

Research Article

Growth and yield of Maize hybrids as effected by different sowing Dates in Swat Pakistan

Imran^{1*}, Izaz Hussain¹, Shahida Naveed², Salim Shah³, Aziz Ur Rahman⁴, Hayat Zada⁵, Inayat Ullah¹, Asad Ali Khan¹ and Subhan Uddin⁶

1. Department of Agronomy, The University of Agriculture Peshawar, Pakistan

2. Department Botany, Government Girls Degree College, Karak, Pakistan

3. Department of Plant Breeding and Genetics, Bacha Khan University Charsadda, Pakistan

4. Department of Plant breeding and genetics, The University of Agriculture Peshawar, Pakistan

5. Department of Plant Protection, The University of Agriculture Peshawar, Pakistan

6. Department of Agricultural Mechanization, The University of Agriculture Peshawar, Pakistan

*Corresponding author's email: imranagrarian@aup.edu.pk

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Abstract

To evaluate the response of maize hybrids to different sowing Dates, an experiment was conducted during kharif season, at farmer field school, Sambat cham, Matta, Swat, during summer 2012. The experiment was carried out in randomized complete block design with split plot arrangement having four replications. Sowing date (June 1st, 15th, 30th) was allotted to main plots, while maize hybrids (PIONEER-30K08, CS 200 and MALKA-TS-1105) were sown in sub plots. A subplot size of 3.5m x 4.0m was used. Each subplot was consisted of six rows having 75 cm row-to-row distance with row length of 3 m. Sowing either on 1st or 15th June gave at par grains ear⁻¹ (560 and 563), grain yield (7820 and 9010 kg ha⁻¹) and biological yield (25055 & 23240 kg ha⁻¹) respectively. Sowing on 15th June gave higher plant height (232 cm). Delayed sowing on 30th June decreased grains ear⁻¹ to 460, grain yield to 6060 kg ha⁻¹, biological yield to 15972 kg ha⁻¹ and plant height to 185 cm. There was no effect of sowing dates on ear m⁻² and thousand grains weight. Among the maize hybrids, PIONEER-30K08 had the optimum number of ears m⁻² (7), grain yield (8343 kg ha⁻¹) and biological yield (22129 kg ha⁻¹) while Malka-TS-1105 showed the lowest grain yield of 7119 kg ha⁻¹ and biological yield of 20231 kg ha⁻¹. The hybrids did not differ from each other in plant height. On the basis of the above results, among the tested hybrids PIONEER-30K08 is recommended for sowing on either June 1st or 15th June under the agro-ecological conditions of Swat valley.

Key words: Maize (*Zea mays* L.); Sowing Dates; Hybrids; Farmer field school (FFS)

Introduction

Maize (*Zea mays* L.) belongs to family poaceae. In Pakistan maize is third most important cereal crop after wheat and rice

[1]. It is an annual, determinate crop, having C₄ carbon fixation pathway. It is a short duration crop and is grown twice a year both for grain and fodder purpose [2].

It is cultivated both in spring and kharif seasons in Pakistan, due to the availability of temperate as well as tropical genetic material both in hybrids and open pollinated maize varieties. Maize is a dominant crop in the farming system because it is a staple food crop for much of rural population. Its grain is used for several industrial purposes such as starch, alcohol, corn sugar, corn oil, acetones and lactic acid. Besides its multipurpose uses, corn is getting popularity for its non-cholesterol oil content in the present day world [3]. Corn grain is valuable source of protein (10.4%), fat (4.5%), starch (71.8%), vitamins and minerals like calcium, phosphorous and sulfur. It also provides raw materials to starch industry and is used in the preparation of many products. It is grown throughout Khyber Pakhtunkhwa [4]. About two-third of the total world production of maize is used for livestock feed or for commercial starch and oil production [5]. In Pakistan, maize was cultivated on an area of 0.974 million ha with an annual production of 3.707 million tones and an average yield of 3805kg ha⁻¹ in Pakistan, whereas in Khyber Pakhtunkhwa average yield of maize crop was 1751 kg ha⁻¹ during the reported year [6]. Soil and climatic conditions of Pakistan are highly favorable for corn production. But unfortunately in Khyber Pakhtunkhwa and especially in Swat district yet its average yield is very low. The reasons for low yield are non-availability of high yielding hybrids, improper use of fertilizer, and insufficient availability of irrigation water at proper time, improper sowing date and lack of modern production technology. Among the various factors of crop production, improved hybrids and proper sowing dates play key role in boosting production of corn [7]. High yielding hybrids are of primary importance for higher yield. Hybrids play vital role in successful maize husbandry [8].

Yield can be increased to a greater extent provided high yielding hybrids are identified and planted at optimum sowing dates. A comparative study of maize hybrids is necessary in order to sort out the most reliable hybrids for agro-climatic conditions of Swat [9, 10]. The main objective of this experiment was to screen out high yielding hybrid(s) that can mature in short period of time with very little or no effects on yield. In this experiment three dates of sowing have been used i.e. 1st June, 15th June and 30th June. Sowing of different hybrids on different sowing dates might give us a clue regarding the best hybrid(s) and suitable planting date(s) that might result in higher or at least somewhat normal yield under irrigated condition of Swat valley.

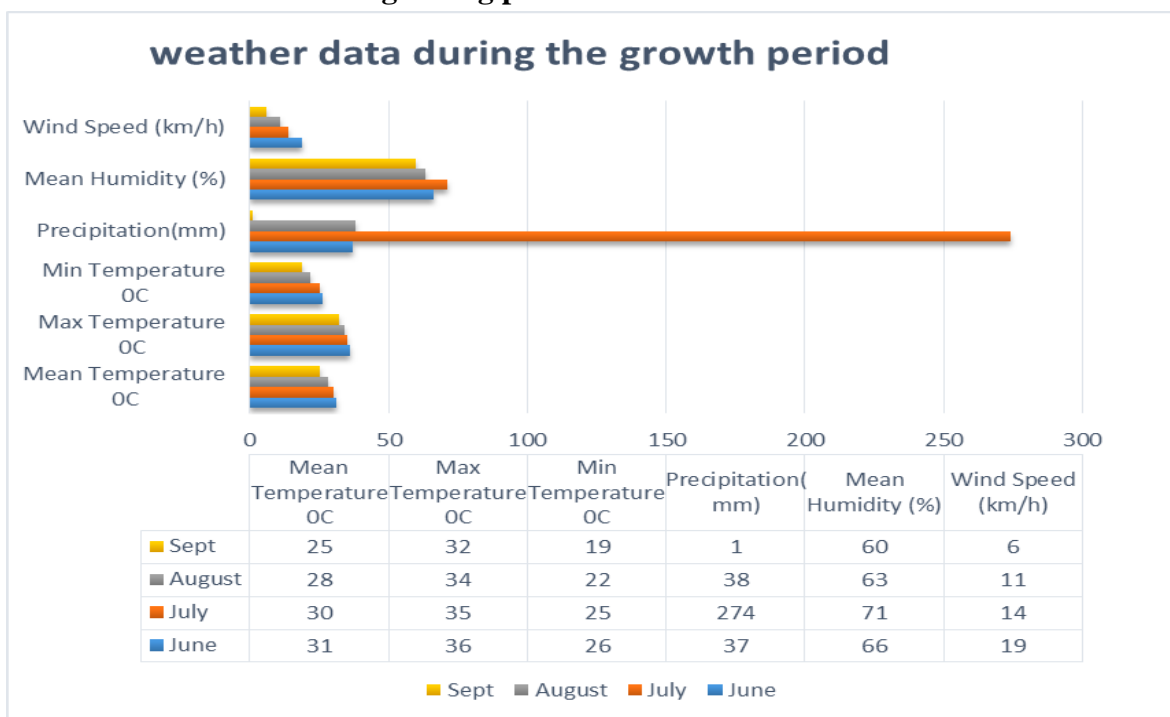
Materials and Methods

To study the effect of various sowing dates on yield and yield attributes of maize hybrids, an experiment was conducted at Farmer Field School, Sambat cham, Matta Swat, Pakistan during summer 2012. The experiment was laid out in randomized complete block (RCB) design with split plot arrangement having four replications. Previous crop in the field was spring wheat (*Triticum aestivum* L.). Sowing dates were allotted to main plots, while maize hybrids were allotted to sub plots. A subplot size of 3m x 4.5m was used. Each sub plot was consisted of 6 rows having 75 cm row-to-row distance with row length of 3 m. All the recommended agronomic practices were followed. Three sowing dates June (1st, 15th, 30th) and three hybrids i.e. PIONEER-30K08, CS 200, and MALKA-TS-1105 were used. Data were recorded on plant height (cm), ears m⁻², grains ear⁻¹, 1000 grain weight, grain yield and biological yield. Plant height was measured at harvesting stage. Plant height from ground level to the last node of the five randomly selected plants in each subplot was

measured through measuring tape and averaged. Ears in one meter square area at three different places in each subplot were counted and averaged to record ears m⁻² area. After harvesting, grains ear⁻¹ were recorded by counting grains in three ears randomly selected in each subplot and then averaged. After shelling the ears, thousand grains were selected randomly to record thousand grain-weights with the help of electronic balance form the produce of each subplot. Grain yield was recorded with the help of a spring balance after shelling all the ears harvested from the central four

rows in each subplot. Grain yield thus obtained was then converted into kg ha⁻¹. Data on biological yield were also recorded from the whole biological matter harvested from the four central rows in each subplot at maturity. After harvest, the plants were sun dried and weighed using spring balance for calculating biological yield. Biological yield per sub plot was then converted into kg ha⁻¹. Data were analyzed using a computer base statistical package “statistics (8.1)” [11] and the significant differences among the treatments were determined using least significant difference (LSD) test.

Weather data for the maize growing period



Results and discussion

Plant height (cm)

Significant differences were observed in average plant height of maize hybrids sown on various sowing dates; however, maize hybrids were not different from each in plant height. Data showed maximum plant height of maize sown on 15th June (232 cm) while minimum plant height was noted in maize sown on 30th June (185 cm). The

possible reason could be that the early June sown crop had longer growth period to avail while end of June sown crop had shorter period for growth and therefore, taller and shorter plants were recorded in early and late sowing dates, respectively. Similar results were reported by [12-14] who stated that plant height was reduced by delayed sowing. [13, 15, 16] found that maize plant height was affected by the

sowing date, but in their trials taller plants were obtained in the plots sown both on the earliest and late sowing dates.

Number of ears m^{-2}

Data regarding ear m^{-2} are presented in Table 1. Statistical analysis of the data revealed that ears m^{-2} were significantly affected by maize hybrids, while sowing dates and the interaction of sowing dates and hybrids showed no effect on ears m^{-2} . Mean values showed that higher number of 7 ears m^{-2} were produced by PIONEER-30K08 followed by MALKA-TS-1105 with 5.9 ears while the minimum number of 4.8 ears m^{-2} was recorded in CS 200. [11, 12] reported significant differences among the maize hybrids for ears m^{-2} . The possible reason is might be the genetic makeup of the maize hybrids that affected number of ears m^{-2} .

Number of grains ear^{-1}

Data regarding number of grains ear^{-1} are presented in Table 1. Statistical analysis of the data revealed that number of grains ear^{-1} was significantly affected by the sowing

dates and hybrids. The interaction of sowing dates and hybrids for grains ear^{-1} was non-significant. Data showed that higher number of grains ear^{-1} (563) was recorded when crop was sown on 15th June followed by at par value of 560 grains ear^{-1} recorded in the June 15th sown crop while minimum number of 460 grains ear^{-1} was noticed in maize sown on 30th June. [15, 17] found that delayed sowing of maize caused decrease in grain number and weight. The reason could be that the early sown crop got optimum growing period while the late crop got a shorter and cooler growing period which probably affected the process of fertilization and grain formation in the crop [13, 17]. Among the hybrids, MALKA-TS-1105 produced maximum number of 554 grains ear^{-1} followed by PIONEER-30K08 with at par number of 534 grains ear^{-1} , while significantly smaller number of 491 grains ear^{-1} was recorded by CS 200. Differences in grains ear^{-1} of the hybrids could be attributed to the genetic potential of the hybrids.

Table 1. Plant height, ears m^{-2} and grains ear^{-1} of maize hybrids as affected by various sowing Dates

Treatment	Plant height (cm)	Ears m^{-2}	Grains ear^{-1}
Sowing Date (SD)			
1 st June	211 b	5.7	560 a
15 th June	232 a	6.1	563 a
30 th June	185 c	5.8	460 b
LSD (0.05)	12.0	ns	62.6
Hybrid (H)			
CS 200	213	4.8 c	491 b
PIONEER-30K08	203	7.0 a	534 a
MALKA.TS.1105	212	5.9 b	554 a
LSD (0.05)	ns	0.7	40.1
Interaction (SD X H)	ns	ns	Ns

Means in the same category followed by different letters are significantly different at $P \leq 0.05$ level. ns = non-significant

Thousand grain weight (g)

Statistical analysis of the data showed that 1000-grains weight was significantly

affected by maize hybrids while sowing Dates showed no effect on 1000-grains weight. The interaction of maize hybrids

and sowing Dates was found significant for 1000-grains weight. Optimum 1000-grain weight of 460 g was produced the CS 200, while PIONEER-30K08 and MALKA-TS-1105 produced 400 g and 370 g 1000-grain weights which both were at par with each other. [13, 14, 18] reported significant differences among maize hybrids for thousand grains weight. The interaction of sowing dates and maize hybrids for 1000-grain weight was also found significant at 5% level of probability. It was noted that

1000-grain weight of MALKA-TS-1105 was the lowest (340 g) when sown on June 15th, which increased and boosted to 390 g when sown on June 15th and June 30th. Thousand grain weight of PIONEER-30K08 was stable i.e. 400, 390 and 400 g when sown on June 1st, 15th and 30th respectively. CS 200, on the other hand, produced 540 g 1000 grains weight when sown on 1st June which reduced to 440 g and again to 400 g when sown on June 15th and 30th, respectively (Figure 1).

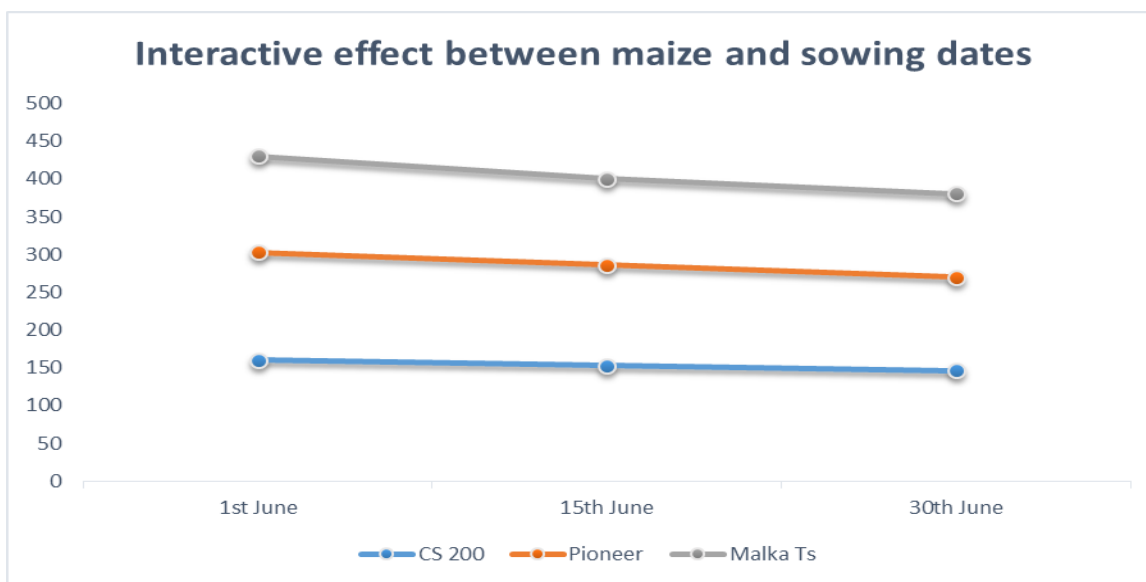


Figure 1. Interactive effect between Maize and sowing Dates

Grain yield (kg ha⁻¹)

Data regarding grain yield of maize hybrids as affected by sowing dates are presented in Table 2. Statistical analysis of the data revealed that grain yield was significantly affected by sowing dates. Maize hybrids also differed significantly from each other while the interaction effect of sowing dates and hybrids for grain yield was non-significant. Crop sown on 15th June showed grain yield (9010 kg ha⁻¹) followed by at par grain yield of 7820 kg ha⁻¹ produced by the crop sown on June 15th. Minimum and significantly smaller grain yield (6060 kg ha⁻¹) was obtained by maize sown on 30th June. Similar results were also obtained by

Gill and Mian [19] who reported that late sowing decreased grain yield. [20, 21] reported that higher grain yields were generally obtained when planting was completed by early May, while yield declined as planting was delayed. Reason for this variation in yield could be the longer growth period and comparatively mild temperature during the grain formation period. Among the maize hybrids, significantly larger grain yield (8343 kg ha⁻¹) was produced by PIONEER-30K08. CS 200 and MALKA-TS-1105 produced smaller and at par grain yields of 7415 and 7119 kg ha⁻¹, respectively. It showed the genetic superiority of the PIONEER-30K08

over CS 200 and MALKA-TS-1105 to produce higher grain yield. Among the yield components, ears m^{-2} and grains ear^{-1} , probably contributed largely to the higher grain yield of the PIONEER-30K08.

Biological yield ($kg\ ha^{-1}$)

Data regarding biological yield of maize hybrids affected by sowing dates are presented in Table 2. Statistical analysis of the data revealed that biological yield was significantly affected by the sowing dates. Significant differences were noted among the maize hybrids in biological yield. The interaction effect of sowing dates and hybrids for the biological yield of hybrids was found non-significant. Data in Table 2 shows that at par biological yields of 25055

and 23240 $kg\ ha^{-1}$ were produced by the maize crop sown on 1st and 15th June while minimum biological yield (15972 $kg\ ha^{-1}$) was obtained by maize sown on 30th June. [16, 22] observed decrease in above ground biomass when planting date was delayed from early March to mid-May in three different maturity groups of corn hybrids. Among the maize hybrids, at par biological yields of 22129 and 21907 $kg\ ha^{-1}$ were produced by PIONEER-30K08 and CS 200 while significantly lower biological yield of 20231 $kg\ ha^{-1}$ was obtained from MALKA-TS-1105. Higher biological yield of PIONEER-30K08 might be due to higher grain yield produced by the hybrid.

Table 2. Thousand grains weight (g), grain yield and biological yield of maize hybrids as affected by various sowing Dates

Treatment	1000 grains weight (g)	Grain yield ($kg\ ha^{-1}$)	Biological yield ($kg\ ha^{-1}$)
Sowing date (SD)			
1 st June	430	7820 a	25055 a
15 th June	410	9010 a	23240 a
30 th June	400	6060 b	15972 b
LSD (0.05)	ns	1304	3290
Hybrid (H)			
CS 200	460 a	7415 b	21907 a
PIONEER-30K08	400 b	8343 a	22129 a
MALKA-TS-1105	370 b	7119 b	20231 b
LSD (0.05)	40.2	888.1	1338
Interaction (SD X H)	*	ns	ns

Means in the same category followed by different letters are significantly different at $P \leq 0.05$ level. ns = non-significant

Conclusion and recommendations

It was concluded that among the hybrids PIONEER-30K08 produced significantly higher grain and biological yields followed by CS 200 and MALKA-TS-1105. Similarly, higher grain and biological yields were obtained when sowing was carried out on either 1st or 15th June as compared with 30th June. Therefore, on the basis of higher grain yield, among the tested hybrids PIONEER-30K08 is recommended for sowing on either June 1st or 15th of maize

under the agro-ecological zone of Swat valley.

Authors' contributions

Design the experiment, data collection and analysis: Imran, AA Khan & S Shah, Technical help and revision of the manuscript: I Hussain, H Zada & I Ullah, Downloaded the related review, data collection and interpretation of the data: S Naveed, S Din & A Rahman, Wrote the paper: Imran.

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