Pak. J. Weed Sci. Res. 17(2): 125-133, 2011

EFFICACY OF DIFFERENT HERBICIDES AGAINST WEEDS IN MAIZE (*Zea mays* L.)

Muhammad Arif[1], Tanweer Mukhtar, Saleem Ur Rahman, Khadim Hussain, Abdul Razaq and Rana Aftab Iqbal

ABSTRACT

A field experiment was conducted at Maize and Millets Research Institute Yusafwala, Sahiwal during Kharif season 2010 to evaluate the efficacy of some herbicides for controlling weeds and their effectiveness on yield and yield components of maize. The experiment was laid out in a Randomized Complete Block (RCB) design having three replications. In current study, different herbicides were compared for their efficacy to control various weed species. The data was recorded on weeds mortality percentage, germination percentage, plant height (cm), days to 50% silking, ear height (cm), number of grains per ear, 1000 grain weight (g) and grain yield (kg ha^{-1}). All the herbicides reduced weed population considerably over check. The most effective herbicide for broad leave weeds and narrow leaf weeds was Primextra gold 720 SC @ 2000 ml ha^{-1}, while Equip 2.25% OD @ 2000 ml ha^{-1} was more efficient against sedges. The herbicides significantly affected ear height (cm), number of grains per ear, 1000 grain weight (g) and grain yield (kg ha^{-1}) while other parameters showed non significant differences. Maximum number of grains per ear (298.8), 1000 grain weight (268.8 g) and grain yield (7187 kg ha^{-1}) were recorded in plots treated with Equip 2.25 OD @ 2000 ml ha^{-1} followed by Primextra gold 720 SC @ 2000 ml ha^{-1}. It is concluded that application of Equip 2.25 OD @ 2000 ml ha^{-1} and Primextra gold 720 SC @ 2000 ml ha^{-1} significantly decreased weeds density and increased grain yield among the herbicides applied and hence recommended for obtaining higher grain yield of maize.

Key words: Maize, herbicide, pre-emergence, post-emergence.

INTRODUCTION

Maize (*Zea mays* L.) is a well known crop belonging to family Poaceae. Maize is well adapted to the climate and soil of Pakistan. It is the world's most grown ranked third among cereal crop after wheat and rice (Ayisi and Poswall, 1997). Maize is gaining important position

[1] Maize & Millets Research Institute Yusafwala, Sahiwal, Pakistan.
Corresponding Author's email: jamarif@gmail.com

in crop husbandry because of its high yielding potentials and short growth duration. The area of production of maize is increasing day by day due to our linear increase in demand for poultry feed and others. In Pakistan, maize is grown on an area of 0.95 million hectares with total annual production of 3.487 million tones of grain giving an average yield of 3670 kg ha^{-1} (Anonymous, 2010).

This is tremendously lower than the yields realized in other countries of the world. The feasibility to increase per unit yield is more as there is a large gap between potential and actual yield per hectare. Among various factors responsible for low yield, weed infestation is of supreme importance. Although maize plant is vigorous and tall growing in nature, yet it is very sensitive to weed competition at early stages of growth (Kumar and Sundari, 2002). Worldwide maize production is hampered up to 40 percent by competition from weeds which are the most important pest group of this crop (Oerke and Dehne, 2004). Weeds being injurious, harmful or poisonous are a constant source of trouble for the successful growth and development of crops. Weeds compete with crops for light, moisture, space and plant nutrients and other environmental requirements and consequently interfere with the normal growth of crops.

Weeds pose severe problem for crop husbandry, reducing the soil fertility and moisture and develop a potential threat to the succeeding crops (Oerke and Dehne, 2004; Oerke, 2005). In addition, weeds harbour insects and plant disease organisms and in some cases, they serve as alternate host for insect pests and disease organisms. Different weed control methods are used in maize crop among which chemical weed control is the most economical and effective method to suppress weeds in order to get healthy and vigorous crop stand. Miller and Libbey (1999) reported that maize yield generally responded positively to increased weed control. Ali *et al.* (2003) concluded that herbicide application increased biological yield and decreased weed biomass significantly. Herbicides application is not only more effective and cheap but also efficient method to check weeds. Haider *et al*. (2009) reported good weed control and increased crop yield with herbicides in maize.

Keeping in view of the importance of the national problem, the present research was conducted to study the impact of herbicides on different weeds and consequent effects of various agronomic parameters including yield and yield components of maize.

MATERIALS AND METHODS

The investigations pertaining to the effect of different herbicides on weed population and yield of maize were carried out at Maize & Millets Research Institute, Yusafwala-Sahiwal during Kharif 2010. The

layout of experiment was in Randomized Complete Block (RCB) design with three replications having a plot size of 5 m X 4.5 m. MMRI Yellow was grown as a test crop. Each plot consisted of 6 rows, each 5 m long and 75 cm apart. Planting was made during the last week of July at 2 seeds / hill and at spacing of 20 cm apart, thinned to one seedling at three leaves stage. Sowing was done with the help of dibler. Herbicidal treatments were done after seed sowing with the help of knapsack hand sprayer fitted with flat fan nozzle. An area of one meter square from two different places was ear marked at random in each plot for recording maize germination count and weed population. Initial weed population was recorded just before spraying. The second weed population was recorded fifteen days after herbicides spray to calculate mortality percentage. The detail of treatments are providing in the Table-1. Meteorological data is given in Table-2.

Table-1. Detail of herbicidal treatments in the experiment.

Treatment	Common name	Application time	Formulation	Dose ml ha^{-1}
Click	Atrazine+acetochlor	PRE	72.4 SE	1250
Click	Atrazine+acetochlor	PRE	72.4 SE	1875
Equip	Foramsulfuron + Isoxadifen-ethyl	POST	2.25 OD	200
Relax	Acetochlor	PRE	50% EC	1250
Acetor	Acetochlor	PRE	50% SL	1250
Primextra Gold	Atrazine + S metachlor	PRE	720 SC	2000
No weeding (check)	-	-	-	-

PRE = Pre emergence, POST = Post emergence.

Table-2. Meteorological data during growth period.

Month	Rainfall (mm)	Mean Min temp (^{0}C)	Mean Max temp (^{0}C)	Mean temp (^{0}C)	Mean Relative humidity at 8.00 am	Mean Relative humidity at 5 pm
August	77.6	27.90	38.58	33.24	55.19	51.23
September	17.3	21.3	38.06	29.68	48.36	38.60
October	-	19.93	36.87	28.40	48.67	28.41
November	-	10.87	30.03	2o.45	51.43	33.30
December	-	4.74	24.48	14.61	78.74	39.58

Table-3. Soil analysis of the experimental area.

E.C. ($ds\ m^{-1}$)	Soil pH	Organic matter (%)	Available P (ppm)	Available K (ppm)	Available Fe (ppm)	Available Zn (ppm)	Available B (ppm)
1.5	8.2	0.83	8.2	164	5.80	0.65	1.04

The following parameters were studied during the course of experiment:

Weeds were counted before and after four days of the application of herbicides from each plot and weed mortality percentage was taken. After completion of emergence, germination percentage was calculated from each plot. Plant height was taken with the help of meter rod from 10 randomly selected plants from each plot at maturity and average was calculated. After the emergence of 50% silk, days to 50% silking were calculated from the date of sowing. Data was recorded after harvesting of two central rows from each plot and average was calculated. Ear height was taken with the help of meter rod from 10 randomly selected plants from each plot at maturity and average was taken. Number of grains per ear were recorded from 10 randomly selected ears and averaged. Three random samples of thousand seeds were obtained from produce of each plot then thousand seeds weight were recorded and averaged. Grain yield was recorded after harvesting of two central rows from each plot and yield per hectare was calculated.

The recommended agronomic practices were followed throughout the course of the study. The data collected were subjected to analysis of variance technique and the treatments means were compared by using Duncan's New Multiple Range (DMR) test at 0.05% probability (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Weeds mortality percentage

In the experimental area, broad leaf weeds, narrow leaf weeds and sedges were present. *Trianthema monogyna, Cyperus rotundus, Sorghum halepense*, *Convolvulus arvensis, Chenopodium album* and *Cynodon dactylon* were the main weed species found in maize field. The data on mortality of broad leaf weeds indicated significant differences among all the herbicide treatments over weedy check (Table-4). All the herbicides reduced weed population considerably. The herbicidal efficiency of the tested herbicides was presented as percentages of reduction in each weed type are shown in Table-4. The most effective herbicide for broad leaf weeds and narrow leaf weeds was Primextra gold 720 SC @ 2000 ml ha^{-1}, while Equip 2.25% OD @ 2000 ml ha^{-1} was more efficient against sedges. The percentages of

reduction of the broad leave weeds, narrow leave weeds and sedges were 89.58 %, 92.51% and 52.84%, respectively. These results are in agreement with the finding of Salarzai (2001). Khan and Haq (2004) also reported that Primextra gold was most effective in controlling weeds.

Germination percentage

Data regarding germination percentage of maize showed that germination percentage was not significantly affected by various herbicide treatments (Table-5). However, the germination percentage on the average varied from 88.13 to 84.87. These results are in agreement with the finding of Maglhaes *et al.* (2000) who reported that herbicide application besides providing good weed control had no phytotoxic effect on maize plants.

Plant Height (cm)

Statistical analysis of the data (Table-5) revealed that different treatments had no significant effect on plant height. Although not approaching the level of statistical significance, the taller plants (279.7, 278, 274 cm) were attained in the plots treated with Relax, Click and Primexra gold while minimum plant height of 257.7 cm was recorded in weedy check plots. Variations in plant height could be attributed to varying effect of weed competition offered by different weed densities in different treatments. These results are contradictory to the findings of Oljaca *et al*. (2007) who reported significant decline in maize plant height due to the weeds infestation.

Days to 50% Silking

None of the herbicide treatments showed significant effect on days to 50% silking (Table-5). This might be due to the fact that this character is genetically controlled and is little influenced by the environmental conditions. However, the means showed that maximum days to 50% silking (55) were recorded in plots treated with Click 72.4 SE @ 1875 ml ha^{-1} and in no weeding plots while minimum days to 50% silking (53.67) was recorded in plot treated with Click 72.4 SE @ 1250 ml ha^{-1}. These findings are in agreement with Subhan *et al.* (2007) who reported that herbicide application had no significant effect on days to 50% silking.

Ear height (cm)

Data concerning the ear height of maize indicated significant differences among all the herbicide treatments over weedy check but the differences among the herbicide treatments were non significant (Table-5). Maximum ear height (266 cm) was recorded in the plots treated with Click 72.4 SE @ 1250 ml ha^{-1} against the minimum (103.3 cm) in weedy check. These results are contradictory to the findings of Subhan *et al*. (2007) who reported that the herbicide application had no significant effect on ear height.

Number of grains ear^{-1}

The number of grains per ear plays an important role in determining the final yield of maize. The data revealed that number of grains per ear varied significantly (Table-5). Maximum grains per ear were recorded in plots treated with Equip 2.25% OD @ 2000 ml ha^{-1} producing 598.8 grains ear^{-1} against the minimum of 419.4 in weedy check. From these results it was observed that good weed control was effective to get higher number of grains ear^{-1}. These results are in line of those reported by Salarzai (2001) who reported that number of grains per ear increased significantly with the application of herbicides.

1000 grain weight (g)

The data regarding 1000-grain weight (Table-5) revealed that there was significant difference between different herbicide treatments. Data indicated that maximum 1000 grain weight (268.8 g) was produced by Equip 2.25% OD @ 2000 ml ha^{-1} while minimum 1000 grain weight (186.7 g) was obtained in the weedy check. This increase in 1000-grain weight was possibly due to better growth and development of maize plant, which resulted in more seed assimilates. These results get support from the previous findings of Sabra *et al.* (2006) who reported significant increase in 1000 grain weight of maize with the application of herbicides.

Grain yield (kg ha^{-1})

Significant differences were observed in grain yield due to weed control treatments (Table-5). In current study Equip 2.25% OD @ 2000 ml/ha gave maximum grain yield (7187 kg ha^{-1}) while significantly minimum grain yield (5038 kg ha^{-1}) was recorded in weedy check. The increase in grain yield could be that weed control by different herbicides in study diverted the nutrients to the crop, which in turn resulted in higher grain yield was due to more number of grains per ear and 1000-grain weight as compared to weedy check. These results are also confirmed by Ali *et al.* (2003). Efficiency of chemicals in increasing grain yield had also been demonstrated by some scientists (Khan *et al.* 2002; Shinde *et al.* 2001). They reported that use of herbicides like Primextra gold and metalachlor resulted in increased maize yield significantly as compared to weedy control.

Cost benefit ratio

All the herbicide treatments gave higher net benefit as compared to weedy check (Table-6). The maximum net income recorded in Equip might be due to the fact that Equip controlled all kinds of weeds effectively and grain of maize was increased which ultimately increased the net income. Maximum cost benefit ratio (1:29) was recorded for Relax followed by Acetor and Primextra gold.

Table-4. Effect of different herbicides on mortality of weeds.

Treatments	BLW %	NLW %	Sedges %
Click 72.4 SE @ 1250 ml ha^{-1}	82.85 a	60.83 c	23.72 bc
Click 72.4 SE @ 1875 ml ha^{-1}	87.25 a	81.55 ab	26.37 b
Equip 2.25% OD @ 2000 ml ha^{-1}	83.08 a	64.67 bc	52.84 a
Relax 50% EC @ 1250 ml ha^{-1}	81.12 a	87.19 a	29.62 b
Acetor 50% SL @1250 ml ha^{-1}	56.63 a	79.31 abc	13.70 cd
Primextra gold 720 SC @ 2000 ml ha^{-1}	89.58 a	92.51 a	4.073 de
No weeding (check)	0.00 b	0.00 d	0.00 e
LSD 5%	35.08	19.45	10.84

Means in the respective columns followed by different letters are significantly different by LSD test at P=0.05
BLW= Broad leaf weeds, NLW= Narrow leaf weeds.

Table-5. Effect of different herbicides on growth and yield components of maize.

Treatments	Germination %age	Plant height (cm)	Days to 50% silking	Ear height (cm)	No. of grains ear^{-1}	1000 grain weight (g)	Grain yield (kg ha^{-1})
Click 72.4 SE @ 1250 ml ha^{-1}	86.87	278.0	53.67	126.0 a	485.0 d	217.5 cd	5827 e
Click 72.4 SE @ 1875 ml ha^{-1}	87.62	268.0	55.00	122.0 a	546.8 b	245.9 b	6569 c
Equip 2.25% OD @ 2000 ml ha^{-1}	84.87	271.3	54.00	123.0 a	598.8 a	268.8 a	7187 a
Relax 50% EC @ 1250 ml ha^{-1}	87.12	279.7	54.33	125.7 a	502.6 c	225.3 c	6038 d
Acetor 50% SL @1250 ml ha^{-1}	88.13	268.3	54.00	123.3 a	479.6 d	214.6 d	5762 f
Primextragold720SC@2000ml ha^{-1}	87.51	274.0	54.67	124.3 a	554.8 b	252.7 b	6773 b
No weeding(check)	87.88	257.7	55.00	103.3 b	419.4 e	186.7 e	5038 g
LSD 5%	NS	NS	NS	8.589	14.85	8.267	17.41

Means in the respective columns followed by different letters are significantly different by LSD test at P=0.05
NS= Non Significant

Table-6. Cost benefit ratio of various herbicide treatments in maize.

Treatments	Price of herbicides (Rs)	Total Cost of herbicides and its application (Rs ha^{-1})	Marginal increase in yield over check (kg ha^{-1})	Net income (Rs)	Cost benefit ratio
Click 72.4 SE @ 1250 ml ha^{-1}	600/600ml	1450	789	15780	1:11
Click 72.4 SE @ 1875 ml ha^{-1}	600/600ml	2075	1531	30620	1:15
Equip 2.25% OD @ 2000 ml ha^{-1}	Not available	Not available	2149	42980	-
Relax 50% EC @ 1250 ml ha^{-1}	390/1000 ml	690	1000	20000	1:29
Acetor 50% SL @1250 ml ha^{-1}	450/1000 ml	765	724	14480	1:19
Primextra gold 720 SC @ 2000 ml ha^{-1}	390/400 ml	2150	1735	34700	1:16
No weeding (check)	-	-	-	-	-

Maize grain price @ 20 Rs kg^{-1}, spray application cost= Rs.200 man^{-1} (one man day^{-1} ha^{-1}).
Note: Equip is a new product which is used only in trials and yet not launch in market.

REFERENCES CITED

Ali, R.S., K. Khalil, S.M. Raza and H. Khan. 2003. Effect of herbicides and rows spacing on maize (*Zea mays* L.). Pak. J. Weed Sci. Res., 9 (3-4): 171-178.

Anonymous, 2010. Economic survey of Pakistan. Ministry of Food and Agriculture, Islamabad, Pakistan, pp. 21.

Ayisi, K.K. and M.A.T. Poswall. 1997. Grain yield potential of maize and dry bean in a strip intercropping system. Appl. Plant Sci., 11: 56-59.

Haider, S.M.S., M.M. Karim, M.I. Ahmed, M.R. Shaheb and M. Shaheenuzzaman. 2009. Efficacy of different herbicides on the yield and yield components of maize. Int. J. Sustain. Crop Prod., 4(2):14-16.

Khan, M. and U.N. Haq. 2004. Weed control in maize (Zea *mays* L.) with pre and post-emergence herbicides. Pak. J. Weed Sci. Res., 10 (1-2): 39-46.

Khan, M.A., K.B. Marwat, H. Gul and K. Naeem. 2002. Impact of weed management on maize (*Zea mays* L.) planted at night. Pak. J. Weed Sci. Res., 8(1-2): 57-62.

Kumar, S.M.S. and A. Sundari. 2002. Studies on the effect of major nutrients and crop-weed competition period in maize. Indian J. Weed Sci., 34(3-4): 309-310.

Miller, T.W. and C.R. Libbey. 1999. Response of three corn cultivars to several herbicides. Res. Prog. Report. Western Soc. Weed Sci. Colorado Springs. USA, 9-11 March, pp. 57-58.

Oerke, E.C. 2005. Crop losses to pest. J. Agri. Sci., 143:1-13.

Oerke, E.C. and H.W. Dehne. 2004. Safeguarding Productionlosses in major crops and the role of crop production. Crop Prot., 23:275-285.

Oljaca, S., S. Vrbnicanin, M. Simic, L. Stefanovic and Z. Dolijanovic. 2007. Jimsonweed (*Datura stramonium* L.) interference in maize. Maydica., 52(3): 329-333.

Sabra, F.S., A.M. El-Bakry, A.E.H. Belal, I.M. El-Nabarawy and M.A. Abbassy. 2006. Effectiveness of herbicides treatments against weeds in maize and their action on yield and yield components. J. Pest Cont. and Environ. Sci., 14(2): 381-390.

Salarzai, A. 2001. Effect of different herbicides on weed population and yield of maize (*Zea mays* L.). Pak. J. Agri. Sci., 38(1-2):75-77.

Shinde, S.H., A.K. Kolage and R.L. Bhilare. 2001. Effect of weed control on growth and yield of maize. J. Maharashtra Agric. Univ., 26(2):212-213.

Steel, R.G.D., J.H. Torrie and D.A. Dickny. 1997. Principle and procedures of statistics. A biometrical Approach. 3rd edition. McGraw Hill Book Co., Inc., NY, U.S.A., pp. 352-358.

Subhan, F., N.U. Din, A. Azim and Z. Shah. 2007. Response of maize crop to various herbicides. Pak. J. Weed Sci. Res., 13(1-2): 9-15.