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EFFECT OF VARIOUS HERBICIDES AND MANUAL CONTROL ON YIELD, YIELD COMPONENTS AND WEEDS OF MAIZE

Amir Khatam[1], Muhammad Zafarullah Khan[2*], Khalid Nawab[2], Ishaq Ahmad Mian[3] and Wiqar Ahmad[4]

ABSTRACT

A field trial was conducted to study the effect of chemical and manual weed control on yield and yield components of maize, and to study the effect of these weed control measures on the weeds infesting maize crop during the year 2011. The trial was having six treatments (weedy check, hoeing, Dual gold (s-metolachlor @ 600 mL ac^{-1}), Heera (propisochlor 40% SE @ 600 mL ac^{-1}), Portico (nicosulfuron 75% WG @ 30 g ac^{-1}) and Atrazine 38% SC @ 400 mL ac^{-1}. Major weeds infesting the maize crop during the trial were Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium, Trianthema portulacastrum and Achyranthus aspera. Results showed that plant height, number of cobs plant^{-1}, number of grains cob^{-1}, cob length, 1000 grain weight, biological yield and grain yield of maize were all significantly affected by the applied weed control measures. The weeds m^{-2} and weed biomass were also significantly affected by the application of herbicides. Hoeing resulted in 85.5% weed control and ranked first followed by Dual gold as the most effective herbicide and ranked second among the treatments with 72.35% weed control over weedy check. Dual gold @ 600 ml ac^{-1} also produced maximum net return of Rs. 60326 ha^{-1} for the crop.

Key words: herbicides, maize, weeds, weed control, yield parameters

INTRODUCTION

Pakistan is an agricultural country and is blessed with four seasons in a year (summer, winter, spring and autumn). Environments of this country suit to the growth of many cultivated crops including maize (*Zea mays* L.). Maize is the third important cereal crop grown in Pakistan after wheat (*Triticum aestivum* L.) and rice (*Oryza sativa* L.).

[1]Agriculture Department (Extension), Khyber Pakhtunkhwa, Pakistan, [2]Dept. of Agricultural Extension Education & Communication, [3]Dept. of Soil and Environmental Sciences, The University of Agriculture, Peshawar (main campus), [4]Dept. of Soil & Environmental Sciences, Amir Muhammad Khan Campus Mardan, 23200-Mardan, Pakistan
Corresponding author's email: drzafar@aup.edu.pk

It is grown mainly for grain and fodder purposes. Maize is used as a raw material in the corn processing industries. It is a cheap source of feed and fodder for poultry and livestock, respectively. It has a high nutritional value as it contains starch, protein, oil, fiber, sugar, and ash with 72, 10, 4.8, 9.5, 3.0 and 1.7 %, respectively (Chaudhry, 1983).

Maize is grown in Pakistan both in irrigated and rain-fed areas. Maize was grown on an area of 0.95 m ha and its production was 3.487 m t with an average yield of 1865 kg ha^{-1} (Government of Pakistan, 2009-10) which is very low as compared to its yields obtained in the other countries of the world like Italy (9530 kg), USA (8600 kg), Canada (6630 kg) and China (4570 kg ha^{-1}) (Anonymous, 2001). Among various reasons responsible for the lower production of maize crop in Pakistan, weeds infestation is one of the most important factors. Inappropriate sowing method and poor weed control practices are the essential agronomic limitations responsible for the gap between the potential and the actual yields. Annual losses due to weeds in Pakistan are more than Rs.10 billions (Khan *et al*., 1998). Weeds reduce the crop yields because they compete with the crop plants for nutrients, water and light. Weeds also impede with crops' harvesting and intensify the cost of production. Various weed control practices have been resulted in about 77-96% higher yields. Weeds can be controlled by cultural, mechanical, biological and chemical measures. The cultural weed control methods are useful, however, these methods are laborious, time consuming and in some countries such methods are expensive. Keeping in view all these limitations, chemical weed control is the main alternative due to the shortage man-power and high labour price. Khan and Haq (2004) stated that chemical weed control is very effective if used properly. They added that application of herbicides improved the grain yield, reduced the density, growth and biomass of weeds in maize crop. Various types of herbicides are available in the market but their proper and judicious application is still lacking and it needs to be improved.

Keeping in view the above mentioned thoughts obtained from the past literature, this present study was designed to look at the effect of various herbicides and manual weed control on yield components of maize crop and to see the effects of these weed control measures upon the weeds infesting the maize crop in Khyber Pakhtunkhwa province of Pakistan.

MATERIALS AND METHODS

An experiment examining the effect of herbicides and manual control on yield, yield components and weeds of maize crop was conducted at High Value Crops Supply Chain Research Station (HVCSCRS), Bamkhel-Swabi, Pakistan, during 2011. A randomized

complete block design (RCBD) was used for laying out the experiment and each treatment was replicated three times. The net plot size was 10m x 3m. The treatments were weedy check, hand hoeing, Dual gold (s-metolachlor) @ 600 mL ac^{-1}, Heera (propisochlor) 40% SE @ 600 mL ac^{-1}, Portico (nicosulfuron) 75% WG @ 30 g ac^{-1} and Atrazine 38% SC @ 400 mL ac^{-1}, respectively studied in the experiment.

The plots were sprayed with herbicides 15, 20, 30 and 35 days after sowing with a hand sprayer using flat fan nozzle. However, the hoeing was carried out twice after the first and the second irrigation with a hand hoe. All the agronomic practices were kept uniform for all the treatments. The data on the following treatments, weeds check, hoeing, Dual Gold @ 600 mL ac^{-1}, Heera 40% SE @ 600 mL ac^{-1}, Portico 75% WG @ 30 g ac^{-1} and Atrazine 38% SC @ 400 mL ac^{-1} were collected by applying the standard methods.

The data was analyzed using analysis of variance (ANOVA) technique and the least significant difference (LSD) was applied at 5% level of probability to compare means of the six treatments (Steel *et al.*, 1997).

RESULTS AN DISCUSSION

Table-1 shows that density of weeds m^{-2} under 15, 20, 25 and 30 days after sowing (DAS) was significantly affected by all weed control measures. The maximum weeds density (78.5 m^{-2}) was recorded in the weedy check while the minimum weeds density (13.7 m^{-2}) in the hand hoeing. However, statistically similar number of weeds (28.0 and 34.0 m^{-2}) was found in the Dual Gold @ 600 mL ac^{-1} and Heera 40% SE @ 600 ml ac^{-1} treatments, respectively.

Similarly, the greatest density of weeds under 20 DAS was 94.7 weed m^{-2} for the weedy check whilst the lowest (14.7 weeds m^{-2}) for the hand hoeing. The highest weed density (98.8 weed m^{-2}) 25 DAS was for the weedy check while significantly least number of weeds (15.0 m^{-2}) for the hand hoeing. Whereas, statistically similar number of weeds i.e. 25 and 27 were recorded in the treatments of Dual Gold and Heera, respectively.

Likewise, maximum density of weeds evidenced m^{-2} at 30 DAS was 97.6 m^{-2} in the weedy check while significantly lowest number of weeds (14.67 m^{-2}) was for the hand hoeing. While, statistically similar number of weeds (29.4 and 26.7 m^{-2}) was recorded for Dual gold and Heera, respectively. Porwal (2000) and Toloraya *et al.* (2001) reported similar results by the application of herbicides and hand hoeing for weed control in maize crop. Equally important were the results showing that number weeds m^{-2} at harvest was affected by all weed control measures (Table-1). However, the significantly maximum weeds density was recorded for weedy check (94.0 m^{-2}), while the

minimum (13.9 m^{-2}) for hand hoeing. Dual Gold and Heera showed statistically at par weed control effectiveness (Table-1). Similar results were shown by Johnson *et al*. (2002) and Janjic *et al*. (2004).

Weed biomass for different herbicides used for weed control in maize indicated that fresh weight of the weeds was significantly reduced (Table-1). The data revealed that significantly maximum weed fresh weight of 812 g m^{-2} was noted for the weedy check. While, fresh weight for hand hoeing and Dual gold treatments were statistically similar and followed by Heera (Table-1). These results can be supported by those of Salarzi (2001) and Adigun and Lagoke (2003) who reported significant reduction in fresh weight of weeds due to application of such herbicides.

Plant height of maize crop was significantly affected in the treatment sprayed with herbicides as indicated from the data given in the Table-2. The significantly maximum plant height 215 was obtained in the plot sprayed with Dual Gold @ 600 ml ac^{-1} and it was statistically similar with Heera 40% SE @ 600 ml ac^{-1} that resulted in plant height of 211 cm. whereas, the significantly lowest plant height was recorded as 191 cm in the treatment did not spray with any herbicides i.e. the weedy check. These findings are strongly supported by those of Stefanovic *et al*. (2004), who concluded from their results that use of herbicides not only controlled weeds but also increased plant height in maize crop.

In the same way, number of cobs in maize crop was significantly influenced by various weed control treatments (Table-2). The maximum number of cobs $plant^{-1}$ (1.22) of maize was recorded in the plot sprayed with Heera 40% SE @ 600 ml ac^{-1} followed by Dual Gold. Minimum number of cobs $plant^{-1}$ was recorded in the weedy check plots. The findings are in line with those of Akhtar *et al*. (1998) who found that number of cobs $plant^{-1}$ was significantly increased with the application of herbicides in the maize crop.

Likewise, Number of grains per cob was considerably affected with the application of various herbicides in the maize crop as shown in Table-2. The statistically highest number of grains cob^{-1} recorded was 561.18 in the plot sprayed with Dual Gold followed by Heera. While statistically lowest number of grains cob^{-1} was recorded in weedy check. These findings are strongly supported with those of Akhtar *et al*. (1998) and Stefanovic *et al.* (2004) who concluded that number of grains cob^{-1} was increased with the utilization of herbicides.

Length of cob was significantly affected with the application of various herbicides in the maize crop as shown in Table-2. The maximum length of cob recorded was 18.62 cm in the plots of Dual Gold followed by Heera 40% SE and it was statistically similar to that of hoeing where length of cob was 17.35 cm. The statistically

minimum length of cob was 14.58 cm in the weedy check plots. These findings are supported with those of Nadeem *et al*. (2006), who found that length of cob was increased with the use of herbicides. Thousand grain weight was significantly affected with the application of herbicides in maize crop (Table-2). The highest 1000-grain weight was 305 g recorded in the treatment of hoeing and statistically minimum 1000-grain weight (223 g) was recorded in weedy check. These findings are in line with those of Nadeem *et al*. (2006) who stated that 1000- grain weight of maize was increased with the use of herbicides.

All weed control treatment significantly affected the biological yield. The highest biological yield was 16.87 t ha^{-1} was obtained in the treatment of hoeing closely followed by that of Heera 40% SE. However, the minimum bio-yield was obtained in the treatment of weedy check. These findings are supported with those of Ali *et al*. (2003) and Khan *et al*. (2012), who stated that use of herbicides to control weeds resulted in increase of biological yield. Grain yield of maize crop was significantly affected by different weed control measures (Table-2). The significantly highest grain yield was 5.34 t ha^{-1} obtained in Dual Gold treatments. However, minimum grain yield of 3.04 was obtained in the treatment of weedy check. These findings are supported by Nadeem *et al*. (2006) who stated that grain yield of maize crop was increased with the use of herbicides named Mechete @ 3 L ha^{-1}, Stomp @ 5 L ha^{-1}, and Rifit @ 2.5 L ha^{-1}. The highest net profit ha^{-1} of Rs. 44746 was obtained from the treatment applied with Dual Gold followed by the plot treated with Heera 40% SE. However, the minimum net profit ha^{-1} (Rs. 25375) was obtained from the treatment of weedy check.

Table-1. Effect of hoeing and various herbicides on controlling weeds of maize crop

Treatments	Weeds m^{-2} (15 DAS)	Weeds m^{-2} (20 DAS)	Weeds m^{-2} (25 DAS)	Weeds m^{-2} (30 DAS)	Weeds m^{-2} (at harvest)	Average weed control (%)	Weed biomass (g m^{-2})
Weedy check	78.5a	94.7a	98.8a	97.6a	94.7a	100-92.8=07.2	812. 3a
Hand hoeing	13.7e	14.7e	15.7e	14.7e	13.9e	100-14.5=85.5	305.78e
Dual Gold (S-metolachlor)	28.1d	27.7d	25.4d	29.4d	27.6d	100-27.7=72.4	323.2d
Heera (propisochlor) 40% SE	33.7d	30.7d	27.5d	26.7d	30.5d	100-29.8=70.2	345.1d
Portico (nicosulfuron) 75% WG	49.2b	50.5b	54.7b	51.6b	53.7b	100-51.9=48.1	470.6b
Atrazine 38% SC	40.7c	43.5c	39.5c	42.2c	38.9c	100-40.9=59.1	367.2c
LSD	4.5	4.763	5.487	5.35	4.52	-	22.75

Means with same letters were not significantly different at 5% level of probability

Table-2. Effect of hoeing and various herbicides on yield and yield components of maize crop

Treatments	Plant height (cm)	Cobs $plant^{-1}$	Grains cob^{-1}	Cob length (cm)	1000 grains weight (g)	Biological yield (t ha^{-1})	Grain yield (t ha^{-1})	Net profit ha^{-1} (Rs.)
Weeds check	191.5c	1.0b	468.4d	14.6d	223.5c	14.1d	3.0d	25375.0
Hoeing	204.6b	1.0ab	517.3bc	17.4a	305.6a	16.9ab	4.7b	36963.0
Dual Gold	215.1a	1.2a	561.2a	18.6a	296.6ab	16.4a	5.3a	44746.0
Heera	211.3ab	1.2a	552.5a	17.2b	287.9ab	16.5a	4.8b	38751.0
Portico	198.6c	1.1ab	506.4c	16.3bc	263.32bc	14.5c	3.7b	31894.0
Atrazine	208.5ab	1.1ab	519.3b	15.5cd	264.6abc	15.7b	4.5b	36734.0
LSD	4.496	0.2	21.2	1.65	1.642	0.83	0.326	-------

Means with same letters were not significantly different at 5% level of probability

CONCLUSION

It is concluded from the results of the present study that the production of maize crop can be increased by the application of both the herbicides and the manual control methods of weeds. Therefore, chemical application is recommended at accurate time and in proper doses. Hoeing in maize crop also resulted in higher net profit. However, maximum net profit can be obtained from maize crop by applying herbicides during 15-20 DAS because they compete with crop for nutrients, light and water. Recommendations of the experiment may be replicated in the regions with the similar soil and environmental conditions.

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