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Integrated Weed Management Studies for Autumn Planted Maize

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Abstract

A field experiment was conducted to evaluate the integrated effect of weed control practices on the weed control efficiency, growth and yield of autumn planted maize (*Zea mays* L.) under agro-ecological conditions of Faisalabad. Treatments comprised manual hoeing and earthing up alone and in combination with metolachlor + atrazine @1110+740 g a.i.ha^{-1}; manual hoeing + earthing up, metolachlor + atrazine @1110+740 g a.i.ha^{-1}, acetachlore @ 618 g a.i.ha^{-1} alongwith weedy check as control. The maximum plant height (213 cm), cob length (16.43 cm), number of cobs per plant (1.53), number of grains per cob (586.33), 1000-grain weight (75.49 g) maximum weed control efficiency at harvest, 30 and 60 days after sowing, and grain yield (4.90 t ha^{-1}) were recorded for manual hoeing along with metalachlor + atrazine @1110+740 g a.i.ha^{-1}.

Key words: Maize, integrated weed control, yield weed control efficiency

Introduction

Maize belongs to poaceae family and has an important position in crop husbandry because of its higher yield potential and short duration. Maize grain contains about 72 % starch, 10 % protein, 4.8 % oil, 9.5 % fiber, 3 % sugar, and 1.7 % ash (Chaudhry, 1983). At present, maize is cultivated at an area of 1.01 million hectares with an average yield of 2893 kg ha^{-1} and total annual production is 3.31 million tons (GOP, 2008). Its per hectare yield is very low as compared with the yield potential of existing cultivars. Among various factors responsible for low yield, weed infestation is of supreme importance. Weed interference in maize leads to 25 to 80% reduction in crop yield (Ford and Pleasant, 1994; Chikoye and Ekeleme, 2003). Different weed control practices like cultural, physical, biological and chemical are used for weed control. No doubt cultural methods are still useful tools but are laborious, time consuming and getting expensive. Moreover, the labour problem is becoming acute day by day and it will not be possible and economical to stick only to the traditional cultural weed control practices. Chemical weed control is an important alternative. Herbicide application can increase yield by 77 to 96.17% than the weedy check (Khan *et al.*, 1998). But herbicides vary greatly in chemical composition and in the degree of threat they pose to the environment and human health. Residual effect of herbicides also can not be neglected. So integrated weed management is a best alternative in these situations. Integrated weed management in maize can reduce weed density and increase growth and yield of maize. The maximum benefit was obtained from the crop plants which were treated with post-emergence application of Aim + atratox copack + one hoeing (Arshad and Akhter, 2001). Maize grain yield was significantly higher in the treatment in which herbicide mixture was combined with 40,000 maize plants ha^{-1} and weeded thrice (Chikoye *et al*., 2004). The highest grain yield was obtained by Pre-emergence application of metolachlor and its combination with atrazine each followed by supplementary weeding at 7 weeks after sowing (Gana *et al.,* 2007). Keeping in view the positive response of maize to this factor, a study was conducted to determine the impact of most appropriate weed control method for higher maize production under agro-climatic conditions of Faisalabad.

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Material and Methods

A field experiment was carried out to study the comparative efficiency of different weed control methods namely Weedy check (W_1), two manual hoeings at 25 and 50 days after sowing (W_2), earthing up at 30 days after sowing (W_3), metolachlor + atrazine (primextra) @1110+740 g a.i.ha^{-1} (W_4), acetachlore (acetore) @ 618 g a.i.ha^{-1} (W_5), manual hoeing along with earthing up (W_6), earthing up along with metolachlor + atrazine (Primextra) @1110+740 g a.i.ha^{-1}(W_7) and manual hoeing along with metolachlor + atrazine (Primextra) @1110+740 g.a.i.ha^{-1} (W_8) in autumn planted maize at Agronomic Research Area, University of Agriculture, Faisalabad. The experiment was laid out in a randomized complete block design (RCBD) with three replications having a net plot size of 5 × 3 m. Maize hybrid Poineer-1661 was sown in last week of July, 2008 with a single row hand drill using a seed rate of 30 kg ha^{-1} in 75 cm apart rows. Plant to plant distance of 25 cm was maintained by thinning at early growth stages. The fertilizer was applied at 120 kg nitrogen and 50 kg phosphorous ha^{-1} as urea and diammonium phosphate, respectively. Whole of phosphorous and half of nitrogen was side dressed just after sowing, while, remaining nitrogen was top dressed with 2nd irrigation. The spray volume was determined by calibration before spraying the herbicide. The herbicide was sprayed with Knapsack hand sprayer fitted with flat fan nozzle. Hoeing was done twice using a hand hoe in manual hoeing treatment when soil was at field capacity. All other agronomic practices will be kept normal and uniform. The samples from an area of one square meter were taken from two places at random to record weed density and dry weight. Ten plants were selected at random to record plant height, number of cobs per plant, number of grains per cob and cob length. Three samples of thousand grains each were taken at random from grain lot of each plot to record 1000-grain weight. Grain and stalk yield were recorded on per plot basis and were converted to tons per hectare. The data collected were analyzed statistically by using Fisher's analysis of variance technique and least significant difference test will be applied at 5% probability level to test the significance of the treatment means (Steel *et al.*,1997).

Results and Discussion

Plant height

Data pertaining to plant height is presented in Table 1. The maximum plant height (213 cm) was recorded in plots of manual hoeing + earthing up and manual hoeing + metolachlore + atrazine @1110+740 g.a.i.ha^{-1} and minimum plant height (170 cm) was recorded in weedy check plots. Decrease in plant height may be due to the fact that weed suppressed the vegetative growth of plants by competition for light, moisture and nutrients. Variation in plant height of maize could be attributed to varying effect of weed competition offered by different weed densities in different treatments. The plots having higher weed control efficiency get more resources and produced taller plants. Increase in plant height of maize by chemical weed control and hand weeding has also been reported by Singh and Singh (2003).

Yield components

The maximum number of cobs (1.53 per plant) was recorded in manual hoeing + metolachlore + atrazine @1110+740 g.a.i.ha^{-1} (W_8), whereas, the minimum number of cobs (1.06 per plant) was recorded in weedy check (W_1). However, these differences could not reach to the level of significance. The non-significant differences can be attributed to the fact that number of cobs per plant is genetically controlled parameter. The cob length was also affected significantly by integration of different weed control practices. The comparison of individual treatment means indicated that the cob length in manual hoeing + metolachlore + atrazine @1110+740 g.a.i.ha^{-1} treated plots was maximum (16.43 cm) and minimum cob length (14.10 cm) was recorded in weedy check plots (W_1).

Number of grains per cob was significantly affected by various weed control treatments. The maximum number of grains (586.33 grains per cob) were recorded from manual hoeing + metolachlore + atrazine @1110+740 g.a.i.ha^{-1} while lowest number of grains (412.00 grains per cob) were obtained from weedy check plots. The maximum number of grains per cob in manual hoeing + metolachlore + atrazine @1110+740 g.a.i.ha^{-1} was due to more number of grain rows per cob and more cob length. Data in Table 1 showed that the highest 1000-grain weight (75.49 g) was recorded in manual hoeing + metolachlore + atrazine @1110+740 g.a.i.ha^{-1} while minimum 1000-grain weight was recorded in weedy check plots. The integration of weed control practices resulted in better performance of maize crop compared with application of weed control practices alone. The increase in number of grains per cob, cob length and grain weight with weed control practices might be due to higher weed control efficiency which resulted enhanced availability of resources under decreased weed crop competition. Sharma and Gautam (2003) also reported that weed control treatments resulted in better yield components of maize crop.

Grain yield (t ha^{-1})

The data showed significant effect of different treatments on seed yield of maize. Manual hoeing + acetachlore @618 g.a.i.ha^{-1} proved to be the best weed controller treatment and in response gave the highest grain yield i.e. 4.9 t ha^{-1}. Minimum grain yield (2.35 t ha^{-1}) was recorded from weedy check plots. Highest grain yield was due to more number of grains per cob, grain weight per cob and 1000 grain weight compared to weedy check. Similar results were also reported by Subhan *et al.* (2007). They reported that herbicides and hand weeding cause an increase in grain yield as compared to weedy check.

Weed control efficiency

The differences among integrated weed control methods were sigficant for weed control efficiency for all the weeds. The control efficiency of *T. potulacastrum* was maximum 30 and 60 days after sowing. The maxim control was obtained when

Table 1 Yield and yield components as effected by integrated weed control practices methods

Treatments	Plant height (cm)	Number of cobs plant^{-1}	Cob length (cm)	Number of grains cob^{-1}	1000- grain weight (g)	Grain yield (t ha^{-1})
W_1 = Weedy check (control)	170.0d	1.06	14.10 b	412.00 c	61.10 f	2.30 c
W_2 = manual hoeings	212.00 a	1.26	16.00 a	537.00 b	74.90 b	4.10 b
W_3 = Earthing up	187.00 bc	1.26	15.83 a	523.30 b	69.90 d	3.20 b
W_4 = Metolachlor + atrazine @1110+740 g a.i.ha^{-1}	179.00 cd	1.20	14.90 b	512.30 b	68.70 d	3.20 b
W_5 = Acetachlore (Acetore) @ 618 g a.i.ha^{-1}	175.00 cd	1.20	14.56 b	436.30c	67.70 e	3.30 b
W_6 = Manual hoeing + earthing up	213.00 a	1.46	16.10 a	540.30 b	72.30 c	4.70 a
W_7 = Earthing up + metolachlor + atrazine @1110+740 g a.i.ha^{-1}	196.00 b	1.46	16.13 a	547.00 a	70.00 c	4.70 a
W_8 = Manual hoeing + metolachlor + atrazine @1110+740 g a.i.ha^{-1}	213.00 a	1.53	16.43 a	586.30 a	75.40 a	4.90 a
LSD (5 %)	12.06	NS	0.82	4.12	1.14	0.96

Any two means not sharing same letters with in a column differ significantly at 5 % level of probability

Table 2 Weed control efficiency as influenced by integrated weed control practices

	Weed control efficiency 30 days after sowing date			Weed control efficiency 60 days after sowing date			Weed control efficiency at harvest		
Treatments	***T. portula-castrum***	***C. rotundus***	**Total**	***T. portula-Castrum***	***C. rotundus***	**Total**	***D. aegyptium***	***C. rotundus***	**Total**
W_1 = Weedy check (control)	-	-	-	-	-	-	-	-	-
W_2 = manual hoeings	53.59 e	79.18 b	91.16 b	91.46 b	81.01 c	90.29 a	64.16 b	45.46 b	57.13 b
W_3 =Earthing up	87.35 d	76.87 c	85.69 c	63.19 c	62.02 d	63.03 b	35.83 e	41.23 c	44.93 d
W_4 = Metola chlor + atrazine @1110+740 g a.i.ha^{-1}	30.18 g	64.37 d	29.31 e	42.50 d	48.12 f	42.39 c	4.58 g	30.92 f	27.46 e
W_5 = Aceta chlore (Acetore) @ 618 g a.i.ha^{-1}	35.97 f	20.62 e	34.50 d	42.88 d	48.12 f	42.71 c	8.33 f	20.61 g	9.99 f
W_6 = Manual ho-eing + earthing up	93.44 b	76.87 c	91.16b	92.79 b	83.55 b	90.45 a	39.16 d	38.14 e	46.25 d
W_7 =Earthing up + metolachlor + atrazine @1110 +740 g a.i.ha^{-1}	92.22 c	75.00 c	90.04 b	63.19 c	50.62 e	60.35 b	52.50 c	41.23 d	50.44 c
W_8 = Manual hoeing + metolachlor + atrazine @1110+740 g a.i.ha^{-1}	95.42 a	93.75 a	94.10 a	94.30 a	88.60 a	91.10 a	69.16 a	65.97 a	63.73 a
LSD (5 %)	1.572	.001	1.975	1.483	1.786	2.107	1.059	1.312	.921

Any two means not sharing same letters with in a column differ significantly at 5 % level of probability manual hoeing was used in integration with metolachlor + atrazine @ 1110+740 g a.i. ha^{-1} (W_8). The lowest weed control efficiency for *T. potulacastrum* was recorded when metolachlor + atrazine @ 1110+740 g a.i. ha^{-1} was applied alone (W_4) 30 and 60 days after sowing and was statistically at par with application of Acetachlor @ 618 g a.i. ha^{-1} (W_5) 60 days after sowing. However, *T. potulacastrum* had completed its life cycle and had disappeared from the field till the final harvest. The comparison of chemical vs. non-chemical treatments showed that non-chemical treatments resulted in higher weed control efficiency than chemical treatments. Among Non-chemical treatments the earthing up treatment showed better weed control than manual hoeing treatments. The control efficiency of *C. rotundus* was maximum with integration of manual hoeing and metolachlor + atrazine @ 1110+740 g a.i. ha^{-1} (W_8) whereas, the minimum weed control efficiency was recorded with Acetachlor @ 618 g a.i. ha^{-1} at harvest, 30 and 60 days after sowing. The performance of metolachlor + atrazine was better in controlling weeds compared with acetachlor. The increased weed density with integration of manual hoeing and matolachlor @1110 g a.i.ha^{-1} + trazine @740 g a.i.$ha^{-1}$was due to mechanical injury due to manual hoeing and mortality due to phytotoxic effect of herbicide. These results are in line with those of Nurse *et al*. (2006) and Abouziena *et al.* (2008) who reported that hand weeding and herbicidal treatments Increased the weed control efficiency in maize (*Zea mays* L.) over weedy check.

Conclusion

This study has shown that manual weed control integrated with metolachlor + atrazine @1110 g a.i.ha^{-1} + @740 g a.i.ha^{-1} (W_8) gave higher grain yield and weed control efficiency than the weedy check and other methods of weed control.

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