



EFFECT OF PLANT POPULATION ON MAIZE HYBRIDS

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ABSTRACT

The experiment was conducted at Malakandher Research Farm, NWFP Agricultural University, Peshawar during summer 2000. It was replicated 4 times in RCB Design with split plot arrangement having plot size of 3 x 3.5m. The maize hybrids included in the experiment were Pioneer 3025, Cargill 707, Cargill 922 and Baber while plant to plant spacing was 15, 25, 35 and 45cm. Emergence m², number of cobs per plant, cob weight, grain yield (kg ha⁻¹) and harvest index were significantly affected by hybrids. Hybrid Pioneer had Emergence m² (10) significantly higher number of cobs plant⁻¹ (1.14), cob weight (324g), grain yield (3275kg ha⁻¹) and higher harvest index (24) as compared with other hybrids. Various spacing had significantly affected emergence m², cobs/m², grains cob m⁻¹, cob weight and biological yield while the effect on other parameters was non-significant. Spacing of 15cm had significantly more emergence m² (10), number of cob per m² (10), lower grains cob⁻¹ (343), lowest cob weight (227g) but higher biological yield (15691kg ha⁻¹). Interaction of hybrid Pioneer and 25cm give highest grain yield ha⁻¹.

Keywords: maize, hybrid, crop, population, grain, yield.

INTRODUCTION

Maize (*Zea mays* L.) belongs to the family Poaceae (Gramineae) and the tribe Maydeae. Maize is an annual short days, cross pollinated crop. Based on area and production, maize is the 3rd most important cereal crop after wheat and rice in Pakistan. Maize plant have an erect stem which bear alternate leaves tassel at the top and auxiliary female inflorescence known as ear in the middle.

In Pakistan, the total cropped area occupied by maize during 1999-2000 was 961.7 thousand hectare while in the NWFP province, the total area was 539.2 thousand hectare. Total production in Pakistan during the same year was 1652 thousand tons and in NWFP the total production was 827.4 thousand tons with an average yield of 1718 kg ha⁻¹ in Pakistan and 1534 kg ha⁻¹ in NWFP (Anonymous, 2000).

The yield of maize in Pakistan is very low as compared to other maize producing countries. Among the various factors responsible for low yield, non availability of seed of improved varieties and sub optimal or super optimal plant population per hectare are the causes of lower yield (Nasir, 2000).

As maize do not have tillering capacity to adjust to variation in plant stand, optimum plant population for grain production and optimum seed rate for forage production are important. Thus to increase grain, we must plant maize at proper plant population. If plant population is too high, then crop net photosynthesis process will be affected due to less light penetration in the crop canopy as well as increase in the competition for available nutrient which will affect grain yield and forage production. On the other hand if plant population is lower than optimum plant population then per hectare production will be low and weeds will also be more. (Khan, 1972).

As not much work has been done on the effect of plant population on maize hybrids, the present study was

designed to find out better variety and proper plant population for obtaining maximum yield of maize in NWFP.

MATERIALS AND METHODS

The experiment was conducted at Malakandher Research Farm, NWFP Agricultural University, Peshawar during summer 2000. The climatic conditions of the experimental location were intense summer + intense winter with clay loam soils and pH of 8.5. The experiment was replicated 4 times in RCB Design with split plot arrangement having plot size of 3x3.5m.

The four hybrids were allotted to main plots and four different populations were allotted to sub-plots. In each sub-plot, there were five rows with row to row distance of 70cm. Different plant populations were maintained by varying plant to plant distance in each sub-plot. All cultural practices like irrigation, pest control and other operations were uniformly carried out whenever needed. Sowing was done on 23rd June 2000.

The following treatments were studied:

- A. Hybrid
 - Pioneer-3025
 - Cargill-707
 - Cargill-922
 - Baber
- B. Four different population were maintained at:
 - 15cm
 - 25cm
 - 35cm
 - 45cm

Before sowing of the crop the field was well prepared by plowing twice with tractor followed by planking to make a fine seed bed. Basal dose of NP was applied at the



rate of 120kg and 90kg P ha⁻¹. Half dose of N and full dose of P was applied before sowing while remaining half dose of N was applied at knee height stage.

The following parameters were studied during the experiment:

- Days to emergence
- Emergence per m²
- Days to tasseling
- Days to silking
- Plant height
- Number of cobs per plant
- Number of cobs per m²
- Number of grains per cob
- Cob length
- Cob weight
- Thousand grain weight
- Grain yield per ha
- Biological yield per ha
- Harvest Index

The above parameters were collected, tabulated and statistically analysed according to the appropriate method for RCB design with split plot arrangement. Least Significant Difference (LSD) test at 5% probability level was used for the comparison of treatment means.

RESULTS AND DISCUSSION

Emergence m⁻²

Data regarding Emergence m⁻² are presented in Table-1. Statistical analysis of the data revealed that maize hybrids and spacing significantly affected emergence m⁻². Maximum emergence m⁻² was recorded for Pioneer 3025 (10) while minimum emergence m⁻² for Baber (8). Minimum plant spacing (15) resulted in maximum emergence m⁻² (10) while minimum emergence m⁻² was recorded for plant spacing 35cm and 45cm.

Days to tasseling

Perusal of the data regarding days to tasseling revealed non significant effect for hybrids, plant spacing and their interaction (Table-2). Among hybrids Cargill 707, Cargill 922 and Baber took maximum days to tasseling (60) and Pioneer 3025 took minimum days to tasseling (59). Similarly plant spacing mean values indicated that plant spacing of 15, 25, 35 and 45cm took maximum (60) days to tasseling.

Days to silking

Data regarding days to silking of maize are presented in Table-3. Statistical analysis of the data indicated that hybrids, spacing and their interaction hybrid x spacing did not significantly affected days to silking. Mean values of the hybrids indicated that maximum (68) days to silking was recorded for plots sown with Cargill 922 and Baber and minimum value was recorded for Pioneer 3025 and Cargill 707 (67). Mean values for plant spacing depicted that plant spacing of 45cm took maximum days to silking (68) and minimum value was recorded at 15, 25 and 35cm (67).

Plant height (cm)

Data regarding the effect of hybrids and plant spacing on plant height are given in Table-4. Statistical analysis of the data revealed that hybrids, spacing and interaction hybrid x spacing did not significantly affected plant height of maize. Mean values for hybrids indicated that maximum (145cm) plant height was recorded for Cargill 707 and minimum value was recorded for Baber (134cm). In case of plant spacing (141cm) plant height was recorded as maximum at 15cm and minimum value was recorded at 25 and 35cm (139cm).

Number of cobs per plant

Data regarding the effect of hybrids and spacing on number of cobs per plant are given in Table-5. Scrutiny of the data revealed that hybrids differed significantly for number of cobs plant⁻¹, while effect of plant spacing and interaction was not significant. Maximum number of cobs per plant (1.14) was recorded for Pioneer 3025 and Baber and minimum for Cargill 707 (1.01). The interaction of hybrids and spacing had also non significant effect on number of cobs plant⁻¹. Karim *et al.* (1984) reported that cob weight and number of cobs per plant increased with increase in N application.

Number of cobs per m²

Data regarding number of cobs per m² of maize are presented in Table-6. Analysis of the data revealed that this parameter was significantly affected only by plant spacing. Maximum number of cobs per m² was recorded at 15cm (10) and minimum for plant spacing 35 and 45cm (8). These results are in conformity with Roy and Biswas (1992) who reported that number of cobs per m² increased with increasing plant density.

Number of grains per cob

Data regarding the effect of hybrids and spacing on number of grains per cob is given in Table-7. The response of number of grains cob⁻¹ to spacing was significant. Maximum (399) number of grains cob⁻¹ was recorded at 35cm and minimum number of grains cob⁻¹ was recorded at 15cm (343). These results are also in agreement with Roy and Biswas (1992) who concluded that grain number per cob was highest at 33300 plants/ha.

Cob length (cm)

Data regarding the effect of hybrids and spacing on cob length is given in Table-8. Statistical analysis of the data revealed that the effect of hybrids, spacing and interaction hybrid x spacing all had non significant effect on cob length. Mean values of hybrids indicated that maximum cob length was recorded for Pioneer 3025 (34cm) and minimum value of cob length was recorded for Cargill 707 and Cargill 922 (31cm). Plant spacing mean values depicted that maximum cob length was recorded at 45cm (33cm) and minimum value was recorded at 15cm (30cm). These results are also in agreement with Al-Rudh and Al-Younis (1978) who reported that row spacing had significantly affected ear length.

**Cob weight (g)**

Data recorded on average cob weight (g) of maize is presented in Table-9. Statistical analysis of the data revealed that hybrids and spacing had significant effect on cob weight. Maximum cob weight was recorded for Pioneer 3025 (324g) and minimum value was recorded for Cargill 922 (235g). Similarly maximum plant spacing (45cm) resulted in maximum cob weight was recorded at 45cm (293g), while minimum for minimum plant spacing (15cm) resulted in minimum cob weight. These results are in line with Sharma and Adamu (1984) who reported that number of cobs, weight of cobs and grain weight per cob were highest at lowest plant population. These results are also in conformity with Alessi and Power (1974) who reported that cob weight decreased with increased population.

Thousand grain weight (g)

Data regarding the effect of hybrids and spacing on thousand grain weight is given in Table-10. Statistical analysis of the data revealed that hybrids, spacing and their interaction hybrid x spacing are non significant. Mean values of hybrids indicated that maximum thousand grain weight was observed for Pioneer 3025 and Cargill 707 (262g) and minimum value was observed for Cargill 922 (253g). Mean values for spacing indicated that maximum thousand grain weight (260g) was recorded at 45cm and minimum value was recorded at 35cm (254g). Similar results were observed by Al-Rudh and Al-Younis (1978) who reported that the row spacing had significantly affected the ear height and length, number of grains per ear, 1000 grain weight etc.

Grain yield (kg ha⁻¹)

Data regarding the effect of hybrids and spacing on grain yield is given in Table-11. Statistical analysis of the data revealed that hybrids and interaction had a significant effect on grain yield. Maximum grain yield was produced by Pioneer 3025 (3275kg ha⁻¹) while minimum by Cargill 922 (2558kg ha⁻¹). The response of grain yield to plant spacing was non significant. The interaction between hybrid x spacing showed that significantly higher grain yield was recorded when hybrid pioneer 3025 was placed at 25cm spacing while Cargill 707 produced minimum grain yield when planted 45cm apart. These results are in line with Ghuman and Gill (1969) who concluded that closer plant spacing gave progressively higher grain yield than wider plant spacing.

Biological yield (kg ha⁻¹)

Data regarding the effect of hybrids and spacing on biological yield is given in Table-12. Statistical analysis of the data revealed that hybrids and interaction had non significant effect on biological yield. Maximum biological yield (17347 kg ha⁻¹) was obtained at 35cm and minimum value was obtained at 45cm (13393 kg ha⁻¹). These results are in agreement with Rezuvaev (1981), Roy and Biswas (1992) who reported that fodder yield increased with increasing plant density.

Harvest index

Inspection of the data regarding harvest index revealed that maize hybrids showed significant variation among maize hybrids (Table-13). Maximum value of (24) harvest index was recorded for Pioneer 3025 while minimum for Cargill 922 (17). The interaction of hybrids and spacing had non significant effect on harvest index.

Table-1. Effect of different hybrids and spacing on Emergence m⁻² of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	13	10	10	8	10 a
25	11	8	8	8	9 b
35	7	9	7	7	8 b
45	8	8	9	7	8 b
Means	10 a	9 ab	9 ab	8 b	-

LSD value at 5% level for hybrids = 1.5

LSD value at 5% level for spacing = 1.2

**Table-2.** Effect of different hybrids and spacing on days to tasseling of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	60	59	60	60	60
25	58	60	60	60	60
35	60	60	60	60	60
45	59	60	61	60	60
Means	59	60	60	60	-

Table-3. Effect of different hybrids and spacing on days to silking of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	67	66	68	68	67
25	66	67	68	68	67
35	67	67	67	67	67
45	68	67	68	67	68
Means	67	67	68	68	-

Table-4. Effect of different hybrids and spacing on plant height (cm) of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	129	149	146	140	141
25	146	139	140	130	139
35	139	147	131	138	139
45	140	145	147	128	140
Means	139	145	141	134	-

Table-5. Effect of different hybrids and spacing on number of cobs per plant of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	1.06	1.00	1.00	1.18	1.06
25	1.25	1.00	1.00	1.12	1.09
35	1.12	1.00	1.00	1.06	1.04
45	1.12	1.06	1.12	1.18	1.12
Means	1.14 a	1.01 b	1.03 b	1.14 a	-

LSD value at 5% level for hybrids = 0.1

Number denoted by different letter(s) is significantly different at 5% level of probability, using LSD test.

**Table-6.** Effect of different hybrids and spacing on number of cobs per m² of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	11	10	10	9	10 a
25	11	8	8	8	9 b
35	7	10	8	8	8 b
45	8	8	9	7	8 b
Means	9	9	9	8	-

LSD value at 5% for spacing = 1.4

Table-7. Effect of different hybrids and spacing on number of grains per cob of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	325	322	320	405	343 b
25	402	354	353	333	361 ab
35	446	384	357	407	399 a
45	374	377	394	410	389 a
Means	387	359	356	389	-

LSD value at 5% level for spacing = 39.4

Table-8. Effect of different hybrids and spacing on cob length (cm) of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	30	30	30	31	30
25	35	31	30	31	32
35	35	31	31	32	32
45	34	33	31	33	33
Means	34	31	31	32	-

Number denoted by different letter(s) is significantly different at 5% level of probability, using LSD test.

**Table-9.** Effect of different hybrids and spacing on cob weight (g) of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	263	225	180	240	227 b
25	365	260	253	233	278 a
35	375	233	245	273	282 a
45	293	310	260	308	293 a
Means	324 a	257 b	235 b	264 b	-

LSD value at 5% level for hybrids = 48.7

LSD value at 5% level for spacing = 45.3

Table-10. Effect of different hybrids and spacing on 1000 grain weight (g) of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	270	268	233	259	258
25	264	255	263	253	259
35	253	255	251	255	254
45	259	268	264	249	260
Means	262	262	253	254	-

Table-11. Effect of different hybrids and spacing on grain yield (kg ha⁻¹) of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	3181 b	2571 c-f	2551 c-f	2657 b-f	2740
25	3786 a	3105 bc	2500 def	2595 c-f	2997
35	3033 bcd	2802 b-e	2386 ef	3000 bcd	2805
45	3101 bc	2157 f	2795 b-e	2857 b-e	2728
Means	3275 a	2659 b	2558 b	2777 b	-

LSD value at 5% level for hybrids = 422.1

LSD value at 5% level for interaction = 564.5

Number denoted by different letter(s) is significantly different at 5% level of probability, using LSD test.

**Table-12.** Effect of different hybrids and spacing on biological yield (kg ha⁻¹) of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	15306	17867	15816	13776	15691 ab
25	13265	15306	15306	12245	14031 b
35	17347	16327	20408	15306	17347 a
45	15306	12755	12755	12755	13393 b
Means	15306	15564	16071	13521	-

LSD value at 5% level for spacing = 2745

Table-13. Effect of different hybrids and spacing on harvest index of maize.

Spacing (cm)	Hybrids				Mean
	Pioneer 3025	Cargill 707	Cargill 922	Baber	
15	23	14	16	21	19
25	30	21	17	22	23
35	19	18	13	20	18
45	22	17	22	23	21
Means	24 a	18 bc	17 c	22 ab	-

LSD value at 5% level for hybrids = 4.3

Number denoted by different letter(s) is significantly different at 5% level of probability, using LSD test.

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