Effect of Sowing Dates on Growth, Yield and Grain Quality of Hybrid Maize

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Abstract: This study was conducted during 2013-14 at Student Farm, Department of Agronomy, Faculty of Crop Production, Sindh Agriculture University, Tandojam. The experiment was laid out in Randomized Complete Block Design (factorial) with three replications having net plot size 3x4m=(12m^2). The effect of three sowing dates 25th October, 10th November and 25th November on three hybrid maize varieties Pioneer 1543, Syngenta 4841 and Monsanto DK-6142 was studied. Yield components and grain quality parameters such as plant height, number of cobs per plant, cob length, grains per cob, grain yield, protein, starch and oil content of maize varieties were significantly affected by different sowing dates. It was concluded from the finding of present research work that all quantity and quality traits were promising when the sowing was completed up to 25th October. Further delay of the sowing had negative effects on the performance of quantity and quality of maize. Hybrid maize variety Pioneer 1543 was promising variety which gave the grain yield more than 8312 kg ha^{-1}.

Keywords: Maize (*Zea mays* L.), hybrid, sowing dates, grain yield.

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop after wheat and rice. It is grown extensively in temperate, tropical and sub-tropical regions of the world. Maize grain is valuable source of protein (10.4%), fat (4.5%), starch (71.8%), vitamins and minerals like calcium, phosphorous and sulfur [1]. It also provides raw materials to starch industry and is used in the preparation of many products. In Pakistan, maize was cultivated on an area of 981 ha with a total production of 3658 tones and an average yield is3805 kg ha^{-1}, while during the same season its area of cultivation and production in Khyber Pakhtunkhwa was 512 ha with1468 tones and average yield of maize crop was 1751 kg ha^{-1} during the reported year [2]. Planting date and variety selection, including soil fertility, temperature regimes and irrigation are the major factors affecting maize production [3]. For optimization of yield, planting at the appropriate time is very critical as delay in planting date can lead to a linear decrease in grain yields [4]. They further contended that early planting in the spring is optimum and more efficient than delayed planting as through early planting germination occur when days are longer and the sun shines impact is more by way of an acute angel; whereas delaying planting date results in a decrease in maize grain yields. Farmer's choice on improved varieties is one of the most crucial factors affecting the productivity of a crop [5]. High yielding varieties are of primary importance for potential yield positively. Yield can be increased to a greater extent through high yielding varieties and appropriate time of planting**,** with advanced agronomic practices [6]. Therefore, it was felt necessary; to conduct an experiment for determination the appropriate time of planting of newly introduced maize hybrids and their performance under Tandojam climatic and soil conditions.

MATERIALS AND METHODS

The proposed research study was conducted at Student Farm, Department of Agronomy, Faculty of Crop Production, Sindh Agriculture University Tandojam, Sindh province of Pakistan located at 26.1o N 68.5o E latitude. Soil analysis is given in Table **1**. The average monthly weather data at the study site Tandojam District Hyderabad, Sindh, Pakistan during cropping season is presented in Figure **1**.

Table 1: Soil Texture and Chemical Analysis of Soil

Physico-chemical Properties	Value
Texture	Silt clay loam
pH (1:5 soil water extract)	7.60
EC	0.98 dS m^{-1}
Calcium carbonate	14.00 %
Organic matter	0.75 %
Total N	0.05 %
AB-DTPA extractable phosphorus	3.12 mg kg^{-1}
AB-DTPA extractable Potassium	140.0 mg kg^{-1}

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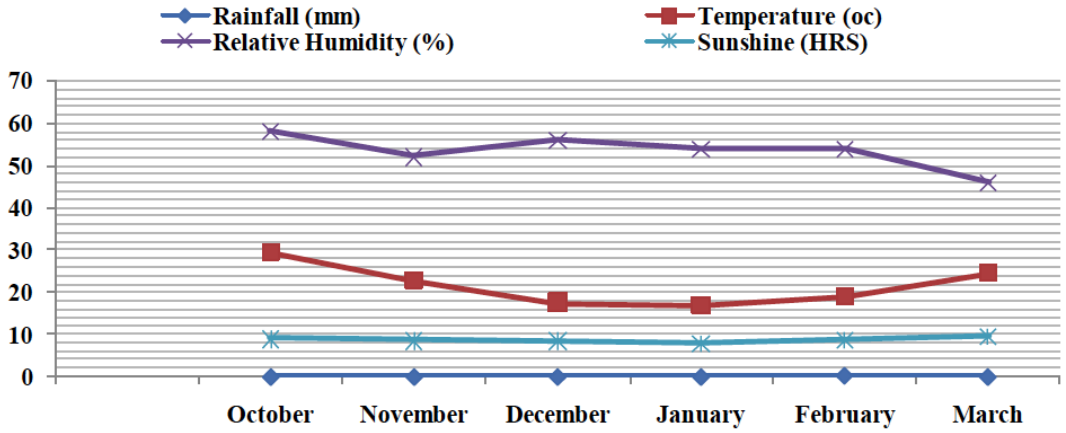

Figure 1: The average monthly weather data at the study site Tandojam District Hyderabad, Sindh, Pakistan during cropping season (2013-14).

The experiment was laid out in Randomized Complete Block Design (factorial) with three replications having net plot size 3 x 4m=(12m^2). Three hybrid maize varieties (Pioneer 1543, Syngenta 4841 and Monsanto DK-6142) were investigated to evaluate the grain yield and their quality traits under various sowing dates (25th October, 10th November and 25th November).

Methodology for Quantitative and Qualitative Traits of Hybrid Maize

Plant height of five randomly selected plants per plot was recorded by using measuring tape from ground to tip of the tassels and total cobs from ten randomly selected plants were counted at the time of maturity. Plant height and cob length at maturity of the maize crop was measured in centimeters with measuring tape and averaged. Grains in the ten cobs were counted after they had been shelled and were divided by the number of cobs. All grains received from each plot were weighed and on the basis of grain yield per plot, grain yield ha^{-1} was calculated in kilograms.

Nitrogen content of maize grain samples, randomly selected from each sub-plot was determined by using microkjeldhal method (Anonymous, 1995) and then the crude protein content was calculated by using the formula i.e. Crude protein = Nitrogen x 6.25. Whereas grain starch content was determined by using the method given by [7] and oil content was determined by Soxhlet method [8].

Recommended dose of 120 kg ha^{-1} nitrogen in the form of urea, 60 kg ha^{-1} of Phosphorous in the form of single super phosphate and 60 ha^{-1} of potash as sulphate of potash was applied to the crop. All P, K and half of N was incorporated in the soil during final seed bed preparation, while remaining N was applied in two equal splits at different growth stages as per crop requirements.

Experimental data was analyzed by using Statistics 8.1 software. To compare treatment means LSD test was applied.

RESULTS AND DISCUSSION

Plant height of various hybrid maize varieties varied significantly due to sowing dates (Figure **2**), where maximum height plant^{-1} (247.0 cm) was noted in Monsanto DK-6142 sown on 25th October which confirms the findings of [9]. The early sowing had significant effect on plant stature, where plants with increased height were obtained by sowing maize earlier as compared to late planting.[10]. Not only

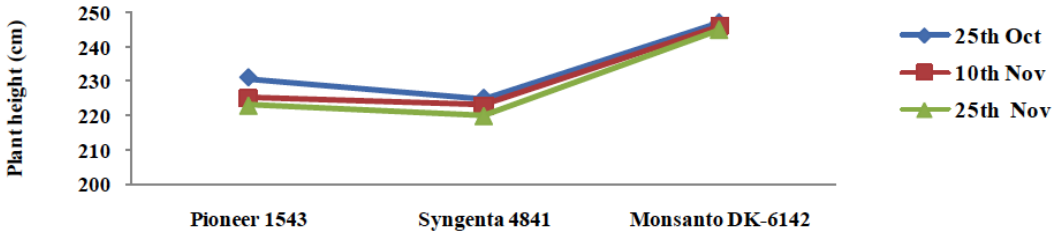

Figure 2: Plant height (cm) of maize varieties as affected by sowing dates.

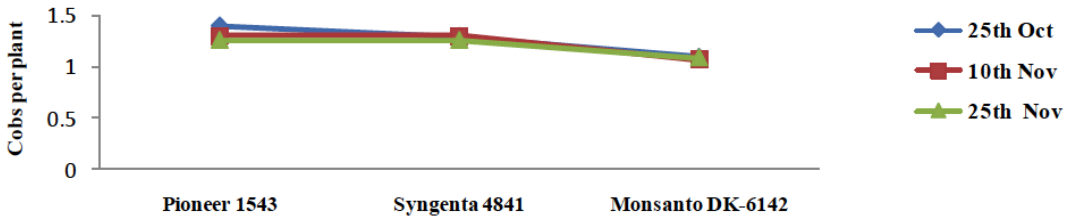

Figure 3: Cobs per plant of maize varieties as affected by sowing dates.

sowing dates but there is great variation among hybrids and the results suggested that the Monsanto DK-6142 is genetically taller growing variety.

In this study sowing dates significantly affected number of cobs plant^{-1} of various maize varieties (Figure **3**). The maximum number of cobs plant^{-1} (1.4) was recorded in Pioneer 1543 sown on 25th October and was relatively better bearing number of cobs plant^{-1} than rest of varieties. However, the minimum number of cobs plant^{-1} (1.1) was observed in the interaction of 10th November x Monsanto DK-6142. The early optimum sowing date produced maximum number of cobs plant^{-1} than late sowing. Short season hybrids can be planted early without damaging effects on their maximum yield potential and can also be minimize the risk of obtaining immature cobs and grains or sustaining early frost damage [11]. 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} [12, 13].

A significant influence of sowing dates was observed on cob length of various maize varieties. Maximum cob length (25.8 cm) was noted in Pioneer 1543 sown on 25th October. However, the lowest cob length (11.5 cm) was observed in Monsanto DK-6142 grown on 25th Nov. It is observed that hybrid maize variety Pioneer 1543 formed genetically maximum cob length than other varieties (Figure **4**). The findings indicate that the optimum sowing date also resulted remarkably improved cob length. This might be due to appropriate time of sowing; as according to findings of [14] delay planting reduces kernel weight, kernel number ofcob1 and cob length.

A significant variation in grains per cob of maize varieties and sowing dates was observed; the hybrid maize variety Pioneer1543 proved to be most superior in bearing number of grain per cob. Moreover, positive effects of sowing date of 25th October on grains per cob were also witnessed (Figure **5**). The findings are supported by [15] who reported that delaying planting would lead to a lesser row number and slighter grain number in the rows.

Environmental changes associated with different sowing dates (sunshine & temperature) have a modifying effect on growth and development of maize plants. Each hybrid has an optimum sowing date, and the greater the variation from this optimum (early or late sowing), greater yield the loss [16]. In current studies, it was observed that maize hybrids gave highest grain yields, when planted in the fourth week of October;. Accordingly the sowing was delayed the reduction in crop yield become substantial. In case of maize varieties, the highest grain yield (8312.1 kg ha^{-1})

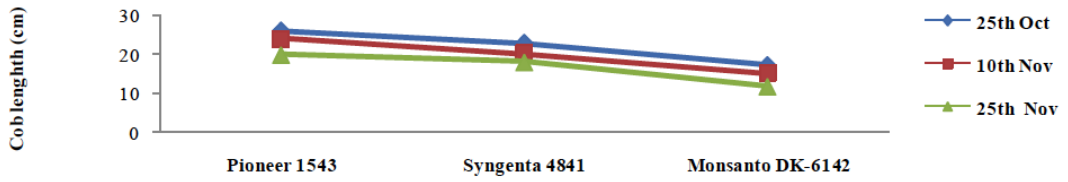

Figure 4: Cob length (cm) of maize varieties as affected by sowing dates.

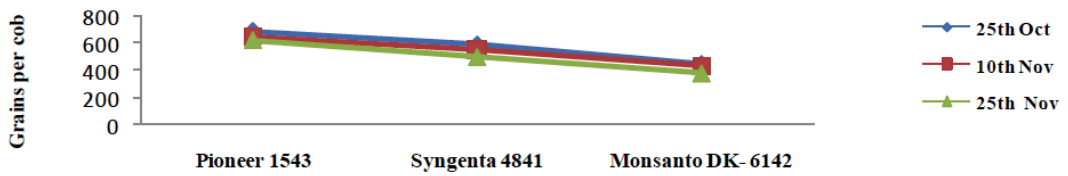

Figure 5: Grains per cob of maize varieties as affected by sowing dates.

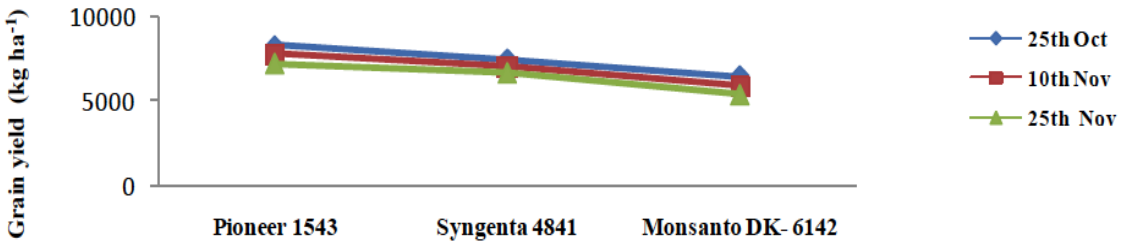

Figure 6: Grains yield (kg ha^{-1}) of maize varieties as affected by sowing dates.

was obtained from Pioneer 1543, which may be due to it's genetically superiority over the rest of varieties (Figure **6**). For optimization of yield, planting high yielding hybrids at the appropriate time is very critical. Our findings are in agreement with the findings of [4, 15] according to whom the yield can be increased to a greater extent provided high yielding varieties are identified and planted at suitable time.

Protein is an important quality component and source of nutritional feed for human and animal feeding as well as its use in the industries. The protein content affected by sowing dates was very different. Protein content was decreased by late sowing, while it was significantly higher in case of early sowing. The results are in line with the findings of [17]. In this study, Pioneer 1543 had maximum protein content (7.7%) whereas, from variety Monsanto DK-6142 minimum protein 5.5% was obtained (Figure **7**).

Like protein Starch is also a main quality component which contented huge amount of carbohydrates in hybrid maize. Increase or decrease in starch content of maize mainly depends on the combination of factors, such as number of grains cob1, weight of grain cob1 and grain yield ha1. A significant variation in starch content of different hybrid maize varieties was observed under various sowing dates. Maximum starch content (73.0%) was found in Pioneer 1543 sown on 25th October. However, minimum starch (55.7%) was noted in Monsanto DK- 6142 25th sown on November (Figure **8**). This indicates that the delaying sowing of maize after 25th October resulting decreased quantity and quality of hybrid maize grains. Variation in starch content of different varieties are quite in line with the findings of [18, 19] who reported that significant genetic differences existed among maize hybrids for crude starch content in grains.

Hybrid maize varieties sown on different sowing dates showed significant variation for oil content (Figure **9**). Maximum oil content (4.3%) was observed from Pioneer1543 sown on 25th October. However, the lowest oil content was determined (3.2%) in variety

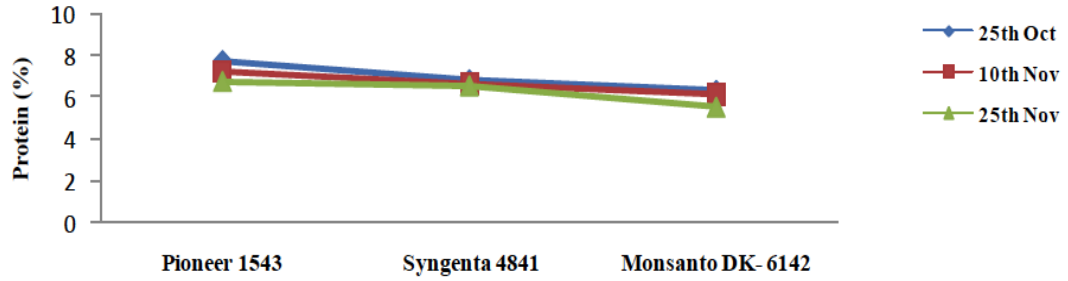

Figure 7: Protein (%) of maize varieties as affected by sowing dates.

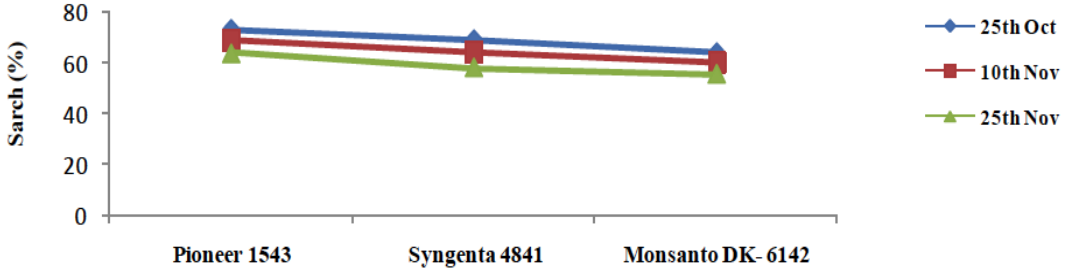

Figure 8: Starch (%) of maize varieties as affected by sowing dates.

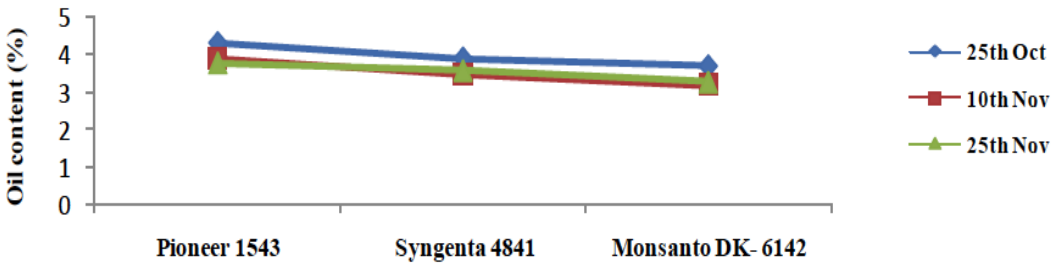

Figure 9: Oil content (%) of maize varieties as affected by sowing dates.

Monsanto DK-6142 sown on 25th November. Our findings are in contradiction to the findings of [20] who observed no significant effect of growing season on the oil content of the 12 single-cross maize hybrids studied in their research.

CONCLUSIONS

It was concluded from the findings of present research work that all quantitative/qualitative traits were promising, when the sowing of hybrid maize crop was completed up to 25th October; delay of the sowing adversely affected yield components which ultimately caused a significant decline in grain yield ha^{-1}. Moreover, Pioneer 1543 was proved to be superior to other hybrids in the sense of all quantity and quality contributing factors followed by Syngenta 4841 and Monsanto DK-6142. It is therefore, suggested that hybrid maize Pioneer 1543 and 25th October may be preferred for sowing to obtain higher grain yields with better quality.

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REFERENCES

[1] Shah SR. Effect of seed priming on yield and yield components of maize. M.Sc. (Hons.) Thesis Deptt. of Agron. KP Agric. Univ., Peshawar, Pakistan 2007; pp. 1-73.

[2] MINFA. Ministry of Food and Agriculture, Agriculture Statistics of Pakistan. Govt. of Pak, Economic Wing, Islamabad 2011.

[3] Ramankutty N, Foley JA, Norman J, McSweeney K. The global distribution of cultivable lands: Current patterns and sensitivity to possible climate change. Global Ecology Biogeogr 2002; 13(11): 377-392. http://dx.doi.org/10.1046/j.1466-822x.2002.00294.x

[4] Anapalli SS, Ma L, Nielsen DC, Vigil MF, Ahuja LR. Simulating planting date effects on corn production using RZWQM and CERES-Maize models. Agronomy J 2005; 17(97): 58-71.

[5] Tolera A, Berg T, Sundstol F. The effect of variety on maize grain and crop residues yield and nutritive value of the stover. J Animal feed Sci Tech 1999; 79(3): 165-177.

[6] Qureshi AS, Qadir M, Heydari N, Turral H, Javadi A. A review of management strategies for salt-prone land and water resources in Iran.International water management Institute. 30P (IWMI working paper 125) Colombo, Sri Lanka 2007.

[7] Juliano BO. A simplified assay for maize analysis. Cereal Sci Today 1991; 16(2): 334-340.

[8] Low NH. Food analysis, 417/717 Laboratory Manual, Deptt. of Microbiology and Food Science, Univ. of Saskatchewn, Canada, 1990; pp. 37-38.

[9] Sarvari M, Molnar Z, Hallof N. Influence of different sowing time and nutrient supply on the productivity of maize hybrids. Analele University din Oradea, Department of Plant Production and Applied Ecology 2007; 4(12): 134-141.

[10] Abdel-Rahman AM, Magboul EL, Nour AE. Effects of sowing date and cultivar on yield and yield components of maize in Northern Sudan. 7th Eastern and Southern Africa Regional Maize Conference, Nairobi, Kenya, 11-15 Feb, 2001; pp. 295-298.

[11] Hicks DR, Harrington JD, Mcgahen JH. Maximizing the advantages of early corn planting. National Corn Handbook, Crop Management. Purdue University Cooperative Extension Service. West Lafayette, Indiana. NCH-35 1993.

[12] Saleem AR, Saleem U, Subhani GM. Correlation and Path coefficient analysis in maize (*Zea mays* L.). J Agric Res 2007; 45(3): 177-183.

[13] Vasic N, Ivanovic M, Peternelli LA, Jockovic D, Stojakovic M, Bocanski J. Genetic relationship between grain yield and yield components in a synthetic maize population and their implications in selection. Acta Agronomica Hungarica 2001; 49(4): 337-342. http://dx.doi.org/10.1556/AAgr.49.2001.4.4

[14] Maryam AB, Saied KK, Habib SS, Mandana D, Khodadad M, Golbashy M. A study on effects of planting dates on growth and yield of 18 corn hybrids (*Zea mays* L.). Am J Exp Agric 2011; 1(3): 110-120. http://dx.doi.org/10.9734/AJEA/2011/339

[15] Khan ZH, Khalil SK, Nigar S, Khalil I, Haq I, Ahmad I, Ali A, Khan MY. Phenology and yield of sweet corn landraces influenced by planting dates. Sarhad J Agric 2009; 25(2): 153-157.

[16] Berzsenyi Z, Lap DQ. Effect of sowing time and N fertilisation on the yield and yield stability of maize (*Zea mays* L.) hybrids between 1991–2000. Acta Agronomica Hungarica 2001; 50: 309-331.

[17] OnurKoca Y, Canavar Ö. The effect of sowing date on yield and yield components and seed quality of corn (Zea mays L.). Scientific Papers. Series A. Agronomy 2014; Vol. LVII, ISSN 2285-5824, 227-231.

[18] Letchworth MB, Lambert RJ. Pollen parent effects on oil, protein and starch concentration in maize kernels. Crop Sci 1998; 38(2): 363-367. http://dx.doi.org/10.2135/cropsci1998.0011183X003800020015x

[19] Munamava MR, Goggi AS, Pollak L. Seed quality of maize inbred lines with different composition and genetic backgrounds. Crop Sci 2006; (44): 542-548.

[20] Gyenes-Hegyi, Pók Z, Kizmus I, Zsubori L, Nagy Z, Marton ELC. Plant height and height of the main ear in maize (Zea mays L.) at different locations and different plant densities. ActaAgr. Hungarica 2002; 50(1): 75-84.

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