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YIELD AND YIELD COMPONENTS OF MAIZE AS AFFECTED BY SOWING DATES AND SOWING METHODS

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Abstract

The experiment was conducted at the Nuclear Institute for Food and Agriculture (NIFA) Peshawar during kharif 2008 to evaluate the effect of sowing dates and methods on maize in a randomized complete block design with split plot arrangement. Sowing methods (broadcast and line sowing) effects were allotted to main plot while sowing dates (*i.e.* 6th, 16th and 26th of June and July, respectively) were kept in sub plot levels. Planting dates affected days to maturity, number of plants at harvest ha^{-1}, biological yield, grains ear^{-1}, grain yield and thousand grains weight significantly. Maize took more days to maturity (115), biological yield (12010 kg ha^{-1}) and thousand grains weight (234.55g) from early sown plots (6th June). Higher number of plants at harvest (74889 plants ha^{-1}) was recorded from 6th July sowing while higher number of grains ear^{-1} (503.86) and grain yield (2906.7 kg ha^{-1}) were recorded from 26th June sowing. Sowing methods significantly affected the days to maturity, number of plants at harvest ha^{-1}, biological yield, grains ear^{-1}, grain yield and thousand grains weight significantly. Higher days to maturity (98.3), plants at harvest (73703 plants ha^{-1}) and biological yield (10751 kg ha^{-1}) were recorded from broadcast sowing while higher number of grains ear^{-1} (412.67), grain yield (2817 kg ha^{-1}) and thousand grains weight (220.67 g) were recorded from line sowing. No interaction effects of sowing dates and methods on the parameters under study were observed except biological, grain yields and thousand grain weight. It was concluded that planting on 26th June resulted in higher grains ear^{-1} and grain yield and the plants which were planted in lines resulted higher grains ear^{-1}, grain yield and thousand grains weight and thus are better for higher outcome from maize.

Introduction

Maize is the world's most widely grown cereal and it is ranked third among major cereal crops (Ayisi and Poswall, 1997). In the developed countries, maize is grown for animal feed and used as raw material for industrial products such as starch, glucose and dextrose (FAO, 1999). Maize production requires an understanding of various management practices as well as environmental conditions that affect crop performance (Eckert, 1995). Of all management aspects of growing a maize crop, planting date is probably the most subject to variation because of the very great differences in weather at planting time between seasons and within the range of climates (Otegui *et al*., 1995). Farmers who plant maize early are concerned about frost, poor emergence and early plant growth while on other hand farmers who plant maize late are concerned about that how late planting might affect the final grain yield and grain moisture (Lauer *et al*., 1999). Drought occurring at flowering can lead to greater losses than when it occurs at other developmental stages (Grant *et al*., 1989). At very early sowing there is a high temperature which has detrimental effects like inhibits pollination, increase respiration and transpiration rates and thus limit dry matter accumulation, which in turn reduces the grain yield (Hortick and Arnold, 1965). If sowing is delayed then the plant doesn't get the proper conditions for its growth so it results in low productivity or complete failure of the germination. Grain yield of maize decreases with the delay of sowing (Obi, 1988). If a plant is planted earlier then it will give some level of productivity. Maize yield is substantially reduced by hot, dry conditions at tasseling. It is important that this growth stage be reached when there would normally be maximum chance of cloud cover and reasonable moisture (Price and Darwin, 1997). Low growth yield rate in the late sown crop is mainly due to unfavorable environmental effects encountered during the reproductive phase and due to the low net assimilation rate (Staggenborg *et al*., 1999).
Planting method is of considerable importance because it ensures optimum plant population and enables plant to utilize land and other resources more efficiently for better growth and development (Ali *et al*., 1998). Farmers use only broadcast method of sowing which is cheap method but has a lot of disadvantages as in some areas of the field there is a dense population in which there is a lot of inter plant and intra plant competition between plants and they consume a lot of resources for only their survival so ultimate yield is reduced and some patches of field are gappy in which weeds grow which compete with the major plants for nutrients, water. The capture of solar radiation with in the canopy could be increased by dense population (Pepper, 1974). For getting dense population the seeds are sown closely or more seed rate is used. In case of thick population, most of the plants bear barren cobs, smaller ears and become susceptible to lodging and pest attack, while in case of thin population yield per unit area is reduced because of less than optimum plants (Ahmad *et al*., 2007). However,

efficiency of conversion of intercepted radiation into economic yield will decrease with increase plant population or uneven stand because of mutual shading of plants (Buren, 1974).

The present study was therefore, planned to determine the effect of sowing dates and sowing methods on yield and yield components of maize.

Materials and Methods

Experimental Site Information: The experiment was performed at Nuclear Institute for Food and Agriculture (NIFA) Peshawar Khyber Pakhtunkhwa (*ca*. 1560 km North of Indian Ocean at 34° N Latitude and 71° E Longitude) during summer 2008. The experimental zone was semi-arid with soil pH of 7.8-8.3 (Alkaline). Texture of the soil was silty clay loam. Electrical conductivity was 0.56 dS m^{-1}, $CaCO_3$ equivalent ratio was 18%, organic matter of the soil was 0.86%, $NaHCO_3$ external was 4.57mg kg^{-1} and percent nitrogen in the soil was 0.06%. The experiment was conducted in RCB design with split plot arrangement with three replications using plot size of 15 m^2. Plant to plant distance in line sowing was 25 cm while row to row distance was 75 cm with a row length of 5 m in each subplot. Seed rate of 30 kg ha^{-1} was used. Nitrogen and phosphorous fertilizers were applied at the rate of 120 - 60 kg ha^{-1}, respectively. Half of N and all of P_2O_5 were applied at the time of sowing, while the remaining half of N was applied at knee height stage. Sowing methods i.e. broadcast and line were allotted to main plots and sowing dates i.e. June 6, 16, 26 and July 6, 16 and 26 were applied to subplots. Data on various parameters were recorded as follows:

Days to maturity were recorded from sowing till 80% plants become physiological matured as the seeds show a black layer formation at the base of the seed. Biological yield was recorded by weighing all the plants harvested from each plot and then converted into kg ha^{-1}. The ear harvested for grain yield were used for the determination of number of grains ear^{-1} by selecting five ears randomly from each subplot, dried and shelled for counting the grains ear^{-1}. The cobs harvested for grain yield were used for the determination of number of grains ear^{-1} by selecting five ear randomly from each subplot, dried and shelled for counting the grains ear^{-1}. Data regarding thousand grains weight was recorded by counting actual number of thousand grains at random and then were weighed with electronic balance.

Results and Discussion

Days to Maturity: Data concerning days to physiological maturity as affected by sowing methods and sowing dates are presented in Table 1. Days to maturity was significantly affected by both sowing methods and sowing dates. The interaction between sowing methods and sowing dates was not significant for days to maturity. Delayed maturity (98.3 days) occurred in broadcast sowing as compared to line sowing (95.2 days). It might be due to the reason that in case of line sowing there was a proper distance between plants and rows so there was no mutual shading between plants and also there was poor inter plant competition due to which it took lesser days to maturity while in case of broadcast there might be intra and inter competition among plants which ultimately resulted in more days to reach maturity. The results are in line with Sharma and Saxena (2002) who reported that broadcast sown maize took more days to maturity. Maturity was delay (114.7 days) for earliest sown (6^{th} June) while late planting on 26^{th} July resulted in early maturity (76.7 days). Early maturity of late sown crop might be due to short vegetative and reproductive period of the late sown crop (Khan *et al*., 2002). These findings are in confirmation with those of Zaki *et al*. (1994) and Khan *et al*. (2002) who reported that maturity enhanced by delay in sowing in maize.

Plants Population (ha^{-1}) at Harvest: Plant population at harvest was significantly affected by sowing methods and sowing dates ($P \leq 0.05$). The interaction effect of sowing method and sowing date was non-significant. Higher plant population of 73703 plants ha^{-1} was recorded in broadcast sowing as compared with 66185 plants ha^{-1} with line sowing (Table 1). It might be due to the reason that a proper distance was maintained between plants and rows and in case of broadcast there was a random population. The results are contradictory to those of Bakht *et al*. (2006) who observed non significant effect of sowing methods on plants at harvest. Among sowing dates, maximum plant population (74889 plants ha^{-1}) was recorded when crop was planted on 6^{th} July, while lower number of plants (67444 plants ha^{-1}) was recorded from the earliest and late sown crops of 6^{th} June and 26^{th} July. The earliest sown crop had less population; which might be due to the reason that some plants were lodged because of their excessive height and due to heavy rain showers in the month of August. In case of late sowing, the smaller population might be due to the reason that the conditions for emergence were not good due to which most of the plants failed to emerge and thus resulted in lower number of plants at harvest.

Biological yield (kg ha^{-1}): Perusal of the data indicated that biological yield was significantly affected by sowing methods and sowing dates. The interaction between planting methods and planting dates was also significant. Greater biological yield (10751 kg ha^{-1}) was recorded in broadcast sowing as compared to line sowing (8547 kg ha^{-1}). It might be due to the reason that broadcast sown crop had produced a good canopy structure and taller plants which ultimately resulted in more biological yield. The results are in contrast with those of Abdullah *et al*. (2008) who reported lower biological yield for broadcast sowing. Incase of planting dates, higher biological yield (12010 kg ha^{-1}) was obtained by the earliest sown crop (6th June) while lower biological yield (7533 kg ha^{-1}) was recorded from the late crop sown which was planted on 26th July (Table 1). Interaction between plating methods and dates indicated that biological yield was decreased with delay in planting for both broad cast and line planting; however, the decrease was lower for line sowing with delay in planting as compare to broad cast (Fig 1). It might be due to the reason that early sown crop had a longer growth period with long days and short nights to avail more sunlight as compared with the late sown crop. The results are in conformity with Cirilo and Andrade (1994) and Maddonni *et al*. (2004) who reported that dry matter yield decreased in maize with delayed sowing.

Grains ear^{-1}: The statistical analysis of the data revealed that grains ear^{-1} were significantly ($P \leq 0.05$) affected by sowing methods and sowing dates. The interaction of sowing methods and sowing date was not significant (Table 2). Higher number of grains ear^{-1} (412.67) was recorded in line sowing as compare with broadcast (386.79). It might be due to the reason that in line sowing the plants have started tasseling and silking before the broadcast sown crop so there was a maximum time available for line sown crop to produce grains. These results are in confirmation with Arif *et al*. (2001) who tested different methods of sowing and concluded that the broadcast sown maize has less number of grains ear^{-1} than line sown crop. In terms of sowing dates, higher number of grains ear^{-1} (503.86) were produced by the early sowing on 26th June while lower number of grains ear^{-1} (287.39) were recorded from the late sown crop on 26th July. There was a random response of grains ear^{-1} in case of sowing date. From first sowing date grains ear^{-1} has increased up to 3rd sowing date which is 26th June but after it the grains ear^{-1} declined with the late sowing date. It happened because may be the mid sown crop was sown optimum growing period, while late sown crop had mostly unfavorable conditions and therefore produced less number of grains ear^{-1}.

Grain yield (kg ha^{-1}): Data on grain yield was recorded in Table 2. Grain yield was significantly affected by planting methods and planting dates. Interaction between planting methods and planting dates was also significant. Higher grain yield (2817 kg ha^{-1}) was recorded in line sowing than broadcast (2158 kg ha^{-1}). It might be due to the reason that line sowing provide equal opportunity to all plants for nutrients, water and light (Chang *et al*., 1991), had more water use efficiency (Hossain and Maniruzzaman, 1992) and these all productivity influencing factors were efficiently used by the plants which were sown in line sowing than the broadcast sowing. Interaction between planting methods and dates showed that grain yield increased with delay in sowing up to 6th July for both line and broad cast, however, incase of broad cast same yield was achieved when the crop was planted on 16th June but further delay decrease grain yield in both plant methods (Fig 2). The results are in confirmation with Arif *et al*. (2001) and Hussain *et al*. (1999) who reported that line sown crop has higher grain yield than the broadcast sown crop in maize. Higher grain yield (2907 kg ha^{-1}) was obtained by the mid sowing of 26th June, while lower grain yield (1797 kg ha^{-1}) recorded from the late sown crop on 26th July. There is a random response because the grain yield increases from the first sowing date up to the 3rd and after 3rd sowing date the yield again start declining. Lesser grain yield of earliest sown crop might be attributed to the fact that earliest sown crop had minimum grains ear^{-1} and also a less population because a lot of plants were lodged due to the rainy season in month of August. The mid sown crop has higher grain yield because drop of temperature and unfavorable conditions for growth at late sowing had decreased the grain yield. Optimum sowing date resulted in higher grain yield than early and late planting dates (Otegui *et al*. (1995). The result are in confirmation with Jaliya *et al*. (2008), Namakka *et al*. (2008), Aziz *et al*. (2007), Khan *et al*. (2002) and Zaki *et al*. (1994) who reported that grain yield was reduced by delay in sowing. The significant correlation between grain yield and thousand grain weight revealed that grain yield reduction associated with delayed sowing was probably due to reduction in thousand grain weight.

Thousand grain weight (g): Analysis of the data indicated that thousand grain weight was significantly affected by planting dates, methods. Interaction between methods and dates was also remained significant (Table 2). Higher thousand grains weight (221 g) was recorded in line sowing than broadcast (206 g). It may be due to the reason that in broadcast the more of assimilates are used for producing biomass and also grains filling starts later than the line sowing due to which the broadcast sown crop has less thousand grains weight. Higher thousand grains weight (235 g) was attained by the early sowing (6th June) while lower thousand grains weight (153 g) was recorded from the late sown crop (26th July). Interaction between planting methods and dates showed that thousand grain weight was similar from 6th June to 26th July after which it was decreased in both methods; however, the decreased was lower in line methods (Fig 3). Early sown crop had produced bold and plump grains, it may be due to the reason that because it had prolong period for growth and development and grain filling period and faster growth of late sown crop has affected the grain size and produced lighter grains.

The thousand grain weight resulting from delayed sowing was probably due to the decrease in translocation of photosynthates to the ripening grain (Rahman *et al*., 2001) and low daily incident radiation Cirilo and Andrade (1996b), which is consistent with findings of Ahmad *et al*. (2007) and Khan *et al*. (2002).

Table 1. Days to maturity, plants at harvest (ha^{-1}) and biological yield ($kg\ ha^{-1}$) of maize (var. Azam) as affected by sowing dates and methods at NIFA Peshawar during kharif 2008.

Planting dates (PD)	Days to maturity	Plant at harvest (ha^{-1})	Biological yield ($kg\ ha^{-1}$)
6th June	115 a	67444 c	12011 a
16th June	109 b	69111 bc	10256 b
26th June	102 c	70778 b	10133 b
6th July	95.5 d	74889 a	9311 c
16th July	83.5 e	70000 bc	8656 d
26th July	76.7 f	67444 c	7533 e
$LSD_{0.05}$	**2.523**	**2892**	**330.6**
Planting methods (PM)			
Broadcast	98.3 a	73703 a	10751a
Line	95.2 b	66185 b	8547b
Significance	**1.457**	**1670**	**188.6**
Interaction			
PD x PM	NS	NS	** (Fig. 1)

Table 2. Number of grains ear^{-1}, grain yield ($kg\ ha^{-1}$) and thousand grains weight (g) of maize (var. Azam) as affected by sowing dates and methods at NIFA Peshawar during kharif 2008.

Planting dates (PD)	Grains ear^{-1}	Grain yield ($kg\ ha^{-1}$)	Thousand grain weight (g)
6th June	318 d	2722 b	235 a
16th June	414 b	2874 a	233 a
26th June	499 a	2908 a	232 a
6th July	477 ab	2604 c	230 a
16th July	361 c	2017 d	197 b
26th July	290 e	1791 e	153 c
$LSD_{0.05}$	**28.79**	**59.01**	**5.174**
Planting methods (PM)			
Broadcast	387 b	2158 b	206 b
Line	413 a	2817 a	221 a
Significance	**16.62**	**34.07**	**2.987**
Interaction			
PD x PM	NS	** (Fig. 2)	** (Fig. 3)

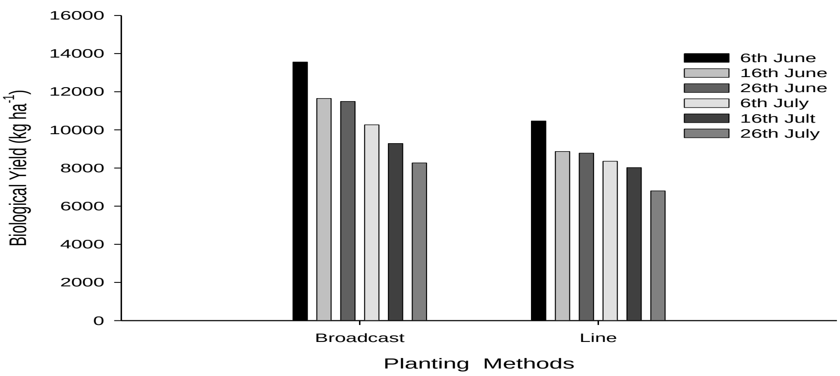

Fig. 1. Interaction between planting methods and planting dates for biological yield.

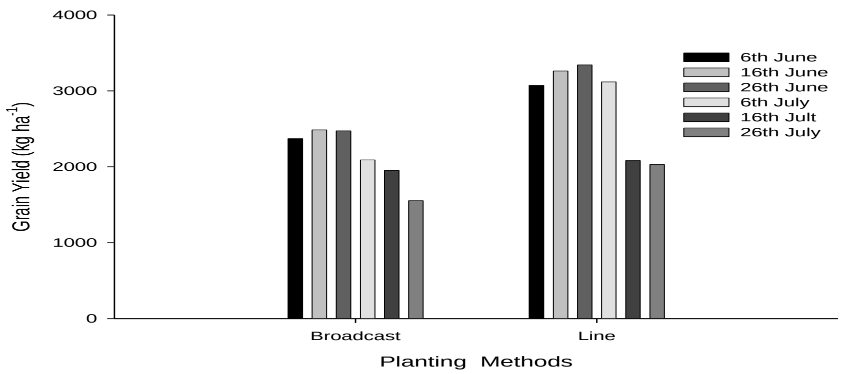

Fig. 2. Interaction between planting methods and planting dates for grain yield.

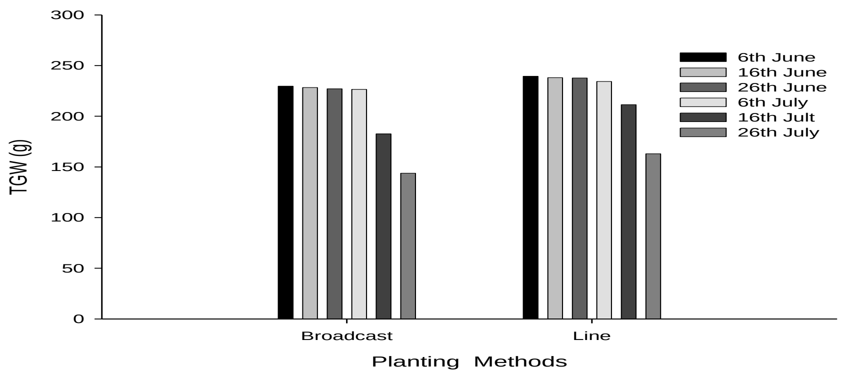

Fig. 3. Interaction between planting methods and planting dates for thousand grain weight.

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