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EFFECT OF PLANTING METHODS AND HERBICIDES ON YIELD AND YIELD COMPONENTS OF MAIZE

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ABSTRACT

A field experiment was conducted at Agricultural Research Farm, NWFP Agricultural University, Peshawar during summer 2006, to study the effect of planting methods and herbicides on yield and yield components of maize hybrid P-3025. Crop was sown on April 22, 2006; using RCB design with split plot arrangement replicated four times. Treatments applied were planting methods (Ridge, Broadcast & Flat sowing) and the herbicides (pendimethalin @ 0.75 kg a.i ha^{-1}, s-metolachlor @ 1.92 kg a.i ha^{-1} & 2,4-D @ 0.80 kg a.i ha^{-1}) and weedy check. Planting methods were allotted to main plots, while herbicides were assigned to the sub-plots. Each sub plot measured 5x3 m^2. Data were recorded on weed density (m^{-2}), number of cobs $plant^{-1}$, cob length (cm), number of kernels cob^{-1}, 1000-kernel weight (g), and grain yield (t ha^{-1}). Results exhibited non-significant differences for number of cobs $plant^{-1}$, while significant differences in weed density (m^{-2}), cob length (cm), number of kernels cob^{-1}, 1000-kernel weight (g) and grain yield (t ha^{-1}) for planting methods. For herbicides significant differences were observed in weed density (m^{-2}), number of cobs $plant^{-1}$, cob length (cm), number of kernels cob^{-1}, 1000-kernel weight (g) and grain yield (t ha^{-1}). For interaction, non-significant differences were recorded for number of cobs $plant^{-1}$, cob length (cm) and 1000-kernel weight (g), while significant differences were noted for weed density (m^{-2}), number of kernels cob^{-1}, and grain yield (t ha^{-1}). Ridge planting, Dual gold 960 EC and their interaction boost up yield and yield components of maize. Dual gold 960 EC out yielded other herbicides and showed the highest yield across all the planting methods. It is thus recommended that application of Dual gold 960 EC under Ridge planting is desired to manage weeds and get maximum economic returns.

Key words: Herbicides, planting methods, weed control, *Zea mays* L.

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INTRODUCTION

Maize is one of the important cereal crops of the world. Botanically it is known as *Zea mays* L. and belongs to family Poaceae. It is annual cross-pollinated crop having erect, thick and strong culms or stalk with nodes and internodes. The corn leaf consists of the blade, sheath and collar like ligule. It is normally monoecious with staminate and pistillate flowers produce on the tassel and ear. In Pakistan maize is increasingly gaining an important position in crop husbandry because of its higher yield potential and short growth duration. It is rich source of food and fodder. Maize is also used in industries for manufacturing of corn oil, corn flakes, corn syrup etc. It constitutes 6.4 % of the total grain production in the country, and occupies a special position in the national economy, as it is good source of food, feed and fodder.

In Pakistan, maize was grown on area of 1042 thousands hectares with a production of 3109.6 thousand tons with an average yield of 2984 kg ha^{-1}, while in NWFP, the area under maize crop was 492.2 thousands hectares which produced 782.4 thousand tons with an average yield of 1590 kg ha^{-1} (MINFAL, 2006).

There are several reasons for low production of maize in Pakistan among them high weed infestation, poor weed management practices and improper planting methods are common problems. Maize crop is highly infested with weeds both in irrigated as well as rainfed areas. They reduce crop yield from 20-40% depending upon weed species and density (Ashique *et al.*1997). Weeds found in maize crop may be classified as broad leaves, grasses and sedges. The most serious weeds that cause damage to the maize crop in NWFP are *Cyperus rotundus, Leptochloa* sp., *Echinochloa crus-galli, Sorghum halepense, Cynodon dactylon, Digitaria sanguinalis, Convolvulus arvensis, Amaranthus viridis, Digera muricata* and *Portulaca olereacea*.

Weeds compete with maize for nutrients, soil moisture, and light and considerably reduce the yield and the quality of crop. To obtain better grain yield and to reduce weed problem planting method and application of suitable herbicide play an important role. Normally maize crop is sown by three methods (Flat sowing, Ridge planting and Broadcast sowing). It is logical aspect that weed management should improve if we apply proper herbicides and best planting method. Introduction of chemical weed control is necessary to replace traditional weed control measures. Chemical weed control certainly has its merits over traditional weed control methods. Weed control in maize through the use of herbicides has received little attention in Pakistan and particularly in NWFP (Shah, 1998).

Keeping in view of the importance of the weed problem in maize, the present experiment was designed with the following objectives a) to screen out the most suitable herbicide for weed control in maize planting methods b) to figure out the effect of different planting methods on the yield and yield components of maize c) to find out the interaction of different planting methods and herbicides on yield and yield components of maize crop.

MATERIAL AND METHODS

The experiment entitled "Effect of planting method and herbicides on yield and yield components of maize hybrid Pioneer-3025" was conducted at Agricultural Research Farm NWFP Agricultural University, Peshawar during summer 2006. The Experiment was laid out in Randomized Complete Block (RCB) Design with split plot arrangement having four replications. The Planting Methods were kept in main plots and the herbicides were assigned to the sub plots. Each sub plot measured 5 x 3 m^2. All other agronomic practices were kept constant for all the treatments. The detail of the treatments during the course of experiment was as under:

Main Plots

M1 Ridge Planting
M2 Broadcast sowing
M3 Flat sowing

Sub Plots

S.No	Trade name	Common name	Time of application	Rate (kg a.i ha^{-1})
T1	Stomp 330 EC	pendimethalin	Pre-emergence	0.75
T2	Dual gold 960 EC	s-metolachlor	Pre-emergence	1.92
T3	2,4-D 72 (ester)	2,4-D	Post-emergence	0.80
T4	Weedy Check	---------------	---------------	-------

The data were recorded on weed weed density m^{-2}, number of cobs $plant^{-1}$, cob length (cm), number of kernels cob^{-1}, 1000-kernel weight and grain yield (t ha^{-1}). The data were subjected to the analysis of variance technique and the significant means were separated by the LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Weed density m^{-2}

Statistical analysis of the data revealed that the planting methods, herbicides and their interaction had significant (P = 0.05) affect on weed density m^{-2}. The data in Table-1 exhibit that maximum weed density m^{-2} (180.69) was recorded in broadcast sowing however it was statistically at par with flat sowing, while minimum weed density m^{-2} (146.75) was noted in ridge planting. For herbicide treatments, the maximum weed density m^{-2} (271.92) were observed in weedy check while minimum weed density m^{-2} (52.67) was recorded in Dual gold 960 EC (s-metolachlor) treated plots. Among interactions, the maximum weed density m^{-2} (291.25) was recorded in broadcast sowing under weedy check, while minimum weed density m^{-2} (41.50) was recorded in flat sowing and Dual gold 960 EC (s-metolachlor), however it was statistically similar with ridge planting and Dual gold 960 EC (48.75) and broadcast sowing with Dual gold 960 EC (67.75m^{-2}). Similar results were reported by Hafeezullah (2000), Sobotak (1983) and Khan (2002). They reported that weed density m^{-2} was significantly affected by different herbicides. Similarly Sharma *et al.* (1998) and Vinod *et al.* (1998) also reported that significant reduction in weed density was observed in herbicides treated plots as compared to weedy check.

Number of cobs plant^{-1}

Statistical analysis of data indicated that number of cobs plant^{-1} was significant (P = 0.05) for herbicides, while non-significant for planting methods and interaction. Maximum (1.00) number of cobs plant^{-1} was recorded for Dual gold 960 EC, however it was statistically similar with Stomp 330 EC (0.99 cobs plant^{-1}) and 2,4-D 72 (0.98 cobs plant^{-1}). Minimum (0.93) number of cobs plant^{-1} was recorded for weedy check (Table-2). The decreasing number of cobs plant^{-1} was due to excessive number of weeds in those plots. Such findings are corresponding with Akhtar *et al.* (1984) and Nawab *et al.* (1999) who reported that number of cobs plant^{-1} was increased by 14.9% in weed free plots as compared to the check plots, which were not weeded throughout the growing period of maize.

Cob length (cm)

Data concerning cob length of different treatments revealed that planting methods and herbicides had a significant (P = 0.05) effect on cob length, while their interaction showed non-significant variation. For planting methods maximum (19.23 cm) cob length was recorded for ridge planting and minimum (17.21 cm) cob length was recorded for broadcast sowing, which was statistically similar with flat sowing (18.03 cm). For herbicides, the maximum (19.23 cm) cob length was recorded for Dual gold 960 EC, however statistically it was at par with Stomp 330 EC (18.93 cm) and 2,4-D 72 (18.55 cm), while minimum cob length (15.92 cm) was recorded for weedy check. For interactions of planting methods and herbicides the differences although were non-significant statistically, yet the maximum (20.35 cm) cob length was recorded in ridge planting and Dual gold 960 EC and minimum (15.10 cm) cob length was noted in broadcast sowing and weedy check (Table-3). Cob length was significantly affected by planting methods and herbicides. Ridge planting and Dual gold 960 EC produced the maximum cob length, while minimum cob length was produced by broadcast sowing and weedy check, which shows that weed control treatments improved cob length. Similar results were reported by Kamel *et al.* (1983), Khan *et al.* (2002) and Ali *et al.* (2003). They concluded that weed control treatments improved cob length in maize.

Number of kernels cob^{-1}

Number of kernels cob^{-1} is an important trait of maize contributing to yield. Statistical analysis of the data showed that number of kernels cob^{-1} was significantly (P = 0.05) affected by planting methods, herbicides and their interaction. For planting methods, the maximum (511.81) number of kernels cob^{-1} was recorded in ridge planting, while minimum (375.63) number of kernels cob^{-1} was noted for broadcast sowing, which was statistically similar with (433.88 kernels cob^{-1}) in flat sowing. Among herbicides, Dual gold 960 EC gave maximum (506.25) number of kernels cob^{-1}, while minimum (324.17) number of kernels cob^{-1} was recorded for weedy check. For interactions, maximum (603.50) number of kernels cob^{-1} was noted for ridge planting and Dual gold 960 EC, which was statistically similar with ridge planting and Stomp 330 EC (576.75 kernels cob^{-1}), while minimum (282.25) number of kernels cob^{-1} was recorded for broadcast sowing and weedy check (Table-4). Kamel *et al.* (1983) reported similar results. Akhtar *et al.* (1998) also reported that weed control treated plots increased number of kernels cob^{-1} as compared to check plots. Similarly Malik *et al.* (2006) concluded that high number of kernels cob^{-1} was noted in Dual gold 960 EC treated plots.

1000-kernel weight (g)

Analysis of the data revealed that 1000-kernel weight was significantly (P = 0.05) affected by different planting methods and herbicide treatments, however their interaction was non-significant statistically. In planting methods, ridge planting gave maximum (237.75 g) 1000-kernel weight, while broadcast sowing gave minimum 1000-kernel weight of 208.25 grams. For herbicides, maximum (240.00 g) 1000-kernel weight was recorded for Dual gold 960 EC treated plots, while minimum (193.00 g) 1000-kernel weight was recorded for weedy check. The data further depicts that the interaction though failed to reach the statistical significance level, yet the maximum (257.00 g) 1000-kernel weight was noted in ridge planting and Dual gold 960 EC and minimum (181.50 g) 1000-kernel weight was recorded in broadcast sowing and weedy check (Table-5). Janjic *et al.* (1983) reported similar results in analogy with our results. Difference in 1000-kernel weights was also observed by Akhtar *et al.* (1998) and Nawab *et al.* (1999). They reported that weeds competition significantly reduced 1000-kernel weight in maize crop.

Grain yield (t ha^{-1})

Statistical analysis of the data revealed that grain yield was significantly ($P = 0.05$) affected by planting methods, herbicides and their interaction. Maximum (2.89 t ha^{-1}) and minimum (1.56 t ha^{-1}) grain yield for planting methods was recorded for ridge planting and broadcast sowing, respectively (Table-6). The findings are in analogy with Majid *et al.* (1986). For herbicide, higher grain yield of 2.85 t ha^{-1} was gained in Dual gold 960 EC treated plots, while minimum grain yield of 1.06 t ha^{-1} was obtained from weedy check. Among interactions, Ridge planting and Dual gold 960 EC gave maximum grain yield of 3.80 t ha^{-1}, while broadcast sowing and weedy check gave minimum grain yield of 0.81 t ha^{-1}, as shown in Table-6. Grain yield was significantly increased by different treatments of planting methods and herbicides like number of kernels cob^{-1}, 1000-kernel weight and cob length. Jinjic *et al.* (1983) and Knezevic and Dukic (1996) found that maize crop gave best grain yield with the application of herbicides for controlling different types of weeds. Zafar *et al.* (1981), Rashid *et al.* (1993), Sharma *et al.* (1998), Khan *et al.* (2002) and Ali *et al.* (2003) also reported that weed control treated plots increased yield as compared to check plots.

Table-1. Weed density (m^{-2}) as affected by planting methods and herbicides.

Herbicides	Planting Methods			Herbicide Means
	Ridge	Broadcast	Flat	
Stomp330 EC	108.50 e	156.00 d	159.00 d	141.16 c
Dual Gold 960EC	48.75 f	67.75 f	41.50 f	52.66 d
2,4-D 72 (ester)	184.50 cd	207.75 c	196.50 c	196.25 b
Weedy Check	245.25 b	291.25 a	279.25 a	271.92 a
Planting methods Means	146.75 b	180.68 a	169.06 a	

$LSD_{0.05}$ for planting methods = 14.25
$LSD_{0.05}$ for herbicides = 24.59
$LSD_{0.05}$ for interaction = 32.74

Table-2. Number of cobs $plant^{-1}$ as affected by planting methods and different herbicides.

Herbicides	Planting Methods			Herbicide Means
	Ridge	Broadcast	Flat	
Stomp330 EC	0.97	1.00	1.00	0.99 a
Dual Gold 960EC	1.00	1.00	1.00	1.00 a
2,4-D 72 (ester)	0.97	0.97	1.00	0.98 a
Weedy Check	0.95	0.90	0.95	0.93 b
Planting methods Means	0.97	0.97	0.99	

$LSD_{0.05}$ for herbicides = 0.041

Table-3. Cob length (cm) as affected by planting methods and different herbicides.

Herbicides	Planting Methods			Herbicide Means
	Ridge	Broadcast	Flat	
Stomp330 EC	20.12	17.95	18.72	18.93 a
Dual Gold 960EC	20.35	18.40	18.95	19.23 a
2,4-D 72 (ester)	19.62	17.40	18.62	18.55 a
Weedy Check	16.82	15.10	15.85	15.92 b
Planting methods Means	19.23 a	17.21 b	18.04 b	

$LSD_{0.05}$ for planting methods = 1.171
$LSD_{0.05}$ for herbicides = 0.797

Table-4. Number of kernels cob^{-1} as affected by planting methods and different herbicides.

Herbicides	Planting Methods			Herbicide Means
	Ridge	Broadcast	Flat	
Stomp330 EC	576.75 a	409.25 def	464.25 bcd	483.42 ab
Dual Gold 960EC	603.50 a	429.25 cde	486.00 bc	506.25 a
2,4-D 72 (ester)	513.33 b	381.75 efg	449.00 cd	447.92 b
Weedy Check	354.00 fg	282.25 h	336.25 gh	324.16 c
Planting methods Means	511.81 a	375.62 b	433.87 b	

$LSD_{0.05}$ for planting methods = 61.69
$LSD_{0.05}$ for herbicides = 44.66
$LSD_{0.05}$ for interaction = 59.48

Table-5. 1000-kernel weight (g) as affected by planting methods and different herbicides.

Herbicides	Planting Methods			Herbicide Means
	Ridge	Broadcast	Flat	
Stomp330 EC	248.50	217.00	233.50	233.00 b
Dual Gold 960EC	257.00	224.50	238.50	240.00 a
2,4-D 72 (ester)	242.00	210.00	229.00	227.00 b
Weedy Check	203.50	181.50	194.00	193.00 c
Planting methods Means	237.75 a	208.25 c	223.75 b	

$LSD_{0.05}$ for planting methods = 6.878
$LSD_{0.05}$ for herbicides = 6.961

Table-6. Grain yield (t ha^{-1}) as affected by planting methods and different herbicides.

Herbicides	Planting Methods			Herbicide Means
	Ridge	Broadcast	Flat	
Stomp330 EC	3.49 a	1.80 e	2.37 cd	2.56 ab
Dual Gold 960EC	3.79 a	2.01 de	2.74 bc	2.84 a
2,4-D 72 (ester)	2.95 b	1.62 ef	2.29 d	2.29 b
Weedy Check	1.35 fg	0.81 h	1.02 gh	1.06 c
Planting methods Means	2.89 a	1.56 b	2.11 b	

$LSD_{0.05}$ for planting methods = 0.619
$LSD_{0.05}$ for herbicides = 0.307 $LSD_{0.05}$ for interaction = 0.409

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