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POTASSIUM APPLICATION REDUCES BARENESS IN DIFFERENT MAIZE HYBRIDS UNDER CROWDING STRESS CONDITIONS

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Higher yield in different maize hybrids is obtained simply by increasing the plant density, but it is not so simple that by increasing plant density would multiply the grain yield through many folds. There is a certain limit where increase in plant density tends to stabilize the grain and biological yield and it tends to decline. For this purpose, an experiment was conducted on a sandy clay loam soil and designed in randomized complete block design with split plot arrangement with four replications, randomizing maize hybrids in main plots (H_1= Pioneer-3012, H_2= Pioneer-3062, H_3= Pioneer – 30D55) and plant density levels P_1 = 15 cm x 70 cm (95238 plants ha^{-1}), P_2 = 25 cm x 70 cm (57142 plants ha^{-1}), and P_3 = 35 cm x 70 cm (40816 plants ha^{-1}) with K application (K_0=0, K_1=100, K_2=150, K_3=200 and K_4=250 Kg ha^{-1}) . It was observed that plant bareness tends to increase with the increase in plant density with widening of period between tasseling and silking time, which resulted in less number of grains, grain rows cob^{-1} and produced less grain weight cob^{-1} and vice versa. Pioneer-30D55 was the most resistant hybrid to plant bareness as compared to Pioneer-3062 and Pioneer-3012. Potassium application definitely reduced plant bareness among all three hybrids. Pioneer-30D55 was the most responsive hybrid as compared to Pioneer-3062 and Pioneer-3012. Potassium application increased fertilization by adjusting the period between tasseling and silking which resulted in more number of grain rows, grain cob^{-1} and produced higher grain weight cob^{-1}, when crop was fertilized from 100 to 200 Kg ha^{-1}, and then it tended to decline. It is therefore suggested that Pioneer-30D55 should be preferably grown at plant density of 95238 plants ha^{-1} to explore maximum production potential with K application 200 Kg ha^{-1} to avoid plant bareness due to crowding stress.
Key Words: Maize hybrids, crowding stress, potassium application, plant bareness

INTRODUCTION

Maize *(Zea mays* L.*)* is an important food and feed crop of the world and is often referred as "the king of grain crops". It ranks third in world production after wheat and rice and is important cereal crop of Pakistan (Akhtar *et al.,* 1999). It forms major dietary part of the millions of the people in the form of bread, cake and porridge in many parts of the world Asia, Africa and America. Besides being an important food grain for human consumption, maize has also become a major component of livestock and poultry feed (Asghar, 1999).

In recent years a large quantity of corn has been used in the manufacturing of shortening compounds, soaps, ammunition, varnishes, paints and similar other products (Ali,1995), whereas the by-product seed cake is a valuable component of livestock feed (Abid, 1989). Maize oil is used in cooking, bakery products, oleomargarine, salad dressing and pharmaceutical. Maize starch is used for producing bio-fuel (as ethanol) after its fermentation (Ali *et al*., 2004), making plastics, cellophane, photographic films, dying of clothes, manufacturing of paper, paper boards and tanning of the hides. It is also utilized for getting the important industrial by-products such as glucose, flakes, custard, jelly and energile etc. (Khan *et al.,* 1999).

Normally, higher yield in different maize hybrids is obtained simply by increasing the plant density. But it is not so simple that by increasing plant density would multiply the grain yield through many folds (Khan *et al*., 1999; Singh and Srivastava, 1991). There is a certain limit where increase in plant density tends to stabilize the grain and biological yield and it tends to decline (Thompson and Goodman, 2004).

There is diverse variety of maize hybrids available in Pakistan for getting bumper yield. However, the potential of every hybrid varies when plant density is increased or decreased per unit area, as this phenomenon tends to develop the abnormality of delayed silking (Bahadur *et al*., 1999; Modarres *et al*., 1998) in maize hybrids as compared to tasseling

(Huang *et al*., 1990), which causes a lot of shedding of pollen grains without fertilizing the ovules (grains) in the ovary (cob). This abnormality in its intensity varies from hybrid to hybrid because of its genetic potential (Ali *et al*., 2004; Sener *et al*., 2004). The hybrids having tolerance to high plant density do not exhibit this abnormality, while poor in tolerance to high plant density exhibit this abnormality. This abnormality have been recognized as plant bareness and expressed in maize hybrids in the form of less number of grains cob^{-1} (Cox, 1996; Khan *et al*., 1999), less number of grain rows cob^{-1} (Esechie,1992; Wang *et al*., 1987) and its ultimately results in relatively less grain weight cob^{-1} (Gozubenli *et al*., 2001; Konuskan, 2000).

One of the possible solutions for the amelioration of plant bareness has been suggested as application of potassium (Rengel and Damon, 2008). Modern maize cultivars respond to K application differently due to difference in its uptake, translocation, accumulation, growth and utilization (Tsai *et al*., 1996; Bresolin *et al*., 1979). K application tends to ameliorate the plant bareness by reducing the difference of silking (Mahmood, 1994) and tasseling period. Final results grain yield is seen in terms of increased grain yield due to increased number of grains cob^{-1} (Shahzad, 1987) and number of grain rows cob^{-1} (Abid, 1989; Akhtar *et al*., 1999) which ultimately ends in relatively more grain weight cob^{-1} (Akhtar *et al*., 1999). But the question again arises that how much quantity of K should be applied for this purpose? Keeping in view the above facts a study was designed to evaluate potential of three maize hybrids for plant bareness under high plant density and to determine the proper dose of K for the amelioration of plant bareness under high plant density.

MATERIALS AND METHODS

The experiment was conducted on a sandy clay loam soil at Government Agricultural Extension Farm, Model Town–A, Bahawalpur. The climate of the region was semi-arid and subtropical. As soil of the experimental area was quite uniform, a composite and representative soil sample to a depth of 30 cm was obtained with soil auger, prior to sowing of the crop. Percentage of sand, silt and clay was determined by Bouyoucos hydrometer method using one percent sodium hexametaphosphate as a dispersing agent. Textural class was determined by using the international textural triangle (Moodie *et al.*, 1959). Soil was analyzed for its various chemical properties by using the methods as described by Homer and Pratt (1961). For post-harvest soil analysis again composite sample to a depth of 30 cm was taken from each experimental unit immediately after harvest of the crop. The soil was analyzed for N and K. The soil was sandy clay loam containing 65% sand, 15% silt and 20% clay. Its chemical characteristics included saturation 36%, pH 7.9, EC_e 1.3 dSm^{-1}, organic matter 0.83%, total nitrogen 0.083%, available phosphorous 1 ppm and available K 125 ppm.

The experiment was laid out in randomized complete block design with split plot arrangement with four replicates, randomizing maize hybrids in main plots (H_1= Pioneer-3012, H_2= Pioneer-3062, H_3= Pioneer –30D55) and plant density levels (P_1 = 15 cm x 70 cm (95238 plants ha^{-1}), P_2 = 25 cm x 70 cm (57142 plants ha^{-1}), and P_3 = 35 cm x 70 cm (40816 plants ha^{-1}) with K application (K_0=0, K_1=100, K_2=150, K_3=200 and K_4=250 Kg ha^{-1}) in subplots. The net plot size measured 3.5m x 7m.

Agro-management practices for the crop were: Before seed bed preparation, presoaking irrigation of 10 cm was applied. When soil reached at proper moisture level locally called as “*Wattar*” condition, the seed bed was prepared by giving four cultivations with a tractor mounted cultivator. Each time soil was cultivated to a depth of 8-10 cm. Planking was given, after every two times cultivations. The crop was planted on August 3, 2005 and August 7, 2006. The seed was drilled with the help of single row-hand drill using seed rate 30 kg ha^{-1}. The NP was applied @ 300 and 200 kg ha^{-1}, respectively. Urea, diammonium phosphate and sulphate of potash were used as sources of N, P and K fertilizers, respectively. All potash and phosphatic and half dose of N fertilizer was applied at the time of sowing, while the remaining N was top dressed at first irrigation stage of the crop. In addition to rainfall received during the growing period of the crop, six irrigations were applied as and when needed at different plant developmental stages till the physiological maturity of the crop. Every irrigation turn was of 7.5 cm. The first irrigation was given ten days after sowing (DAS).

The crop was kept free of weeds by hoeing twice and hand weeding to avoid weed crop competition. Sunfuran was applied @ 20 kg ha^{-1} with second irrigation against stem borer control. All other agronomic operations except the ones under study were kept normal and uniform for all the treatments. Crop was harvested manually on November 11, 2005 and November 16, 2006. After harvesting, the plants were left in the field for two days and thereafter, tied into bundles and stalked for 4 weeks. Then the cobs were separated from the stalk and allowed to dry in sunshine for a few days before threshing.The following observations were recorded during the course of study to measure plant bareness among maize hybrids.

Data on number of days taken to tasseling in each subplot were recorded from the date of sowing to the completion of 50% tasseling. Number of days to 50% silking in each subplot was taken from the date of sowing to the completion of 50% silking. Thirty plants from each subplot were selected at random and their total cobs were counted and then average was computed. Number of grains cob^{-1} was averaged from total number of grains of ten randomly selected cobs from each subplot. Correspondingly, Number of grain rows cob^{-1} was averaged from total number of grains of ten randomly selected cobs from each subplot. Grains collected from ten randomly selected cobs in each subplot were weighed and then average grain weight cob^{-1} was calculated.

The data were analyzed by the "MSTATC" statistical package on a computer (Freed and Eisensmith, 1986). When a significant "F" value was obtained for treatment effect, least significant differences (LSD) test at P = 0.05 was applied to determine the significance of the treatment means (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

1. Days taken to 50% tasseling:

***Hybrids vs Plant density**:* The data presented in Table 1 indicated that tasseling was affected significantly by the maize hybrids. Pioneer-30D55 was significantly late in tasseling (52.01) as compared to Pioneer-3062 (50.84) and Pioneer-3012 (47.13), which also significantly differed from each other. These results are supported by the findings of Ali *et al.* (2004), Gozubenli (2001), Modarres *et al.* (1998), Sener *et al.* (2004) and Zamir (1998) who supported that tasseling period was a variable in maize hybrids. The longer season hybrids took more time to reach tasseling and maturation than did the shorter season hybrids.

Tasseling period also varied significantly among different PD treatments. Although tasseling (50.58 days) was significantly delayed at PD 95238 plants ha^{-1} than tasseling (49.32 days) at PD 40816 plants ha^{-1}, yet it was at par (50.08 days), at PD 57142 plants ha^{-1}. These differences were probably attributed to variable interception of light and circulation of air among the plants because of different interplant spacing.

Interactive effects of hybrids and PD on tasseling were significant (Table 2). Pioneer-30D55 grown at PD 95238 plants ha^{-1} took the longest time to tassel (52.77days), while Pioneer-3012 took the shortest time to tassel (46.46 days) at PD 40816 plants ha^{-1}. The results are in harmony with the findings of Bahadur *et al.* (1999), Huang *et al.* (1990), Modarres *et al.* (1998), who reported that increase in PD, tended to delay in days taken to 50% tasseling but Konuskan (2000) contradicted to these findings.

Table 1. Plant bareness in different maize hybrids as influenced by varying plant density levels (two years mean)

Treatments	Days taken to 50% tasseling	Days taken to 50% silking	Number of grain rows cob^{-1}	Number of grains cob^{-1}	Grain weight cob^{-1}	Grain yield (t ha^{-1})
A-Hybrids (H)						
H_1:Pioneer 3012	47.13 c	52.09 c	10.94 c	326.68 b	78.72 c	5.43 c
H_2:Pioneer 3062	50.84 b	54.79 b	12.68 b	342.09 a	83.42 b	5.68 b
H_3:Pioneer 30D55	52.01 a	57.57 a	14.45 a	358.55 a	87.85 a	6.01a
LSD=0.05	0.3146	0.5044	0.1895	19.74	3.02798	0.2119
B-Plant Density (PD)						
P_1: 15 cmx 70 cm (95238 plants ha^{-1})	50.58 a	55.72 a	12.13 c	304.28 c	69.84c	6.20 a
P_2: 25 cmx 70 cm (57142plants ha^{-1})	50.08 a	55.05 b	12.68 b	344.07 b	82.26 b	5.71 b
P_3: 35 cm x 70 cm (40816 plants ha^{-1})	49.32 b	53.69 c	13.26 a	378.97 a	97.89 a	5.21 c
LSD=0.05	0.8004	0.0332	0.2425	12.8465	3.966981	0.2933

Means followed by different letters in columns are significantly different at P=0.05.

Table 2. Interactive effect of plant bareness in different maize hybrids as influenced by varying plant density levels (two years mean)

Treatments	Days taken to 50% tasseling	Days taken to 50% silking	Number of grain rows cob^{-1}	Number of grains cob^{-1}	Grain weight cob^{-1}	Grain yield ($t\ ha^{-1}$)
H_1 x P_1	47.70 d	52.77 ef	N.S	N.S	N.S	5.89 c
H_1 x P_2	47.21 d	52.26 f				5.44 d
H_1 x P_3	46.46 d	51.25 g				4.98 de
H_2 x P_1	51.26 bc	55.80 d				6.20 b
H_2 x P_2	51.00 bc	55.29 d				5.67 c
H_2 x P_3	50.24 c	53.27 e				5.17 d
H_3 x P_1	52.77 a	58.58 a				6.53 a
H_3 x P_2	52.01 ab	57.57 b				5.02 b
H_3 x P_3	51.25 bc	56.56 c				5.48 cd
LSD= 0.05	1.386	0.5772				0.3185*
CV (%)	1.87	0.71	2.23	6.37	9.56	5.98

Means followed by different letters in columns are significantly different at P=0.05, N.S= Non significant

Hybrids vs K levels: Tasseling was significantly affected by different maize hybrids (Table 3). Pioneer-30D55 produced significantly earlier tasseling (48.98 days) than Pioneer-3062 (53.42 days) and Pioneer-3012 (55.56 days), with significant variation between them. Comparable trends have also been reported by Bresolin *et al*. (1979) and Tsai *et al.* (1996) who reported that different hybrids varied in days taken to tasseling due to difference in their genetic potential.

Tasseling period also varied significantly among K levels. Crop receiving no fertilizer took significantly greater number of days to tassel than rest of the K treatments. The longest tasseling period (54.09 days) was observed in control, which significantly differed with tasseling period (52.74 days) obtained when 100 kg K ha^{-1} was applied, where as the shortest tasseling period (51.96 days) was recorded when 200 kg K ha^{-1} was applied. Interactive effects of maize hybrids and K levels on tasseling period were, non-significant (Table 3). These results are in accordance with findings of Mahmood, (1994) who confirmed that K application reduced the days taken to tasseling.

2. Days taken to 50% silking:

Hybrids vs Plant density: The crop sown by different

Table 3. Plant bareness in different maize hybrids as influenced by varying Potassium application levels (two years mean)

Treatments	Days taken to 50% tasseling	Days taken to 50% silking	Number of grain rows cob^{-1}	Number of grains cob^{-1}	Grain weight cob^{-1}	Grain yield ($t\ ha^{-1}$)
A-Hybrids (H)						
H_1:Pioneer 3012	55.56 a	61.49 a	11.72 b	448.07 b	123.25 b	5.45 b
H_2:Pioneer 3062	53.42 b	57.72 b	12.18 b	476.05 a	132.16 a	5.67 a
H_3:Pioneer 30D55	48.98 c	54.56 c	13.99 a	481.81a	135.82 a	5.86 a
LSD=0.05	0.3738	0.5815	0.7774	9.2461	6.1115	0.285
B-K levels (K)						
K_0=0	54.09 a	58.69 a	11.04 d	444.87 c	119.87 c	5.32 c
K_1=100	52.74 b	58.35 a	12.34 c	458.81 bc	126.42 bc	5.52 bc
K_2=150	52.41 bc	57.57 b	12.96 b	472.17 ab	131.76 ab	5.71 ab
K_3=200	51.96 c	57.46 b	13.54 a	484.86 a	137.67 a	5.89 a
K_4=250	52.08 c	57.55 b	13.29 ab	482.51a	136.34 a	5.87 a
LSD=0.05	0.5184	0.6130	0.3467	18.1485	8.7452	0.2967
C-Interaction (H x K)	N.S					
CV=%	1.01	1.09	2.82	3.98	6.89	6.40

Means followed by different letters in columns are significantly different at P=0.05, N.S= Non significant maize hybrids showed significant variation with regard to silking period. Pioneer-30D55 was significantly late in silking (57.57 days) as compared to Pioneer-3062 (54.79 days) and Pioneer-3012 (52.09 days), which also significantly differed from each other. These results were in agreement with the findings of Ali *et al.* (2004), Liu *et al.* (2004) and Luque *et al.* (2006) who reported that maize hybrids differed for days taken to 50% silking due to their genetic variation.

Number of days taken to 50% silking was also influenced by various PD levels. Crop sown at PD 95238 plants ha^{-1}, significantly delayed silking (55.72 days) as compared to 55.05 days and 53.69 days at PD 57142 and 40816 plants ha^{-1}, which also differed significantly from each other, and showed 55.05 and 53.69 days to silking, respectively.

Combinations of maize hybrids and PD treatments also showed significant effect on days taken to silking. Pioneer-30D55 grown at PD 95238 plants ha^{-1} took the longest time to silking (58.58 days), while Pioneer-3012 at PD 40816 plants ha^{-1} took the shortest time to silk (51.25 days).

The results are in conformity with the findings of Bahadur *et al.* (1999) and Modarres *et al.* (1998) who stated that increase in PD delayed number of days taken to 50% silking.

Hybrids vs K levels**:** Maize hybrids showed significant variation with regard to silking period in both years (Table 3). Pioneer-30D55 produced significantly earlier silking (54.56 days) than Pioneer-3062 (57.72) and Pioneer-3012 (61.49 days), which also significantly varied with each other. These outcomes are supported by the findings of Asghar (1999) and Bresolin *et al*. (1979).The possible reason might be the inherent ability of the hybrids.

Silking period also varied significantly among different K levels in both years. Crop receiving no fertilizer took significantly more of days to silking than rest of the K treatments. The longest silking period (58.69 days) was observed in control, which was par with silking period (58.35 days) obtained when 100 kg K ha^{-1} was applied, where as the shortest silking period (57.46 days) was recorded when 200 kg K ha^{-1} was applied. Interactive effects of maize hybrids and K levels on silking were, however, non-significant, in both years. These results are in consonance with the findings of Mahmood, (1994) who confirmed that K application brought earliness in days taken to 50 % silking, but contrary with findings of Ali (1995), who argued that K application did not reduce the days taken to silking.

3. Number of grain rows cob^{-1}:

Hybrids vs Plant density**:** Different maize hybrids affected grain rows cob^{-1} significantly. Pioneer-30D55 significantly produced more number of grain rows cob^{-1} (14.45) as compared to 12.68 and 10.94 for Pioneer-3062 and Pioneer-3012, respectively, which also significantly differed from each other. These results are in line with those reported by Khan *et al*. (1999), Zamir (1998) and Thompson and Goodman (2004) who stated that maize hybrids differed in grain number of rows cob^{-1}, due to their genetic character.

Number of grain rows cob^{-1} were also influenced by various PD levels. Crop sown at PD 40816 plants ha^{-1}, significantly produced more number of grain rows cob^{-1} (13.26) than at PD 57142 and 95238 plants ha^{-1}, which also differed significantly from each other, and showed number of grains rows cob^{-1}, 12.68 and 12.13, respectively. Interactive effects of hybrids and PD on number of grain rows cob^{-1} were, however, non-significant (Table 2). Similar suppressive effects of high PD on number of grain rows cob^{-1} of maize has been reportd by Bahadur *et al.* (1999), Esechie (1992) and Wang *et al.* (1987).

Hybrids vs K levels**:** Different maize hybrids affected grain rows cob^{-1} significantly (Table 3). Although Pioneer-30D55 produced significantly more number of grain rows cob^{-1} (13.99) than Pioneer-3062 (12.18), yet it was at par with Pioneer-3012 (11.72). Similar trends were found by Khan *et al*. (1999), Rengel and Damon (2008) and Minjian *et al*. (2007) who reported that maize hybrids varied in the number of grain rows cob^{-1}, possibly due to difference in genetic potential of hybrids.

Number of grain rows cob^{-1} also varied significantly among different K levels. Crop receiving no fertilizer had significantly low grain rows cob^{-1} than rest of the K treatments. Maximum number of grain rows cob^{-1} (13.54) was observed, when 200 kg K ha^{-1} was applied followed by number of grain rows cob^{-1} (13.29) obtained when applied @ 250 kg K ha^{-1}, where as minimum number of grain rows cob^{-1} (11.04) was recorded in control. Interactive effects of maize hybrids and K levels on number of grain rows cob^{-1} were, however, non-significant. Similar results were noted by Abid (1989), Akhtar *et al*. (1999) and Shahzad (1987) and who reported that K application increased the number of grain rows cob^{-1}.

4. Number of grains cob^{-1}:

Hybrids vs Plant density**:** Different maize hybrids affected number of grains cob^{-1} significantly. Although

Pioneer-30D55 significantly produced more number of grains cob^{-1} (358.55) as compared to Pioneer-3012 (326.68), yet it was at par with Pioneer-3062 (342.09). These results are in accordance with findings of Cox (1996), Khan *et al*. (1999) and Thompson and Goodman (2004), who reported that maize hybrids differed in number of grains cob^{-1} due to their genetic character.

There were significant variations in number of grains cob^{-1} among different PD levels. Crop sown at PD 95238 plants ha^{-1}, produced more number of grains cob^{-1} (378.97) than at PD 57142 and 40816 plants ha^{-1}, which also differed significantly from each other and produced 344.07 and 304.28 number of grains cob^{-1}, respectively. Interactive effects of maize hybrids and PD affecting mean number of grains cob^{-1} were, however, non-significant (Table 2). Similar observations were noted by Pagano and Maddonni (2007), Sharma and Adamu (1984) and Singh and Srivastava (1991) who reported that crowding stress reduced number of grains cob^{-1}.

***Hybrids vs K levels*:** There was significant variation among different hybrids regarding number of grains cob^{-1} (Table 3). Although Pioneer-30D55 produced significantly more number of grains cob^{-1} (481.81) than Pioneer-3012(448.07), yet it was at par with Pioneer-3062 (476.05). These results are in harmony with the findings of Abid (1989), Asghar (1999), Shahzad (1987), and Khan *et al*. (1999) who stated that variation in number of grains cob^{-1} was due to difference in genetic potential.

Number of grains cob^{-1} also varied significantly by the application of potassium. Crop receiving no fertilizer had significantly low number of grains cob^{-1} than rest of the K treatments. Maximum number of grain cob^{-1} (484.86) was observed, when 200 kg K ha^{-1} was applied which was at par in number of grain cob^{-1} (482.51) obtained when 250 kg K ha^{-1} was applied, where as minimum number of grain cob^{-1} (444.87) was recorded in control. Interactive effects of maize hybrids and potassium levels on number of grains cob^{-1} were, however, non-significant. These results are in conformity with the findings of Shahzad (1987) and Abid (1989), who claimed that potassium application increased the number of grains cob^{-1}.

5. Grain weight cob^{-1}:

***Hybrids vs Plant density*:** Grain weight cob^{-1} differed significantly among various maize hybrids. Pioneer-30D55 produced significantly more grain weight cob^{-1} (87.85 g) against 83.42 g and 78.72 g in Pioneer-3062 and Pioneer-3012, respectively, with significant variation among them. These results are in line with the findings of Ali *et al.* (2004), Gozubenli *et al.* (2001), Konuskan (2000) and Sener *et al.* (2004) who stated that different maize hybrids differed in grain weight cob^{-1} due to the difference of their genetic make up.

Different PD levels also exhibited significant variation among themselves in respect of grain weight cob^{-1}. Crop planted at PD 40816 plants ha^{-1} produced significantly more grain weight cob^{-1}(97.89 g) against 82.26 g and 69.84 g at PD 57142 plants ha^{-1} and at PD 95238 plants ha^{-1}, respectively, with significant variation among them. Interactive effects of maize hybrids and PD on grain weight cob^{-1} were, however, non significant (Table 2). Suppressive effect of high PD on grain weight cob^{-1} has also been reported previously (Singh and Srivastava, 1991).

***Hybrids vs K levels*:** Grain weight cob^{-1} varied significantly among different maize hybrids (Table 3). Although Pioneer-30D55 produced more grain weight cob^{-1} (135.82 g) than Pioneer-3012 (123.25 g), yet it was at par with Pioneer-3062 (132.16 g).These results are in accordance with the findings of the Echarte *et al*. (2006) and Gambin *et al.* (2006) who reported that different maize hybrids produced different grain weight cob^{-1} due to difference in partitioning of assimilates from root to reproductive structures.

Grain weight cob^{-1} was significantly influenced by different K levels. Maximum grain weight cob^{-1} (137.67 g) was observed, when 200 kg K ha^{-1} was applied which was at par with grain weight cob^{-1} (136.34 g) obtained when 250 kg K ha^{-1} was applied, where as minimum grain weight cob^{-1} (119.87 g) was recorded in control. Interactive effects of maize hybrids and potassium levels on grain weight cob^{-1} were, however, non- significant. These results corroborate with the findings of Akhtar *et al*. (1999) who stated that potassium application increased grain weight cob^{-1} due to more leaf area and DMA per unit area.

6. Grain yield (t ha^{-1}):

***Hybrids vs Plant density*:** Grain yield differed significantly among maize hybrids (Table 1). Highest grain yield was recorded in Pioneer-30D55 followed by Pioneer-3062. Plant density levels had significant effect on grain yield. Increase number of plants per unit area increased the grain yield. Maximum grain yield was obtained with highest plant density (95238 plants ha^{-1}) and decreased gradually as the density decreased. The interactive effect of maize hybrids and plant density was also found significant (Table 2). Highest grain yield was recorded in Pioneer-30D55 with highest plant density (95238 plants ha^{-1}). These results are in agreement with the findings of Ali *et al.* (2004), Gozubenli *et al.* (2001), Khan *et al*. (1999), Knouskan (2000), Liu *et al.* (2004), Luque *et al.* (2006).

***Hybrids vs K levels*:** Grain yield was significantly influenced by various hybrids (Table 3). Highest grain yield was observed in Pioneer-30D55 and was statistically similar to Pioneer-3062. Different K levels also affected grain yield. Maximum grain yield was recorded at potassium level of 200 kg ha^{-1} and was similar to K level of 250 kg ha^{-1} and 150 kg ha^{-1}. The possible reason may be the growth of crop is limited by the nutrient element in the short supply. The interactive effect of maize hybrids and K levels was found non-significant (Table 3). These results are in line with the findings of Khan *et al*. (1999), who reported that different hybrids responded differently for grain yield due to their different genetic potential expressed in terms of difference in grain number cob^{-1}, 1000 grain weight, and prolificacy.

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