop plants. on the other hand, narrow row spacing even if not provide much space for weed growth but can lead to intra-specific competition among crop plants by itself that is one of the reason that yield of crop decline under intense densities (Marwat, 2002, Mudarres *et al*., 1998). Deficient resources might contribute to decrease crop growth in spite of lesser row spacing (Sobkowicz and Tendziagolska, 2005). The results are line agreement with Ehsanullah *et al*. (2011) who stated that increase row to row distance in sugarcane increase Cane yield. Chattha *et al*. (2004) revealed that about 30 % more cane yield was obtained by planting of cane at wider row spacing (120 cm) as compared to narrow row spacing (60 cm). Similar results were also reported by (Chattha *et al*., 2007) who found that sugarcane planted in 45 cm apart resulted in lesser millable canes and higher cane yield (95.39 t ha^{-1}).

CONCLUSION

It is concluded that increase in row spacing up to 120 cm had enhanced weeds density, fresh and dry weight as well as the individual weed density and weight. Unlike other crop, cane yield was also enhanced with increase row spacing up to 120 cm despite of higher weed infestation. Thus the higher weeds infestation under wider spacing might be addressed for further improvement in cane yield of chip bud plantation through an integrated weed management approach.

Table-1. Density of weed flora and over all weed density as affected by row spacing in sugar cane

Row spacing	*C. dactylon*	*S. halepense*	*C. rotundus*	*D. arvensis*	Weeds density (m^{-2})
60 cm	20.30 b	17.00 b	15.33 c	8.67 b	61.3 c
90 cm	25.00 ab	22.67 ab	17.33 b	14.00 ab	79.0 b
120 cm	31.00 a	24.67 a	24.67 a	16.67 a	97.0 a
$LSD_{0.05}$	7.21	6.32	1.51	6.84	11.3

Table-2. Influence of row spacing on individual and overall weeds fresh weight in chip bud settling of sugar cane

Row spacing	*C. dactylon* (g m^{-2})	*S. halepense* (g m^{-2})	*C. rotundus* (g m^{-2})	*D. arvensis* (g m^{-2})	Weed biomass (g m^{-2})
60 cm	90.3 a	175.7 b	167.7 b	207.7 a	641.3 b
90 cm	94.3 ab	186.3 b	180.3 ab	258.7 a	719.7 ab
120 cm	101.3 a	209.0 a	207.0 a	258.7 a	776.0 a
$LSD_{0.05}$	7.11	19.59	30.27	91.37	98.2

Table-3. Influence of row spacing on individual and total dry weeds weight in chip bud settling sugar cane.

Row spacing	*C. dactylon* (g m^{-2})	*S. halepense* (g m^{-2})	*C. rotundus* (g m^{-2})	*D. arvensis* (g m^{-2})	Weed dry weight (g m^{-2})
60 cm	20.3 b	17.0 b	15.33 c	8.67 b	153.3 b
90 cm	25.0 ab	22.7 ab	17.33 b	14.00 ab	175.0 ab
120 cm	31.0 a	24.7 a	24.67 a	16.67 a	187.3 a
$LSD_{0.05}$	7.2	6.3	1.5	6.84	31.2

Table-4. Influence of row spacing on the cane yield (tons ha^{-1})

Row spacing	**Can yield (tons ha^{-1})**
60 cm	77.0 b
90 cm	84.0 b
120 cm	92.0 a
$LSD_{0.05}$	7.68

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