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Effect of Tillage, Seed Rate and Weed Control Methods on Weeds and Maize (*Zea mays* L.)

C. K. Sarma[1] and R. C. Gautam
Department of Agronomy
G. B. Pant University of Agriculture & Technology, Pantnagar-263 145 (Uttaranchal), India

ABSTRACT

Tillage operation resulted in significant reduction in weed dry weight at all the growth stages and increased the grain yield over no tillage practice. The lowest weed dry weight and the highest grain yield in one season were recorded with 24 kg seed ha^{-1}. Hand weedings at 25 and 45 DAS recorded significantly higher grain yield and lower weed dry weight at silking and maturity stages.

INTRODUCTION

Maize is one of the most important cereals grown over diverse environments and has varied uses as food, feed and fodder. Rainy season maize suffers heavy yield loss due to severe crop-weed competition and the loss is further aggravated when weeds are not controlled within a specific period of time. Manual weeding is often difficult due to inadequate and non-availability of labour in time, higher cost and lack of workable field condition. In such situation, use of herbicides becomes an obvious choice, Competition for growth factors in favour of crop can also be exploited with favourable growth condition and by establishing optimum plant population. Considering the above views, the present investigation was planned to assess the effect of tillage, seed rate and weed control methods on weed growth and yield of **kharif** maize.

MATERIALS AND METHODS

Field experiment was conducted at Crop Research Centre, G. B. Pant University of Agriculture & Technology, Pantnagar (29° N latitude, 79.29° E longitude and 243.8 m altitude), Uttaranchal during **kharif** seasons of 2003 and 2004. The soil of the experimental site was clay-loam in texture, neutral in reaction, high in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium. Treatments comprised two tillage practices (tilled and no-tilled), three seed rates (16, 20 and 24 kg ha^{-1}) and four weed control methods (hand weeding at 25 and 45 DAS, paraquat at 25 DAS, paraquat at 45 DAS and weedy check). Twenty-four treatment combinations were replicated thrice in a split-plot design, keeping tillage practices and seed rates in main-plots and weed control methods in sub-plots. Three harrowings followed by one planking were followed in tilled plot, while under no-tilled condition, paraquat was applied at 0.75 kg ha^{-1} with spray volume of 450 litre ha^{-1} for seed bed preparation one week before sowing of the crop to kill the existing weeds. Hand weeding was done with the help of **khurpi** and paraquat was applied at 0.75 kg ha^{-1} as directed spray in between the rows of maize as per the treatment. Seeds of composite maize cv. Gaurav were sown at a seed to seed distance of 25, 20 and 15 cm for 16, 20 and 24 kg seed ha^{-1}, respectively, at 4-5 cm depth in furrows opened 60 cm apart with the help of a tractor drawn furrow opener. Crop was raised with all other recommended package of practices. Total amount of rainfall received during crop seasons of 2003 and 2004 was 1587.2 and 1095.6 mm, respectively. Maximum temperature (37.5°C in

[1]Present Address : Training Associate, K. V. K., Kajalgaon, Chirang (Assam), India.

Table 1. Effect of tillage, seed rate and weed control methods on weeds in maize at different stages

Treatment	Weed density (No. m^{-2})						Weed dry weight (g m^{-2})					
	Knee high		Silking		Maturity		Knee high		Silking		Maturity	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Tillage methods												
Tilled	11.8	11.1	11.4	10.4	14.8	14.1	7.0	6.8	11.6	10.3	17.9	17.0
	(175)	(156)	(157)	(135)	(227)	(207)	(63.9)	(60.4)	(167.7)	(141.5)	(338.6)	(308.9)
No-tilled	12.8	12.5	12.5	11.6	15.5	14.9	8.1	8.0	12.5	11.9	18.4	17.9
	(206)	(199)	(183)	(165)	(250)	(231)	(85.8)	(80.7)	(191.1)	(176.2)	(354.6)	(341.7)
LSD (P=0.05)	NS	0.86	0.46	0.23	0.26	0.29	0.43	0.69	0.37	0.53	0.29	0.42
Seed rates (kg ha^{-1})												
16	12.5	12.1	12.4	11.5	15.7	15.0	7.9	7.7	12.5	11.7	18.8	18.1
	(200)	(186)	(183)	(162)	(256)	(234)	(81.5)	(75.6)	(193.2)	(175.1)	(370.1)	(347.4)
20	12.2	12.0	12.1	11.0	15.1	14.5	7.5	7.4	12.1	10.8	18.0	17.4
	(189)	(186)	(173)	(149)	(236)	(218)	(73.7)	(70.3)	(180.6)	(152.2)	(342.2)	(322.3)
24	12.1	11.2	11.4	10.5	14.6	14.0	7.2	7.2	17.5	10.7	17.6	16.9
	(183)	(160)	(156)	(139)	(223)	(204)	(69.3)	(65.6)	(164.4)	(149.3)	(327.5)	(306.2)
LSD (P=0.05)	NS	NS	0.57	0.28	0.31	0.36	NS	NS	0.46	0.65	0.35	0.52
Weed control method												
Weedings at 25 and 45 DAS	5.5	5.3	7.4	6.6	12.8	12.0	2.9	3.0	4.9	3.8	12.9	12.2
(33)	(33)	(31)	(56)	(44)	(163)	(144)	(8.7)	(9.4)	(24.4)	(15.0)	(166.7)	(149.0)
Paraquat at 25 DAS	6.74	6.4	11.5	10.0	14.7	14.4	4.1	4.3	13.2	11.1	18.5	18.9
(48)	(42)	(135)	(100)	(217)	(209)	(17.0)	(18.6)	(175.0)	(124.9)	(344.9)	(356.4)	
Paraquat at 45 DAS	18.3	17.7	8.5	7.6	13.2	12.7	11.7	11.2	9.4	9.5	16.6	14.9
(337)	(315)	(73)	(59)	(174)	(162)	(137.2)	(127.0)	(89.9)	(92.5)	(276.7)	(225.0)	
Weedy	18.5	17.8	20.4	19.9	20.0	18.9	11.6	11.2	20.7	20.0	24.4	23.8
	(346)	(320)	(417)	(397)	(399)	(361)	(136.6)	(127.0)	(428.3)	(403.0)	(598.1)	(570.7)
LSD (P=0.05)	0.70	0.96	0.76	0.76	0.46	0.69	0.47	0.33	0.62	0.79	0.56	0.82

DAS–Days after sowing. Data subjected to square root transformation. Data in parentheses are original values. NS–Not Significant.

2003 and 36.8°C in 2004) and minimum temperature (21.5°C in 2003 and 22.4°C in 2004) were recorded in the months of July and September, respectively.

Observations on weed density and weed dry weight were recorded at knee high, silking and harvesting stages of maize.

RESULTS AND DISCUSSION

Effect on Weeds

Dominant weed species present in the experimental site were *Cynodon dactylon* (21%), *Cyperus rotundus* (15%), *Echinochloa crusgalli* (12%), *Echinochloa colonum* (13%), *Agropyron repens* (11%), *Parthenium hysterophorus* (9%), *Digitaria sanguinalis* (8%), *Eclipta alba* (5%), *Euphorbia hirta* (4%) and *Commelina benghalensis* (2%).

Tillage operation resulted in significant reduction in weed density and weed dry weight over no-tillage practice at all the stages of crop growth during both the years except weed density at knee high stage during 2003 (Table 1). Minimum weed density and weed dry weight were recorded with 24 kg seed ha^{-1} which were significantly lower than that of 16 and 20 kg seed ha^{-1} during both the seasons except the weed dry weight with 20 kg seed ha^{-1} at silking and maturity stages during 2004. Weed density and weed dry weight recorded with 20 kg seed ha^{-1} were significantly lower than 16 kg seed ha^{-1} at all the stages during both the seasons except at silking stage during 2003. Significant reduction in weed density and weed dry weight at higher seed rate might he attributed to more competitive efficiency of crop at higher seed rate. Similar result was also observed by Kumar and Walia (2003). All the weed control methods except paraquat application at 45 DAS at knee high stage caused significant reduction in weed density and weed dry weight over weedy check at all the stages. Minimum weed density and weed dry weight were recorded under the two hand weedings treatment done at 25 and 45 DAS which were significantly lower than rest of the weed control methods. Better control of weeds under two hand weedings treatment might have resulted in lower weed density and weed dry weight at all the stages.

Effect on Crop and Grain Yield

Significant increase in total number of cobs per hectare under tilled treatment over no-tilled was observed during 2003. Maximum number of cobs per hectare was observed with 24 kg seed ha^{-1} which was significantly higher than rest of the seed rates. All the weed control methods except paraquat application at 45 DAS resulted in significant increase in number of cobs over weedy check and maximum number of cobs was recorded with two hand weedings.

Grain yield recorded under tilled treatment was significantly higher than that of no-tilled treatment which might be due to favourable soil condition for growth and development as well as less crop-weed competition under tilled treatment. The highest grain yield was recorded with 24 kg seed ha^{-1}. More number of cobs per unit area might have resulted in higher grain yield at higher seed rate. All the weed control methods resulted in significant increase in grain yield over weedy check and the highest grain yield was recorded with two hand weedings done at 25 and 45 DAS. Higher grain yield under two hand weedings might be due to effective control of weeds during critical period of crop growth.

Economics

Higher net return and net return per rupee invested were recorded under tilled treatment compared to no-tilled (Table 2).

Higher seed rate resulted in higher net return and net return per rupee invested compared to lower one and the highest values were obtained with 24 kg seed ha^{-1}. Among the weed control treatments, higher net return during both the years and net return per rupee invested during 2003 were recorded under the two hand weedings treatment, while during 2004, application of paraquat at 25 DAS resulted in highest net return per rupee invested.

Table 2. Effect of tillage, seed rate and weed control methods on maize and their economics

Treatment	No. of cobs ('000 ha^{-1})		Grain yield (kg ha^{-1})		Net return (Rs. ha^{-1})		Net return per rupee invested Rs.	
	2003	2004	2003	2004	2003	2004	2003	2004
Tillage methods								
Tilled	68.5	70.1	4576	4824	15901	16951	1.51	1.56
No-tilled	59.2	66.9	3536	4233	10756	14481	1.09	1.45
LSD (P=0.05)	3.40	NS	116.6	125.7	-	-	-	-
Seed rate (kg ha^{-1})								
16	54.8	62.3	3868	4447	12374	15373	1.22	1.49
20	63.6	66.2	4082	4509	13477	15605	1.31	1.50
24	73.1	77.0	4218	4629	14135	16171	1.36	1.53
LSD (P=0.05)	4.17	7.84	142.8	NS	-	-	-	-
Weed control methods								
Weedings at 25 and 45 DAS	74.8	75.9	5099	5039	18155	17826	1.62	1.52
Paraquat at 25 DAS	66.3	71.6	4336	4752	14912	16948	1.47	1.62
Paraquat at 45 DAS	59.8	64.7	3200	4326	10672	14593	1.04	1.40
Weedy	54.4	61.7	161.4	3996	9574	13832	1.05	1.48
LSD (P=0.05)	1.51	1.69	62.8	152.9	-	-	-	-

NS–Not Significant.

Higher net return and net return per rupee invested might be attributed to higher gross return resulted from higher crop yield and higher net return, respectively, relative to the cost of cultivation under these treatments in the respective years.

REFERENCE

Kumar, B. and U. S. Walia, 2003. Effect of nitrogen and plant population level on competition of maize (*Zea mays* L.). *Indian J. Weed Sci.* **35** : 53-56.