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EFFECT OF HERBICIDES AND ROW SPACING ON MAIZE (*ZEA MAYS* L.)

Rahat Ali[1], Shad K. Khalil[1], Syed Mohsin Raza[1] and Haroon Khan[2]

ABSTRACT

Cultural as well as chemical weed control is a basic requirement and major component of management in most crop production systems. Various levels of pre-em (Harness xtra) and post-em (atrazine) herbicides in combination with narrow, medium and wider row spacing were evaluated to investigate their effect on days to emergence, dry weight of weeds m^{-2}, days to tasseling, days to maturity and biological yield. Row spacing did not significantly affect any parameter, different levels of Harness xtra and atrazine significantly affected all the parameters. Harness xtra resulted in minimum dry weight of weeds (22.84 g m^{-2}) and maximum biological yield (9472.17 kg ha^{-1}) at 2.5 L ha^{-1}. Minimum days to emergence (7.33 days), maximum days to tasseling (55.17 days) and maturity (103.17 days) were recorded at 2.0 L Harness xtra ha^{-1}. Maximum dry weight of weeds (92.25 g m^{-2}), minimum days to tasseling (51.58 days), maturity (92.25 days) and biological yield (7652.71 kg ha^{-1}) were recorded in check plots. It was concluded that herbicide application increased days to tasseling, maturity and biological yield, while decreased days to emergence and dry weight of weeds.

Key words: Row spacing, pre- and post-em herbicides, dry weight of weeds, biological yield.

INTRODUCTION

Maize (*Zea mays* L.) is the most important cereal crop of the world, after wheat and rice grown everywhere in the irrigated as well as in the rainfed areas. Maize is also one of the important crops of Pakistan. Maize crop was planted on 941.6 thousand hectares that produced about 1664.4 thousand tons with average yield of 1768 kg ha^{-1} (MINFAL, 2002). It is estimated that 75% of the total production of maize is used as food by the farming community and the remaining finds its way in starch manufacturing industry, poultry feed and urban food grain sales (Muhammad, 1979).

To obtain better grain yields; it is essential to maintain the optimum number of plants per hectare. Row spacing is an important factor for controlling weeds and increase yield. It would be logical to expect that weed management should improve if the row spacing of corn is narrowed (Harvey *et al.*1997). Weed compete with maize for nutrients, soil moisture and light and considerably reduces the yield and quality of the crop (Hussain, 1983). Full herbicides rates gave 95% weed control in both narrow and wide row cultivated corn (Forcella *et al.*1992). Jehangiri (1979) reported that herbicides controlled 65 to 90% of weed flora and gave 100 – 150% more maize yield than weedy check.

1 Department of Agronomy, NWFP Agricultural University Peshawar - Pakistan.
2 Department of Weed Science, NWFP Agricultural University, Peshawar – Pakistan.

This research was conducted to evaluate the effect of different doses of pre- and post-em herbicides in integration with various row spacings on maize crop.

Materials and Methods

An experiment was conducted at Malkandher Farm, NWFP Agricultural University, Peshawar during 2002. Maize variety Kisan-90 was sown on July 17, 2002 using randomized complete block design with split plot arrangement. Row spacing was allotted to main plots while pre and post-em herbicides were randomized in sub-plots replicated four times. Three row spacing (50,75,100 cm) and three doses of pre-em herbicide Harness xtra @ 1.5, 2.0, 2.5 L ha^{-1}) and three levels of post-em herbicide atrazine @ 0.5, 1.0, 1.5 L ha^{-1} were applied and studied in comparison with hand weeding and weedy check. The soil of the experimental site was silty clay loam with a clay type montmorillonite, low in nitrogen (0.03-0.04%), low in organic matter (0.8-0.9%) and alkaline in reaction with a pH of 8.0-8.2 (Shah *et al.* 1993). A basal dose of 200-100 kg N:P ha^{-1} was used. Full dose of phosphorous and half of nitrogen was applied at sowing time while remaining half of nitrogen was applied before silking time. Thinning was done in order to maintain plant population constant in each sub plot. A plant population of 130 plants $plot^{-1}$ (65000 plants ha^{-1}) were maintained in each plot. For phytotoxicity of herbicides on crop each treatment was observed thoroughly but no such effect was noticed during the course of our studies. Data were recorded on days to emergence, dry weight of weeds m^{-2}, days to tasseling, days to maturity and biological yield. Number of days to emergence was calculated from the date of sowing to the date when plots showed 80% emergence. For dry weight, weeds were randomly taken after 30 days of emergence at three different locations in each sub-plot and averaged. All weeds were sundried and weighted on an electric balance. Days to tasseling were recorded when 50% plants produced tassel in each sub plot and days to maturity were recorded when 80% plants become physiologically mature in each plot. Biological yield were recorded by harvesting six, three and two central rows from 50,75 and 100 cm row spacing in each subplot respectively and then were bundled, sun-dried and weighted.

Data were subjected to analysis of variance for partitioning sums of squares among factors and their interactions and for testing effects with single degrees of freedom for significance. For factors and their interaction with greater than single degree of freedom, significant relationship among means were determined with orthogonal comparisons (Steel and Torrie, 1980).

Results and Discussion

Days to emergence

Row spacing (S), check vs weed control treatment (Check vs T), pre linear, pre quadratic, post linear, post quadratic and SxT showed non significant effect on days to emergence except weed control treatments (T) and Pre vs post-em herbicide (Pre E.H vs Post E.H) significantly affected days to emergence (Table 1). In mean values for pre E.H vs Post E.H (Harness xtra vs atrazine), pre E.H resulted minimum days to emergence as compared to post E.H (Table 2). It may be due to less competition between maize seeds and weed seeds for available space, moisture and nutrients in the plots treated earlier with pre-em herbicides.

Dry weight of weeds m^{-2} after 30 days of emergence

Weed control treatments (T), check vs T, hand weeding vs herbicides (Hw vs H), pre E.H vs post E.H pre linear and post linear significantly affected dry weight of weeds m^{-2} after 30 days of emergence (Table 1), while the effect of the rest of variables and their interaction

was non significant. Highest dry weight of weeds were noted in check plots, while lowest dry weight were recorded in plots that received 2.5 L Harness xtra ha^{-1} as pre E.H. Full herbicide rates of both herbicides gave excellent control of weeds (Table 3). These results agreed with Forcella *et al.*(1992), who concluded that full herbicide rates gave 95% weed control in both the narrow and wide row cultivated corn.

Days to tasseling

Significant differences in days to 50% tasseling were observed due to weed control treatments (T), check vs T, hand weeding vs herbicides (Hw vs H) and pre quadratic (Table 1). The effect of the rest of variable and their interaction was non significant. Weed control treated plots (T) recorded maximum days to 50% tasseling, while check plots took minimum days. The results are in agreement with Nawab *et al.*(1997), who reported that number of days to tasseling was increased in weed free plots as compared to check plots (Table 4). Maximum days to 50% tasseling were recorded in plots that treated with 2.0 L Harness xtra ha^{-1}, while minimum days to 50% tasseling were noted in check plots.

Days to maturity

Weed control treatments (T), check vs T, pre E.H. vs Post E.H, pre linear, pre quadratic and post linear significantly affected days to maturity, while row spacing (S), Hw vs H, post quadratic and SxT did not significantly affect days to maturity (Table 1). Maximum days to maturity were recorded in (T) plots as compared to check plots. This is confirmed by Nawab *et al.*, (1997), who reported that days to maturity were increased in weed free plots as compared to check plots. Comparing pre E.H vs post E.H, pre E.H resulted maximum days to maturity as compared to post E.H. It may be due to the fact that maximum weeds free plot resulted in delaying the maturity by having sufficient nutrients and moisture etc. Maximum and at par days to maturity were recorded when plots treated with 2.0 and 2.5 L Harness xtra ha^{-1}, while minimum days to maturity were recorded in check plots (Table 5). It might be due to the fact this level of pre E.H have good control of weeds resulted maximum days to maturity. These results agree with Johnson *et al.* (1998), who reported that (Harness or Surpass) alone or followed by post-em dicamba control weeds in both narrow and wide row corn.

Biological yield

Significant differences were observed in biological yield due to weed control treated plots (T), check vs T, Hw vs H, pre E.H vs post E.H, pre linear and SxT (Table 1). Maximum biological yield produced by weed control treated plots. The results are in agreement with Saini (2000) who reported that weed control treated plots increased yield and Kamel *et al.*, (1983) who also reported that leaf area, number of leaves $plant^{-1}$, plant height, cob length and number of grains contribute in increasing the biological yield. In case of pre E.H vs post E.H, highest biological yield resulted from pre E.H treated plots. Regarding rates of pre E.H, highest and at par biological yield was produced at 2.5 and 2 L Harness xtra ha^{-1}, while minimum biological yield was produced at 1.5 L Harness xtra ha^{-1} (Table 6). Regarding SxT revealed that maximum biological yield was obtained by 75 cm apart rows receiving 1.5 L Harness xtra ha^{-1}, while minimum biological yield was produced by 100 cm apart rows in check plots.

Conclusion

It may be concluded that minimum dry weight of weeds and maximum biological yield were recorded when plots treated with pre-em (Harness xtra) @ 2.5 L ha^{-1}.

Table-1. Mean squares and sources of variation of maize as affected by row spacing and different levels of pre- and post-em herbicides

Source of variation	df	Days to emergence	Dry weight of weeds m^{-2} after 30 days of emergence	Days to tasseling	Days to maturity	Biological yield
Replications	3	0.20	21.58	0.20	0.37	35812.9
Row spacing(s)	2	0.04	16.54	0.26	0.78	83453.1
Error A	6	0.36	15.58	0.12	1.30	120808.9
Weed control treatment (T)	7	3.96**	6022.87**	2.24**	148.15**	428827.3**
Check vs T	1	0.12	38050.76**	63.76**	702.33**	15572197.0**
Hw vs H	1	1.78	369.34**	4.19*	3.33	385205.0**
Harness xtra vs Atrazine	1	22.22**	2259.37**	0.88	115.01**	7543067.0**
Pre linear	1	1.50	636.02**	0.04	80.66**	1712622.0*
Pre quadratic	1	1.38	33.27	15.12*	43.55*	422224.2
Post linear	1	0.66	755.33**	0.04	92.04**	831457.9
Post quadratic	1	0.05	55.96	1.68	0.12	8435771.0
SxT	14	0.13	14.10	0.53	1.62	782847.4**
Error B	63	0.84	17.30	0.75	3.09	233603.0

*, ** = Significant at the 0.05 and 0.01 probability levels respectively.

Table-2. Days to emergence of maize as affected by different levels of pre- and post-em herbicides and row spacing

Row spacing (cm)	Herbicides (L ha^{-1})								
	Harness xtra (pre-em)			atrazine (post-em)			Hw	Check	Mean
	1.5	2.0	2.5	0.5	1.0	1.5			
50	8.00	7.25	7.50	8.75	8.75	8.75	8.50	8.25	8.22
75	8.00	7.50	7.35	9.00	8.50	8.75	8.50	8.25	8.22
100	8.00	7.25	7.75	9.00	8.75	8.25	8.75	8.50	8.28
Mean	8.00bc	7.33c	7.50c	8.92a	8.67ab	8.58ab	8.58ab	8.33ab	

Treatment	Days to emergence	Treatment	Days to emergence	Difference
No weeding	8.33	Weed control	8.23	0.10
Hand weeding	8.58	Herbicide	8.17	0.41
Pre-em.H	7.61	Post-em.H	8.72	1.11

LSD value (at 5% probability level) for treatments = 0.7482

Means of the same category followed by different letters are significantly different using LSD test.

Table-3. Dry weight of weeds m^{-2} after 30 days of emergence of maize as affected by different levels of pre- and post-em herbicides and row spacing

Row spacing (cm)	Herbicides (L ha^{-1})								
	Harness xtra (pre-em)			atrazine (post-em)			Hw	Check	Mean
	1.5	2.0	2.5	0.5	1.0	1.5			
50	30.80	25.70	22.02	48.04	36.29	33.14	26.56	91.33	39.28
75	33.59	27.09	22.43	43.30	35.35	34.45	26.53	89.69	39.05
100	35.00	25.04	24.06	43.30	38.59	33.80	27.65	95.72	40.39
Mean	33.13d	25.94ef	22.84f	45.00b	36.74c	33.78cd	26.91e	92.25a	

Treatment	Dry weight of weeds	Treatment	Dry wt. of weeds	Difference
No weeding	92.25	Weed control	32.05	60.20
Hand weeding	26.91	Herbicide	32.91	6.00
Pre-em.H	27.30	Post-em.H	38.51	11.21

LSD value (at 5% probability level) for treatment = 3.394

Table-4. Days to 50% tasseling of maize as affected by different levels of pre- and post-em herbicides and row spacing

Row spacing (cm)	Herbicides (L ha^{-1})								
	Harness xtra (pre-em)			Atrazine (post-em)			Hw	Check	Mean
	1.5	2.0	2.5	0.5	1.0	1.5			
50	53.50	55.25	54.00	53.50	54.75	53.75	53.00	51.75	53.69
75	53.75	55.25	54.00	54.25	54.50	53.75	54.00	51.25	53.84
100	54.00	55.00	53.50	53.75	53.75	54.25	53.50	51.75	53.69
Mean	53.75bc	55.17a	53.83bc	53.83bc	54.33b	53.92bc	53.50c	51.58d	

Treatment	Days to 50% tasseling	Treatment	Days to 50% tasseling	Difference
No weeding	51.58	Weed control	54.05	2.47
Hand weeding	53.50	Herbicide	54.14	0.64
Pre-em.H	54.25	Post-em.H	54.03	0.22

LSD value (at 5% probability level) for treatment = 0.7075

Means of the same category followed by different letters are significantly different using LSD test.

Table-5. Days to maturity of maize as affected by different levels of pre- and post-em herbicides and row spacing

Row spacing (cm)	Herbicides (L ha^{-1})								
	Harness xtra (pre-em)			Atrazine (post-em)			Hw	Check	Mean
	1.5	2.0	2.5	0.5	1.0	1.5			
50	98.50	103.00	102.75	98.25	98.75	100.50	101.25	92.25	99.41
75	99.00	103.00	103.00	97.50	99.75	101.25	100.75	92.25	99.56
100	99.50	103.50	102.25	95.50	99.00	101.25	100.75	92.25	99.25
Mean	99.00c	103.17a	102.67a	97.08d	99.17c	101.00b	100.92b	92.25e	

Treatment	Days to maturity	Treatment	Days to maturity	Difference
No weeding	92.25	Weed control	100.43	8.18
Hand weeding	100.92	Herbicide	100.35	0.57
Pre-em.H	101.61	Post-em.H	99.08	2.53

LSD value (at 5% probability level) for treatment = 1.435

Table-6. Biological yield (kg ha^{-1}) of maize as affected by different levels of pre- and post-em herbicides and row spacing.

Row spacing (cm)	Herbicides (L ha^{-1})								
	Harness xtra (pre-em)			Atrazine (post-em)			Hw	Check	Mean
	1.5	2.0	2.5	0.5	1.0	1.5			
50	8333.40 efg	9300.40 abc	9046.55 bcd	8478.59 d-g	8551.84 d-g	8851.62 cde	8643.69 c-f	7641.13 hi	8605.90
75	9850.97 a	9693.60 ab	9662.79 ab	8007.62 fgh	8845.36 cde	8558.69 def	8521.82 d-g	8085.97 fgh	8903.35
100	8629.36 c-f	9310.33 abc	9707.17 ab	8960.91 cde	8300.24 e-h	9153.59 bcd	7872.44 ghi	7231.03 I	8645.63
Mean	8937.91 b	9434.78 a	9472.17 a	8482.37 cd	8565.81 bcd	8854.63 bc	8345.98 d	7652.71 e	

Treatment	Biological yield	Treatment	Biological yield	Difference
No weeding	7652.71	Weed control	8870.52	1217.81
Hand weeding	8345.98	Herbicide	8957.95	611.97
Pre-em.H	9281.62	Post-em.H	8634.27	647.35

LSD value (at 5% probability level) for treatment = 394.3
LSD value (at 5% probability level) for interaction = 683.0

Means of the same category followed by different letters are significantly different using LSD test.

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