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Influence of Planting Pattern and Weed Control Practices on Weed Growth and Productivity of Sweet Corn (*Zea mays* L.)

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ABSTRACT

A field experiment was conducted during the *rabi* seasons of 2004 & 2005 at S.V.Agricultural College Farm, Tirupati, to study the effect of planting pattern and weed control practices on weed dynamics and productivity of sweet corn. Planting pattern of 60x20 cm was effective in suppressing the weed growth at all the stages of crop growth and was comparable with 75x16 cm. The highest yield attributes were recorded with 60x25 cm and was on par with 75x20 cm. The highest green cob and green fodder yield were obtained with 60x20 cm, which were comparable with 75x16 cm due to the higher plant density of 83,333 plants ha^{-1}. Pre-emergence application of atrazine @ 1.0 kg ha^{-1} + hand weeding at 30 DAS recorded significantly lesser density and dryweight of weeds, higher weed control efficiency which resulted in enhanced level of yield attributes, green cob and fodder yield which were comparable with pre-emergence application of atrazine @ 1.0 kg ha^{-1} + post-emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS and hand weeding (HW) twice at 15 and 30 DAS.

Key words : Atrazine, Planting pattern, Sweet corn, Weed control practices.

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From the beginning of 20th century, sweet corn has become a distinctly beloved vegetable and gaining popularity among nutritive and health conscious urban mass in India. It is of short duration, harvested at milky stage and can be grown all round the year under irrigated conditions, enabling it to fit in the intensive cropping systems. Sweet corn, unlike seed corn is far less competitive in growth, lacks dense plant canopy and allows considerable light to enter for the development of weeds (Pierce, 1989). This factor coupled with higher nutrient requirement of the crop makes it susceptible to heavy weed infestation. Unweeded control in sweet corn reduced the green cob yield by 56 per cent compared to pre-emergence application of atrazine (Van Wychen *et al.,* 1999). Planting pattern is a cost effective technique that modifies the crop canopy structure and micro climate, enhances crop competitiveness in weed suppression, improves the resource use efficiency and maximizes crop productivity. As sweet corn is a new plant type, there is an urgent need to fine-tune suitable agro-techniques for higher production and income to farmers. Therefore, these facts necessitate for detecting the effect of cultural manipulation by different planting patterns in combination with weed control measures on weed dynamics as well as crop performance to suggest a suitable planting pattern and an efficient integrated weed management strategy for sweet corn.

MATERIAL AND METHODS

Field experiment was conducted during two consecutive *rabi* seasons of 2004-05 and 2005-06 at S.V. Agricultural College farm, Tirupati, in the southern agro-climatic zone of Andhra Pradesh.

The experiment was laid out in split plot design with three replications. The treatments comprised of four planting patterns - 75 x 16 cm and 60 x 20 cm with 83,333 plants/ha ; 75 x 20 cm and 60 x 25 cm with 66,666 plants ha^{-1} in main plots and four weed control practices Weedy check ; Hand weeding (HW) at 15 and 30 DAS; pre-emergence application of atrazine @ 1.0 kg ha^{-1} + HW at 30 DAS; pre-emergence application of atrazine @ 1.0 kg ha^{-1} + post-emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS in subplots. The soil was sandy loam in texture, low in organic carbon (0.25%) and available N (203.5 kg ha^{-1}), medium in available P_2O_5 (31.7 kg ha^{-1}) and K_2O (198.5 kg ha^{-1}). The seeds of test variety Madhuri, a super sweet and succulent corn seeds were dibbled at a depth of 4-5 cm in four planting patterns, as per the treatments. Recommended dose of fertilizers *viz.,* 120-60-45 kg ha^{-1} of N, P_2O_5 and K_2O was applied in the form of urea, single super phosphate and muriate of potash respectively. Half the dose of N and full dose of P and K fertilizers were applied basally and remaining half the dose of N was top dressed in two equal splits at knee high (30 DAS) and tasseling stage(50 DAS). Calibrated quantity of herbicides were applied

as aqueous spray (600 lit ha^{-1}) with knap sack sprayer. Pre-emergence application of atrazine @ 1 kg ha^{-1} was done within 24 hours after sowing of sweet corn. Post-emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS was done as directed spraying in between the rows, with the help of specially designed hood to maintain width of spray drift, without any affect on crop. Nine irrigations were given during *rabi*, 2004 and six irrigations during *rabi*, 2005. Green cobs along with husk were harvested at milky stage (75 DAS). Data on weeds was recorded with a quadrate (0.5 x 0.5 m) at two places per plot. Weeds were counted and removed for recording their dry weights. These data was subjected to square root transformation ($\sqrt{X+0.5}$) before the statistical analysis.

The data obtained on weeds and crop was statistically analyzed by following the analysis of variance for split plot design. Statistical significance was tested by 'F' test at 5 per cent level of probability. Least significant difference for the significant variation was calculated at five percent level of significance.

RESULTS AND DISCUSSION

Effect on weeds:

During both the years of study, twenty three weed species including six grasses, two sedges and fifteen broad leaved weeds were identified in the experimental field.Among these, *Panicum repens* (21.4%), *Digitaria sanguinalis* (18.5%), *Celosia argentia* (16.4), *Acanthospermum hispidum* (15.5%) and *Cleome viscose* (14.0%) were found to be the dominant weeds. The lowest density of grasses, sedges and broad leaved weeds at 30 and 45 DAS, were noticed with the planting pattern of 60x20 cm, however it was on par with 75x16 cm(Table.1). The narrow row spacing of 60 cm along with higher plant population of 83,333 plants ha^{-1}, might have provided lesser space for weed emergence and modified the crop canopy structure, which in turn reduced the light transmittance to ground to stimulate the weed growth up to 45 DAS as reported by Teasdale (1995).At harvest, the lowest total weed density, weed dryweight obtained with 60x20 cm and were also comparable with 75x16 cm(Table.2) Higher plant population per unit area with these two planting patterns might have created better micro environment to shift the balance in favour of crops, resulting in reduced weed dry weight. The higher density and biomass accumulation of weeds were registered with 75x20 cm and 60x25 cm of planting patterns. This might be due to sparse plant stand of 66,666 plants ha^{-1}, that allowed luxuriant weed growth, presumably due to the increased availability of growth resources to weeds. These results are in conformity with the findings of Choudhary (1981) and Tollenar *et al*., (1994).

With regard to weed control practices, the sedges density at 30 DAS, was found to be the lowest with hand weeding twice at 15 and 30 DAS, which was significantly lesser than with other two treatments that involved pre-emergence application of atrazine @ 1 kg ha^{-1} + post- emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS (Table.1). In this situation, first hand weeding imposed at 15 DAS, might have significantly reduced the sedges than with the pre-emergence application of atrazine, which proved to be the least effective against them, especially *Cyperus iria* , as reported by Pandey *et al.,* (1999). At 45 DAS, all the three weed control practices proved to be equally effective in controlling the second flush of weeds. This might be due to the hand weeding and post-emergence application of paraquat imposed at 30 DAS in the respective treatments to control weeds during the critical period of crop-weed competition in sweet corn up to 45 DAS. At harvest, the lowest density and dryweights of total weeds with the highest weed control efficiency was resulted with the integrated weed management practice of pre-emergence application of atrazine @ 1 kg ha^{-1} + HW at 30 DAS, which was on par with the other two weed control practices (Table.2).This was due to the effective control of weeds throughout the crop growth period. These results are in conformity with the findings of Audi Reddy *et al*., (2004).

Effect on crop

The higher stature of yield attributes i.e. cob length and green cob weight (with husk) were noticed with 60 x 25 cm and was on par with 75 x 20 cm which accommodated 66, 666 plants ha^{-1} (Table.3).It was due to effective utilization of all the available growth resources by each individual plant without competition among the plant community, during any stage of crop growth. The inter plant competition existed for the growth resources under higher plant population of 83,333 plants ha^{-1} with 60 x 20 cm and 75 x 16 cm have resulted in the reduced stature of cobs. But, the highest green cob yield and green fodder yields realized with these planting patterns was due to the cumulative effect of more number of plants accommodated per unit area. Duncan (1958) reported that the individual plant yield decreases with increasing plant population whereas the yield per unit area will increase upto optimum plant population. The lowest green cob yield with 75x20 cm and 60x25 cm might be due to the inadequate

Table 1. Effect of planting pattern and weed control practices on weed density (No.m^{-2}) at 30 and 45 DAS

Treatments	At 30 DAS						At 45 DAS					
	Grasses		Sedges		Broad leaved weeds		Grasses		Sedges		Broad leaved weeds	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting pattern												
75 x 16 cm (83,333 plants/ha)	3.38 (11.9)	3.53 (14.2)	7.27 (61.1)	7.49 (64.3)	3.39 (12.9)	3.17 (13.4)	3.04 (10.4)	4.02 (18.3)	6.10 (50.3)	6.65 (57.1)	2.82 (11.9)	3.53 (15.7)
60 x 20 cm (83,333 plants/ha)	3.06 (9.1)	2.87 (9.1)	6.69 (52.9)	6.97 (53.9)	3.07 (10.5)	2.65 (10.3)	2.79 (8.9)	3.28 (13.3)	5.41 (41.5)	5.92 (44.3)	2.40 (9.2)	2.98 (11.6)
75 x 20 cm (66,666 plants/ha)	4.07 (17.5)	4.92 (25.6)	8.40 (79.1)	8.72 (84.6)	4.36 (19.5)	4.29 (18.7)	4.18 (18.6)	5.15 (29.1)	7.62 (71.5)	8.21 (80.9)	3.68 (17.6)	4.42 (22.6)
60 x 25 cm (66,666 plants/ha)	3.88 (15.7)	4.61 (23.2)	8.08 (73.4)	8.41 (77.2)	4.15 (17.9)	3.89 (18.3)	3.74 (15.1)	4.86 (25.9)	7.15 (64.2)	7.72 (71.5)	3.31 (15.6)	4.16 (22.2)
S Em ±	0.136	0.198	0.176	0.158	0.183	0.197	0.186	0.226	0.404	0.229	0.128	0.168
CD (P=0.05)	0.47	0.68	0.61	0.55	0.63	0.68	0.64	0.78	0.64	0.79	0.44	0.58
Weed control practices												
Weedy check	5.33 (28.3)	6.36 (40.9)	11.89 (142.1)	12.22 (150.0)	6.15 (37.9)	6.76 (46.3)	5.54 (31.6)	7.09 (50.8)	12.88 (166.6)	13.27 (177.5)	6.50 (42.4)	6.90 (48.1)
Two hand weedings at 15 and 30 DAS	2.89 (7.1)	2.79 (7.5)	3.88 (15.7)	4.12 (17.6)	3.08 (9.5)	2.80 (6.3)	2.76 (7.2)	3.38 (11.4)	4.34 (19.1)	5.05 (26.4)	2.02 (3.9)	2.75 (8.1)
Pre-emergence application of atrazine @ 1 kg ha^{-1} + HW at 30 DAS	3.25 (10.4)	3.24 (11.5)	7.39 (55.2)	7.53 (56.9)	2.80 (7.1)	2.71 (4.1)	2.30 (5.0)	3.45 (12.3)	4.28 (18.8)	4.83 (23.3)	1.85 (3.2)	2.34 (5.5)
Pre-emergence application of atrazine @ 1 kg ha^{-1} + post emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS	2.93 (8.5)	3.32 (12.2)	7.28 (55.1)	7.42 (55.4)	2.90 (6.5)	2.15 (4.1)	2.95 (8.5)	3.49 (12.1)	4.76 (22.9)	5.28 (28.6)	2.19 (4.7)	2.52 (6.4)
S Em ±	0.127	0.210	0.247	0.210	0.319	0.208	0.291	0.158	0.380	0.175	0.122	0.212
CD (P=0.05)	0.37	0.61	0.72	0.61	0.93	0.82	0.85	0.46	0.11	0.51	0.35	0.62

Original data given in parenthesis were subjected to square root transformation before statistical analysis.

Table 2. Effect of planting pattern and weed control practices on weed density, weed dryweight and weed control efficiency at harvest of sweet corn

Treatments	Weed density (No. m^{-2})		Weed dryweight (g m^{-2})		Weed control efficiency (%)	
	2004	2005	2004	2005	2004	2005
Planting pattern						
75 x 16 cm (83,333 plants/ha)	10.5 (123.2)	10.9 (137.2)	11.5 (148.4)	11.6 (159.6)	54.9	59.0
60 x 20 cm (83,333 plants/ha)	9.8 (104.4)	9.5 (109.5)	10.6 (126.7)	10.4 (137.3)	62.9	63.5
75 x 20 cm (66,666 plants/ha)	12.7 (172.9)	12.8 (194.0)	13.4 (199.8)	13.7 (218.1)	45.8	54.5
60 x 25 cm (66,666 plants/ha)	120.0 (158.1)	12.5 (178.9)	12.9 (189.7)	13.1 (200.5)	47.2	44.9
S Em ±	0.518	0.427	0.257	0.452	-	-
CD (P=0.05)	1.79	1.47	0.89	1.56	-	-
Weed control practices						
Weedy check	16.7 (310.5)	19.3 (375.6)	19.2 (373.9)	21.0 (448.0)	-	-
Two hand weedings at 15 and 30 DAS	8.8 (79.3)	8.7 (77.5)	9.8 (98.9)	9.2 (87.6)	77.7	77.5
Pre-emergence application of atrazine @ 1 kg ha^{-1} + HW at 30 DAS	8.5 (72.6)	8.4 (73.5)	9.35 (88.7)	8.9 (81.8)	80.6	81.9
Pre-emergence application of atrazine @ 1 kg ha^{-1} + post emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS	9.7 (96.3)	9.2 (87.0)	10.11 (102.6)	9.8 (98.4)	75.8	73.5
S Em ±	0.574	0.325	0.498	0.458		
CD (P=0.05)	1.67	0.95	1.45	1.33	-	-

Original data given in parenthesis were subjected to square root transformation before statistical analysis.
HW - Hand weeding DAS – Days after sowing.

plant stand and shortage of sink, for fully utilizing the production potential of assimilates. Therefore, higher stature of cobs with these two planting patterns failed to over perform the other two planting patterns as 60x25 cm and 75x20 cm, with respect to economic yield. The best planting pattern of 60 x 20 cm recorded 27.8 and 27.3 per cent higher green cob yield over 75x20 cm, during 2004 and 2005 respectively. The outcome of present study corroborates with the findings of Raja (2001) and Sahoo and Mahapatra (2004).

It can be inferred that planting pattern of 60 x 20 cm with an optimum plant population of 83, 333 plants ha^{-1} in combination with integrated weed management practice of pre-emergence application of atrazine @ 1 kg ha^{-1} + HW at 30 DAS may provide effective weed control and realize the highest green cob productivity of sweet corn crop with remunerative returns.

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Table 3. Effect of planting pattern and weed control practices on the yield attributes, yield and economics of sweet corn

Treatments	Cob length (cm)		Green cob weight (g)		Green cob yield (with husk) (kg ha^{-1})		Green fodder yield (kg ha^{-1})		Net returns (Rs ha^{-1})	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting pattern										
75 x 16 cm (83,333 plants/ha)	18.5	17.6	189.7	182.6	13180	12599	16629	15775	23174	21532
60 x 20 cm (83,333 plants/ha)	19.0	18.3	198.6	192.0	13970	13192	17614	16690	24987	23024
75 x 20 cm (66,666 plants/ha)	20.6	20.2	212.5	207.3	10930	10376	13870	13018	17359	15827
60 x 25 cm (66,666 plants/ha)	21.2	20.7	220.2	218.7	11777	10934	15024	14117	19500	17235
S Em ±	0.3	0.2	3.5	3.9	267	195	442	464	668	784
CD (P=0.05)	1.2	0.8	12.4	13.8	924	677	1531	1605	2310	2714
Weed control practices										
Weedy check	17.6	17.2	164.0	161.8	8.24	7.88	11060	10303	11262	10359
Two hand weedings at 15 and 30 DAS	20.1	19.4	213.6	208.7	13.52	12.74	16218	15560	23562	21372
Pre-emergence application of atrazine @ 1 kg ha^{-1} + HW at 30 DAS	21.1	20.2	223.4	218.9	14.22	13.41	18049	17196	25251	23221
Pre-emergence application of atrazine @ 1 kg ha^{-1} + post emergence application of paraquat @ 0.5 kg ha^{-1} at 30 DAS	20.5	19.9	219.8	214.1	13.88	13.07	17574	16590	24310	22664
S Em ±	0.4	0.3	6.7	6.0	317	126	639	593	767	859
CD (P=0.05)	1.2	1.0	19.7	17.7	928	1003	1866	1732	2238	2507

HW - Hand weeding DAS – Days after sowing.

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