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EFFECT OF PHOSPHORUS AND HERBICIDE ON YIELD AND YIELD COMPONENTS OF MAIZE

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ABSTRACT

To evaluate different levels of phosphorus i.e. 60, 90 120 and 150 kg ha^{-1} and application of herbicide (Primextra-Gold @ 3 L ha^{-1} as pre-emergence and 1.5 L ha^{-1} as post-emergence) in maize crop, an experiment was conducted at the Agricultural Research Institute (ARI), Dera Ismail Khan during the year 2009. The results revealed that application of various doses of phosphorous along with Primextra-Gold significantly affected weed density, leaves per plant, 1000-grain weight, biomass and grain yield of maize. The combination of 120 kg ha^{-1} of phosphorus and pre-emergence herbicide application gave highest grain yield of 2522 kg ha^{-1} as compared to other treatments. Application of phosphorous @ 90 kg ha^{-1} and pre-emergence of herbicide application also gave higher maize yield than untreated control. On the basis of results obtained, the use of 120 kg ha^{-1} phosphorus and pre-emergence application of Primextra-Gold @ 3 L ha^{-1} is recommended for higher maize yield in Dera Ismail Khan.

Key words: Maize, weeds, phosphorous levels, herbicide.

INTRODUCTION

Maize (*Zea mays* L.) is third leading cereal crop of the world after wheat and rice. It is extensively grown in temperate, subtropical and tropical regions. The production of maize crop ranges from 50^{o}N to 40^{o}S latitude and from sea level 3300 meters altitude (Saeed and Saleem, 2000). Being a short duration cereal crop, it has attained top priority in the areas of high mountains especially in the Northern parts of Pakistan and Azad Jammu & Kashmir, where water scarcity, chilling conditions and snowfall limits the growing period of other cereals. Maize cultivation is more common in Hazara, Malakand, Peshawar, Dera Ismail Khan and Kohat divisions of Khyber Pakhtunkhwa and Rawalpindi, Faisalabad,

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Sargodha and Multan of Punjab Province. It is mainly grown during spring and summer seasons. Maize is versatile one because it provides food for human beings, feed for animals and poultry (Sasson, 2010). It has greater value because it contains 72% starch, 10% protein, 4.8% oil, 3% sugar and 1.7% ash (Hokmalipour *et al*., 2010).

Among plant nutrients, phosphorus plays an inevitable role in plant growth promotion, cell division and nucleus formation. It promotes maturity and counteracts the ill effect of excess nitrogen. Phosphorus is responsible for ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) formation which are responsible for heredity transmission. It provides strength to straw in cereal and thereby decreases lodging. It increases crop resistance to certain diseases. In maize, phosphorus deficiency adversely effects silking and ears formation and its optimum application increases yield and quality by increasing plant height and number of leaves per plant.

Like in many other crops, weeds cause reduction in crop yield by competing for light, nutrients, water, Carbon dioxide and interfere in farm operations besides increasing the cost of production. In addition, they serve as alternate host for insect pests and disease organisms. Weeds not only reduce the crop yield but impure the crop quality of farm produces by contamination and lowers its market value. Therefore, weed control is pre-requisite for making agriculture a profitable business. It has been estimated that in cereals yield losses range from 20 to 40% due to weeds (Ahmad and Sheikh, 2003). Weeds can be controlled physically, chemically and biologically. In general, cultural methods are useful but are expensive, laborious and time consuming. Therefore, chemical weed control is an important, effective and efficient alternative (Shakoor *et al.,* 1986; Schaub *et al.*, 2006).

The present study was planned to evaluate the effect of pre and post-emergence herbicides application together with different doses of phosphorus on yield of maize under the agro-ecology of Dera Ismail Khan.

MATERIALS AND METHODS

An experiment was laid out in a randomized complete black design (factorial) with 3 replications at the Agricultural Research Institute, Dera Ismail Khan, during 2009.

The net plot size was 3x5 m^2 with 4 rows having row to row distance of 75 cm and plant to plant 20 cm. After proper seed bed preparation, sowing was done manually. Maize variety "Azam" was sown after mid July. Fertilizer was applied @ 110: 75 kg N and K_2O kg ha^{-1} in all plots while different levels of phosphorus i.e. 60: 90: 120 and 150 kg ha^{-1} were applied in respective treatments. All potash and

different doses of phosphorus were applied at the time of sowing. Nitrogen was applied in three equal split doses i.e. first dose was applied at seed bed preparation, second dose 20 days after sowing and third after 40 days after sowing. The sources of N, P_2O_5 and K_2O were Urea**,** Triple super phosphate (TSP) and Sulphate of potash (SOP), respectively.

Herbicide (Primextra-Gold) was applied as pre-emergence @ 3 L ha^{-1} 4 days after sowing. The same herbicide was also applied as post-emergence @ 1.5 L ha^{-1} 15 days after germination of crop.

The data were recorded on five guarded plants for each entry on weed density (m^{-2}), number of leaves ($plant^{-1}$), leaf area index, number of ears $plant^{-1}$, number of grains ear^{-1}, 1000-grain weight (g), biomass and grain yield (kg ha^{-1}). The data thus obtained were analyzed statistically using analysis of variance technique (Steel and Torrie, 1984) and subsequently least significance test (LSD) was applied for comparing the treatment means by MSTATC computer software.

RESULTS AND DISCUSSION

Weed density (m^{-2})

The data revealed that different herbicidal treatments (pre/post application) significantly affected the weed population (Table-1). The maximum weed populations (21.56 m^{-2}) were recorded in control as compared to minimum weed population (15.56 m^{-2}) in pre-emergence treated plot @ 3 L ha^{-1}. The lower weed population in treated plots reduces the competition between weed flora and maize crop especially after the pre-emergence application of herbicide. These results also suggest that herbicide application provided favorable environment to maize as compared to un-treated plots. Subhan *et al.* (2007) also found that the use of Primextra-Gold was most effective in controlling weeds of maize. Kovacs *et al*. (2006) reported 34% yield loss in weedy plots as compared to weed free control.

Leaf area index

The data showed that neither the phosphorus levels nor the herbicide application affected the leaf area index significantly (Table-1). However, the leaf area index (LAI) was slightly higher in treated plots as compared to control treatments. The maximum LAI was noted in T3 (1.473) as compared to minimum in control (1.303). Mukuralinda *et al.* (2009) reported that LAI was increased when sufficient phosphorus was available to maize.

Number of leaves ($plant^{-1}$)

The number of leaves per plant was significantly affected by different levels of phosphorus and herbicide application (Table-1). The number of leaves per plant was significantly higher (9.44) in T3 by the

application of phosphorus @ 120 kg ha^{-1} and pre-emergence of herbicide. The pre-emergence application of herbicide was better than the post-emergence. The minimum number of leaves (8.22) was noted in control. The addition of 120 kg ha^{-1} of phosphorus and pre-emergence of herbicide was found optimum in getting increased number of leaves per plant.

Number of ears $plant^{-1}$

The data presented in Table-1 showed that various levels of phosphorus and herbicide application (pre/post-emergence) had no significant affect on number of ears per plant. However, T3 produced higher number of ears per plant (1.22) as compared to other treatments including control. Shah and Dillard (2006) also reported non-significant differences among various phosphorous levels however it's higher doses boosted corn crop biomass, which in turn led to higher number of ears per plant.

Number of grains ear^{-1}

The number of grains per ear was non-significantly affected by various levels of phosphorus and herbicide application (Table-1). However, higher number of grains per ear (427) was obtained in T3, which received 120 kg ha^{-1} of phosphorus and 3 L ha^{-1} of herbicide used as pre-emergence. The lowest number of grains per ear (314.9) was recorded in control probably due to higher weed population, which increased the deficiency of phosphorus and adversely affected the grains per ear (Shah and Dillard, 2006).

1000-grain weight (g)

The data on 1000-grain weight as influenced by various levels of phosphorus and herbicide are given in Table-1. The use of different phosphorus levels along with herbicide affected the grain weight significantly. The highest grain weight (366.7g) was recorded in treatments receiving 120 kg ha^{-1} of phosphorus and 3 L ha^{-1} of herbicide (Primextra-Gold). The minimum grain weight was obtained in weedy check. These results were in line with Resende *et al.* (2006) and Desse *et al*. (2009) who reported higher grain weight by weed management in maize crop.

Biomass yield (kg ha^{-1})

The data on biomass yield of maize showed significant variations among treatment means by the application of phosphorus and pre and post-emergence of herbicide application (Table-1). The maximum biomass (21560 kg ha^{-1}) was recorded in T3, while minimum biomass (15560 kg ha^{-1}) was recorded in control. These results showed that biomass yield obtained in phosphorus and herbicide treated plots were significantly higher than that obtained without herbicide application. The results are supported by Schroetter *et al.* (2006) and Resende *et al.* (2006) who reported that phosphorus

Table-1. Effect of phosphorous and herbicide on yield and yield components of maize.

Treatments	Weed density (m^{-2})	Leaf area index	Leaves ($plant^{-1}$)	Ears ($plant^{-1}$)	No. of grains (ear^{-1})	1000-grain weight (g)	Biomass yield ($kg\ ha^{-1}$)	Grain yield ($kg\ ha^{-1}$)
T 1: P_2O_5 60 kg ha^{-1} + Primextra Gold 3L (Pre-Emg.)	15.56 c	1.39^{NS}	0.89 abc	1.11^{NS}	364.7^{NS}	300.0 bcd	18000 bc	1782 abc
T 2: P_2O_5 90 kg ha^{-1} + Primextra Gold 3L (Pre-Emg.)	15.56 c	1.46	922 ab	1.11	376.1	316.7 abc	20440 ab	1942 ab
T 3: P_2O_5 120 kg ha^{-1} + Primextra Gold 3L (Pre-Emg.)	16.00 c	1.47	0.44 a	1.22	427.0	366.7 a	21560 a	2522 a
T 4: P_2O_5 150 kg ha^{-1} + Primextra Gold 3L (Pre-Emg.)	16.00 c	1.35	0.66 abc	1.00	359.6	316.7 abc	16890 c	1684 ad
T 5: P_2O_5 60 kg ha^{-1} + Primextra Gold 1.5L (Post-Emg.)	16.00 c	1.37	8.55 abc	1.00	345.3	266.7 cd	16000 c	1456 be
T 6: P_2O_5 90 kg ha^{-1} + Primextra Gold 1.5L (Post-Emg.)	16.22 c	1.41	9.00 abc	1.11	347.0	300.0 bcd	18440 bc	1696 ad
T 7: P_2O_5 120 kg ha^{-1} + Primextra Gold 1.5L (Post-Emg.)	18.89 bc	1.43	9.22 ab	1.11	364.9	350.0 ab	20670 ab	1933 ab
T 8: P_2O_5 150 kg ha^{-1} + Primextra Gold 1.5L (Post-Emg.)	18.00 bc	1.35	8.55 abc	1.00	330.3	266.7 cd	16000 c	1167 be
T 9: P_2O_5 60 kg ha^{-1} + control	18.44 cb	1.34	8.33 bc	1.00	318.7	250.0 d	15840 c	02.2 de
T 10: P_2O_5 90 kg ha^{-1} + control	20.44 ab	1.38	8.44 bc	1.00	323.5	266.7 cd	16000 c	1051 cde
T 11: P_2O_5 120 kg ha^{-1} + control	20.67 ab	1.39	8.77 abc	1.00	342.5	300.0 bcd	16220 c	1121 be
T 12: P_2O_5 150 kg ha^{-1} + control	21.56 a	1.30	8.22 c	1.00	314.9	250.0 d	15560 c	757.8 e
$LSD_{0.05}$	9.67	---	0.948	---	---	62.53	3072	862.1

Means followed by different letter(s) in respective column are significant at 5% level of probability.
NS = Non-significant

fertilizer applied at optimum rates (120 kg ha^{-1}) maximized the corn biomass. Galzina *et al.* (2008) reported that the shoot mass of maize plants was more than 40% lower in weedy check than herbicide treated plots.

Grain yield (kg ha^{-1})

The grain yield is a function of the integrated effect of the yield components, which ultimately affect the grain yield of crop. The data presented in Table-1 indicated that pre-emergence herbicide treated plots significantly increased the grain yield of maize as compared to control. The maximum grain yield (2522 kg ha^{-1}) was obtained in T3 as compared to lowest grain yield (757.8 kg ha^{-1}) in control plot. These results suggested that the phosphorus treatment along with pre-emergence herbicide boosted the plant growth which ultimately increased the grain yield of crop. Grain yield of T3 treatment was increased due to higher number of ears $plant^{-1}$, biomass yield and 1000-grain yield than the untreated control. Kovacs *et al.* (2006), Subhan *et al.* (2007) and Bloem *et al.* (2009) also reported lesser weed infestation with low weed biomass and maximum maize grain yield when the crop was treated with pre-emergence application of Primextra-Gold.

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