



Asian Journal of Plant Sciences

ISSN 1682-3974

science
alert

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Efficacy of Different Herbicides on the Yield and Yield Components of Maize

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Abstract: The research work was conducted to investigate the effectiveness of various weed control measures in maize hybrid P-3203. The treatments were pre-emergence application of dual gold (S-metolachlor) at 1.92, primextra (atrazine + metolachlor) at 2.25, treflan (trifluralin) at 1.5, stomp (pendimethalin) at 0.75 and jinong (atrazine) at 0.90 kg a.i. ha⁻¹ and post-emergence application of 2,4-D at 0.80 and banvel (dicamba) at 0.84 kg a.i. ha⁻¹. The treatments increased plant height (cm), cob length (cm), biological yield (t ha⁻¹), leaf area (cm²), number of leaves plant⁻¹, number of kernels cob⁻¹, 500 kernel weight (g) and grain yield (t ha⁻¹) significantly ($P \leq 0.05$), while broadleaf weeds, number of cobs plant⁻¹ and harvest index were not significantly affected by different treatments. For controlling weeds, dual gold suppressed 88, primextra 82, stomp 45, treflan 48, Jinong 38, 2,4-D 23 and banvel 5% as compared to 248.7 number of weeds m⁻² in weedy check. The dominant weed species found were *Leptochloa* sp., *Echinochloa crus-galli*, *Cyperus* sp. and *Digiteria sanguinalis*. Hand weeded and dual gold treated plots produced significantly taller plants, more kernels per cob (548.7 and 544.7) and the highest 500 kernel weight (121.33 and 119 g), respectively. Hand weeded, dual gold and primextra treated plots increased grain yield by 22.7, 21 and 15.3%. Application of dual gold proved to be the best and most economical weed control, giving maximum returns of Rs. 42030 ha⁻¹. Primextra emerged as the next best alternative for weed management in maize.

Key words: Hand weeding, pre-emergence/post-emergence herbicides, maize

Introduction

Pakistan, despite an agricultural country, is deficient in food grains and other food items. The main cause of food shortage in Pakistan has been the failure of production of food grain to keep pace with the linear increase in population. For bridging the gap between demand and supply of food grains, productivity needs to be enhanced. The feasibility to increase per unit yield is more because yield potential of maize crop has not been realized so far, as there is a large gap between potential and actual yield per acre.

Besides other factors, yield is greatly affected by weeds in the field. Weeds being injurious, harmful or poisonous, are a constant source of trouble for the successful growth and development of economic crops. Weeds compete with crops for light, moisture, space and plant nutrients and thus indirectly deprive the crops of nutrients and other environmental requirements and consequently interfere with the normal growth of crops. In NWFP, the yield losses due to weeds are approximately 20-40% (Anonymous, 2001). Weeds pose severe problems for crop husbandry and infest fallow land, reducing the soil fertility and soil moisture and develop a potential threat to the succeeding crops. About two hundred and eighty different types of weeds have been recorded in NWFP with varying infestation status. The most serious weeds that cause damage to the maize crop in NWFP are

Echinochloa crus-galli, *Leptochloa* sp., *Cyperus rotundus*, *Sorghum halepense*, *Cynodon dactylon*, *Digiteria sanguinalis*, *Convolvulus arvensis*, *Tribulus terrestris*, *Digera muricata* and *Portulaca oleracea* (Marwat, 1984).

Shad *et al.* (1993) reported that application of primextra provided excellent weed control in maize. Miller and Libbey (1999) reported that maize yield generally responded positively to increased weed control. Knezevic *et al.* (1996) reported that grain yield was significantly increased by herbicides treatments in maize. Rout and Satapathy (1996) reported that highest grain yield of maize was obtained from the herbicides treated plots.

In view of the importance of the problem from the national point of view, the research work was conducted to study the impact of different herbicides on different weeds and to know the response of crop to such herbicides in terms of tolerance, yield and yield components.

Materials and Methods

The study was conducted at Malkandher Research Farm, NWFP Agricultural University, Peshawar during kharif 2001. Maize hybrid P – 3203 was used in the experiment. The lay out of experiment was in randomized complete block (RCB) design. There were nine treatments in each replication (Table 1) with at plot size of 5 x 3.75 m².

Table 1: Different treatments used in experiment

Treatments	Common name	Time of application	Kg ha ⁻¹ a.i.	Dose ha ⁻¹ (L)
Dual gold 960 EC (T ₁)	S-metolachlor	Pre-emergence	1.92	2.00
Primextra 500 FW (T ₂)	Atrazine+Metolachlor	Pre-emergence	2.25	4.50
Treflan 48 EC (T ₃)	Trifluralin	Pre-emergence	1.50	1.75
2,4-D 72 (ester) (T ₄)	2,4-D	Post-emergence	0.80	1.25
Stomp 330E (T ₅)	Pendimethalin	Pre-emergence	0.75	4.50
Jinong 38 SL (T ₆)	Atrazine	Pre-emergence	0.90	2.00
Banvel 720 E (T ₇)	Dicamba	Post-emergence	0.84	1.00
Hand weeding (T ₈)	-----	-----	-----	-----
Weedy check (T ₉)	-----	-----	-----	-----

Numbers of rows per treatment were five and plant to plant distance and row to row distance was maintained at 25 and 75 cm, respectively.

The data on the following parameters was recorded during the course of experiment:

Number of sedges m⁻², number of grassy weeds m⁻², number of broadleaf weeds m⁻², weeds density m⁻², weeds biomass (g m⁻²), phytotoxicity of herbicides on crop, germination percentage of crop, plant height (cm), number of leaves plant⁻¹, leaf area (cm²), number of cobs plant⁻¹, cob length (cm), number of kernels cob⁻¹, 500 kernel weight (g), biological yield of maize (t ha⁻¹), grain yield (t ha⁻¹), harvest index and finally economics of weed control.

Standard procedures were adopted for recording and calculating data on various parameters of weeds and crop and finally the data recorded were subjected to statistical analysis and the treatments

means were separated by least significance difference (LSD) test (Steel and Torrie, 1980).

Results and Discussion

Number of sedges m⁻²: Data indicated that sedges m⁻² were significantly ($P \leq 0.05$) affected by different herbicides (Table 2). It could be inferred from the data that maximum number (97.67 m⁻²) of sedges were recorded in the plots treated with stomp and minimum (19.33 m⁻²) sedges were observed in the plots treated with dual gold followed by primextra, (23.33) and 2,4-D with (47.33 sedges m⁻²). The best treatments were statistically comparable with the hand weeded check (Table 2). The *Cyperus rotundus* recorded in stomp treated plots were noted with dried leaves and stunted growth. Similar results were reported by Shad *et al.* (1993).

Number of grasses m⁻²: Statistical analysis of the data (Table 2) revealed that number of grasses m⁻² were significantly ($P \leq 0.05$) affected by different weeds control measures. Mean values of the data indicated that maximum number of 176.7 grasses m⁻² were observed in

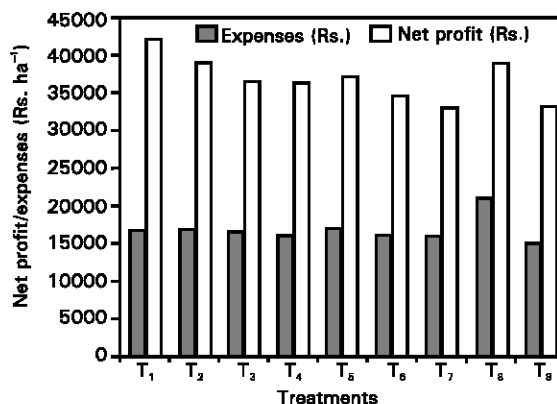


Fig. 1: Net Profit from different weed control treatments in maize crop

the weedy check plots followed by Banvel (183). While minimum number (10) of grasses m⁻² were comparable with the hand weeded check noted in plots treated with dual gold followed by plots receiving primextra having 19.67 grassy weeds m⁻². It could be inferred from the results that statistically the results of hand weeded plots, dual gold and primextra treated plots were at par with each other. The species of grasses found were *Leptochloa* sp., *Echinochloa crusgalli* and *Digiteria sanguinalis*. The results are in analogy with those reported by Shad *et al.* (1993). They reported that application of metolachlor + atrazine provided excellent control of *Echinochloa* sp., *Cyperus rotundus* and *Cynodon dactylon*.

Number of broad leaf weeds m⁻²: Data indicated that broad leaf m⁻² were non-significantly ($P \leq 0.05$) affected by various weeds control treatments applied in maize crop (Table 2). However, maximum number of 2.33 broad leaf weeds m⁻² were noted in trifluralin treated plots, whereas zero (no weed) broad leaf weeds m⁻² were recorded in plots treated with 2,4-D. The data indicates that overall there was a abundance of grasses in the experiment and the broadleaf were in small percentage of the overall weed count. However, the control was statistically at par with

Table 2: Number of sedges m^{-2} , grasses m^{-2} , broadleaf weeds m^{-2} , weeds density m^{-2} and weeds biomass (g m^{-2}) as affected by different treatments

Treatments	Number of sedges m^{-2}	Number of grasses m^{-2}	Number of broad leaves m^{-2}	Weed density m^{-2}	Weeds biomass (g m^{-2})
Dual gold 960 EC	19.33bc	10.00e	0.67	30.00c	173.33e
Primextra 500 FW	23.33bc	19.67e	1.67	44.67c	198.33de
Treflan 48 EC	56.00abc	71.33cd	2.33	129.0b	242.67cd
2,4-D 72%	47.33abc	143.30b	0.00	190.6ab	298.33bc
Stomp 330 E	97.67a	36.67de	2.00	136.3b	223.33de
Jinong 38 SL	71.69ab	81.00c	1.33	154.0b	378.33a
Banvel 720 E	50.00abc	183.00a	1.33	234.30a	405.00a
Hand weeding	00.00c	0.00e	0.00	0.00c	0.00ef
Weedy check	70.00ab	176.70ab	2.00	248.7a	403.33a
LSD (0.05)	64.32	36.85	NS	74.38	51.25

Table 3: Data regarding yield and yield components of maize as affected by different treatments

Treatments	Plant height (cm)	Number of leaves plant ⁻¹	Leaf area (cm ²)	Number of cobs plant ⁻¹	Cob length (cm)	Number of kernels cob ⁻¹	500 kernels weight (g)	Biological yield (t ha ⁻¹)	Grain yield (t ha ⁻¹)	Harvest index (%)
Dual gold 960 EC	216.00ab	13.17ab	7607.33a	1.00	18.00b	544.67a	119.00b	14.10ab	6.00a	42.53
Primextra 500 FW	213.33ab	12.67cd	7073.00ab	1.00	17.33bc	540.00a	118.33c	14.00a-c	5.60ab	39.73
Treflan 48 EC	201.67c	12.87bc	6561.67bc	1.00	16.33c	481.67d	115.00f	13.30c-e	5.30b-d	39.60
2,4-D 72%	189.00d	13.00b	6538.67bc	0.97	14.33d	521.33b	117.33d	12.90de	5.30b-d	40.83
Stomp 330 E	206.33bc	13.10ab	7221.67ab	1.00	17.33bc	538.33a	118.33c	13.70b-d	5.40bc	39.40
Jinong 38 SL	185.67d	12.50d	5752.33cd	0.97	14.00d	499.33c	115.67e	13.03c-e	5.00b-d	38.37
Banvel 720 E	181.33d	11.10e	5138.67d	0.97	16.37d	462.00e	114.00g	12.40e	4.90cd	39.27
Hand weeding	220.33a	13.40a	7744.00a	1.00	19.67a	548.67a	121.33a	14.40a	6.13a	42.57
Weedy check	180.67d	11.33e	5019.33d	0.97	13.33d	461.00e	114.00g	12.50e	4.74d	37.60
LSD (0.05)	10.89	0.322	820.10	NS	1.368	12.33	0.5435	1.017	0.5715	NS

Means in the column followed by different letters are significantly different at $P \leq 0.05$,

NS = non significant

all other herbicidal applications except hand weeded, 2,4-D and Dual gold treated plots. The broadleaf weeds found in the field in density wise were *Euphorbia prostrata*, *Digera muricata*, *Portulac aoleracea* and *Convolvulus arvensis*, respectively.

Weed density m^{-2} : Statistical analysis of the data (Table 2) revealed that number of weeds m^{-2} were significantly ($P \leq 0.05$) affected by various herbicides in maize crop. Mean values of the data indicated that maximum weeds (248.7 m^{-2}) were recorded in weedy check plots, while among the herbicidal treatments minimum weeds (30 and 44.67 m^{-2}) were recorded in dual gold and primextra treated plots, respectively. The density of weeds in dual gold and primextra was even statistically at par with the hand weeded check. Weed density was significantly affected by different treatments. After first irrigation *Cyperus rotundus* and *Digiteria sanguinalis* were the major weed species. However, after second and third irrigations, the population of *Echinochloa crus-gali* and *Leptochloa* sp. dominated all the species throughout the remaining season. There was no increase in the weed population after fourth irrigation. So dual gold indicated good control of grasses as well as broad leaf weeds. The weed density of banvel treated plots (234.3 m^{-2}) was statistically at par with the weedy check. This was attributed to the fact that banvel is broadleaf killer and the majority of weeds found in the experimental field, belonged to grassy nature or sedges. The result is in agreement with Hafeezullah (2000) and Sobotka *et al.*

(1983). They reported that weed control methods significantly affected weed density m^{-2} .

Weeds biomass (g m^{-2}): Statistical analysis of the data presented in Table 2 indicated the weeds biomass harvested from different weed control treatments in maize crop. Analysis of the data revealed that weed biomass was significantly ($P \leq 0.05$) affected by various herbicides in maize crop (Table 2). Maximum dry weight of 405.00, 403.33 and 378.33 g were recorded in banvel, weedy control and jinong treated plots, respectively. While minimum (173.33, 198.33 and 223.33 g) weeds biomass were recorded in dual gold, primextra and stomp treated plots, respectively. It was observed that dry weight of weeds m^{-2} decreased with the application of herbicides and hand weeding. Lower dry weight of 173 g m^{-2} was obtained from dual gold treated plot and greater dry weights of 403.33 and 378.33 g m^{-2} was obtained from weedy control and banvel treated plots, respectively. The results were in agreement with Hafeezullah (2000) and Shakoor *et al.* (1986). They observed that dry matter of weeds from the weedy control plots was significantly greater than the chemically and manually weeded plots. There was no specific phytotoxicity of herbicides to crop except banvel, which affected the number and growth of cobs. Abnormal terminal leaves of maize plants were recorded in banvel treated plots. Rolling of leaves in a few plants is the similar result reported by Krishnamurthy *et al.* (1974).

Germination percentage of crop: The results and thoroughly observations showed that germination percentage of the maize, hybrid P-3203 was hundred percent. However, in the plots where density of *Cyperus rotundus* was in greater numbers, the germination percentage was little affected by delaying the germination of maize seeds.

Plant height (cm) of maize: Statistical analysis of the data (Table 3) revealed that different treatments had a significant ($P \leq 0.05$) effect on plant height. Mean values of the data indicated that maximum plant height of 220.33 cm was recorded in hand weeded plots which was statistically at par with dual gold (216 cm) and primextra (213.33 cm). The minimum plant height of 180 cm was measured in weedy check plots which was statistically equal with banvel treated plots with 181.33 cm plant height. The difference in plant height is attributed to the various intensities of weed competition with maize plant. Similar results were obtained by Kamel *et al.* (1983).

Number of leaves plant⁻¹: Statistical analysis of the data (Table 3) revealed that number of leaves per plant were significantly ($P \leq 0.05$) affected by different treatments. It could be inferred from

the data that maximum number of (13.4) leaves plant⁻¹ were recorded in hand weeded plots. These were however, statistically at par with dual gold (13.17) and stomp (13.10). The minimum (11.10) leaves plant⁻¹ were recorded in the plots treated with banvel and weedy control, with 11.33 leaves plant⁻¹.

Leaf area (cm²): Leaf area was significantly ($P \leq 0.05$) affected by different treatments (Table 3). Maximum leaf area of 7744.00 cm² was recorded in hand weeded plots which was comparable with plots receiving dual gold with leaf area of 7607.33 cm² and primextra (7073 cm²). The minimum of 5019.33 cm² leaf area was computed in weedy control and banvel treated plots with only 5138 cm² leaf area. As leaf is the basic photosynthetic machinery for plant food, hence its size would directly affect the yield and yield components of crop. The results were in agreement with Akhtar *et al.* (1984). They observed that manual weed control gave greatest leaf area at tasseling.

Number of cobs plant⁻¹: Non significant differences were obtained for number of cobs per plant due to different treatments (Table 3). In all the treatments, one cob per plant was recorded. However, mean value of a few treatments had less than one cob per plant. The decrease in number of cob per plant was due to excessive number of weeds in the plots. Similar results were reported by

Akhtar *et al.* (1984).

Cob length (cm): Statistical analysis of the data (Table 3) revealed that different treatments had a significant ($P \leq 0.05$) effect on cob length. Mean values indicated that maximum cob length of 19.67 cm was recorded in hand weeded plots, while minimum cob length of 13.33 cm was observed in weedy control plots. However it was statistically at par with all other treatments except dual gold and primextra with 18 and 17.33 cm cob length. These results are in conformity with the results of Kamel *et al.* (1983). They reported that weed control treatments improved cob length.

Number of kernels cob⁻¹: Number of kernels cob⁻¹ was significantly ($P \leq 0.05$) affected by different treatments (Table 3). It could be inferred from the data presented that maximum (548) kernels cob⁻¹ were recorded in hand weeded plots. These were however, statistically at par with dual gold (544.67) and primextra (540). The minimum (461) kernels cob⁻¹ were comparable in banvel treated plots with 462 kernels cob⁻¹. Similar results were reported by Kamel *et al.* (1983).

500 kernels weight: Statistical analysis of the data (Table 3) revealed that 500 kernels weight was significantly ($P \leq 0.05$) affected by different treatments (Table 3). Mean value of the data revealed that maximum 500 kernel weight of 121.33 g was recorded in hand weeded plots followed by dual gold treated plots with 119 g 500 kernels weight. The minimum (114 g) 500 kernels weight was recorded in both weedy control plots and plots receiving banvel. These results are in agreement with the results of Janjic *et al.* (1983).

Biological yield (t ha⁻¹): Higher biological yield of 14.43 t ha⁻¹ was obtained from hand weeded plots (Table 3). However this was comparable with the plots treated with dual gold and primextra with 14.10 and 14.00 t ha⁻¹ biological yield. The lowest (12.50 t ha⁻¹) biological yield was recorded in weedy control plots which was statistically at par with Banvel (12.40 t ha⁻¹). As leaf area, number of leaves per plant, plant height, ear length, diameter and number of grains contribute in increasing the biological yield, the results reported by Kamel *et al.* (1983) are in analogy with our results.

Grain yield (t ha⁻¹): It could be inferred from the data (Table 3) that maximum (6.13 t ha⁻¹) grain yield was recorded in hand weeded plots which was statistically at par with dual gold (6.00 t ha⁻¹). The minimum (4.47 t ha⁻¹) grain yield was recorded in weedy control plots. However

this was comparable with the banvel (4.85 t ha^{-1}). As the number of kernels cob^{-1} , 500 kernels weight and cob length increased significantly by different treatments, the yield was also increased. Janjic *et al.* (1983) and Knezevic *et al.* (1996) reported that best grain yield of maize was achieved with application of metolachlor at the rate of 4 kg ha^{-1} .

Harvest index (%): Statistical analysis of the data revealed (Table 3) that harvest index was nonsignificantly affected by different treatments. The maximum of 42.56% harvest index was recorded in hand weeded plots and minimum of 37.93% harvest index in weedy control plots.

Economics of weed control: Net profit of different treated plots were compared and it was recorded that maximum grain yield and biological yield of 6.13 and 14.43 t ha^{-1} was obtained from hand weeded plots. However due to increasing amount of labour expenses, the net profit was decreased. The results of the experiment showed that maximum net profit of Rs. 42030 per hectare was obtained from plot treated with dual gold followed by primextra (39020) and minimum of Rs. 33050 and 33108 per hectare was obtained from banvel treated plots and weedy control plots (Fig. 1).

In conclusions, hand weeding is the best method for controlling weeds and getting higher yield but shortage of labour and higher costs are great hurdles for adoption this method. Maximum net profit of Rs. 42030 ha^{-1} was obtained from dual gold treated plots followed by hand weeded and primextra treated plots. Integrated weed control methods may be employed where feasible.

References

- Anonymous, 2001. Losses in different crops due to weeds. Crop Physiology Section, Tarnab Agriculture Research Institute, Peshawar, Pakistan.
- Akhtar, M., M. Ashraf and M. S. Nazir, 1984. Maize productivity and weed growth as affected by pre-emergence and post-emergence herbicide application. J. Agric. Res., 22: 245-250.
- Hafeezullah, 2000. Effect of different sowing and weed control methods on the performance of sunflower. M.Sc. (Hons), thesis, Agric. Univ., Peshawar, Pakistan.
- Janjic, V., M. Trifunovic, V. Bogdanovic, B. Sinzar and M. Misovic, 1983. A study on the effect of herbicides on yield and quality of maize grain. Fragments Herbologica Jugoslavica, 12: 51-58.
- Krishnamurthy, K., A. Bommegowda and M. Jagannath, 1974. Studies on herbicidal tolerance in maize. Indian J. Weed Sci., 5: 114-119.
- Kamel, M.S., M.S. Abdel-Raouf, E.A. Mahmoud and S. Amer, 1983. Response of two maize varieties to different plant densities in relation to weed control treatments. Ann. Agric. Sci. Moshtohor, 19: 79-93.
- Knezevic, M. and M. Dukic, 1996. Effects of some agrotechnical measures upon predominant weed species and maize grain yield. Macedonian Agric. Review, 43: 29-32.
- Marwat, K.B., 1984. Studies on weeds of important cereal crops of NWFP. Ph.D. thesis, Botany Department, Peshawar Univ., Peshawar, Pakistan.
- 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.
- Rout, D. and M.R. Satapathy, 1996. Chemical weed control in rainfed maize (*Zea mays*). Indian J. Agron., 41: 51-53.
- Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics-A Biological Approach; 2nd ed., McGraw Hill Book Co. Inc., New York, USA.
- Sobotka, F.E. and J.N. Barlow, 1983. Banvel herbicide: A programmed approach to economic weed control in maize. Fragmenta Herbologica Jugoslavica, 12: 51-58.
- Shakoor, A., M. Naeem and C.O. Ahmad, 1986. Efficacy of different herbicides for control of weeds in maize. Pak. J. Agric., 7: 264-269.
- Shad, R.A., M.Q. Chatha and H. Nawaz, 1993. Weed management studies in maize. Pak. J. Agric. Res., 14: 44-50.