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OPTIMIZING MAIZE SOWING WINDOWS FOR IMPROVED PRODUCTIVITY UNDER THE AGRO-CLIMATIC CONDITIONS OF MOHMAND AGENCY, PAKISTAN

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KEYWORDS	ABSTRACT
Maize, sowing dates, agro-climatic condition	The experiment was conducted to evaluate the performance of different varieties of maize sown on different time under the agro-climatic conditions of Mohmand Agency Ghazi Beg Kaly FATA (Federal Administrated Tribal Area) during summer 2015. The experiment was laid out in Randomized Complete Block Design (RCBD) having three replications and ten maize varieties including open pollinated and hybrids i.e. Iqbal, Azam, Jalal, Babar, SB-989, SB-909, SB-292, CS-200, CS-220, and W-888. The crops was grown on five sowing dates i.e. 1 June, 10 June, 22 July, 3 July and 13 July. Data on plant height, biological yield and grain yield were recorded the results showed that there were significant variations in yield among different varieties as well as different time. It was noted that early sowing significantly affected all parameters. Tallest plant (259 cm), maximum biological yield (35874 kg ha⁻¹) and maximum grain yield (4937 kg ha⁻¹) were recorded when the crop was grown on June 1. Early sowing is recommended for obtaining higher grain yield. In case of varieties, SB-909 produced maximum grain yield of 4666 kg ha⁻¹. Based on the results, it was concluded that grown early (First week of June) performed better under the agro-climatic condition of Mohmand Agency while delayed sowing may not be suitable.
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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 (Nelson and Sommer, 1982). 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 is 3805 kg ha⁻¹, while during the same season, its area of cultivation and production in Khyber Pakhtunkhwa was 512 ha with 1468 tones and average yield of maize crop was 1751 kg ha⁻¹ during the reported year (Hardman and Gunsolus 2002). Planting date and variety selection, including soil fertility, temperature regimes and irrigation are the major factors affecting maize production Muchow, 1989). 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 (Ali et al., 2015). They further reported that early planting in the spring is optimum and more efficient than delayed planting as through early planting germination occurs when days are longer and the sun shines impact is more by way of an acute angle; 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 (Ramankutty et al., 2002). 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 (MINFA. 2011). The climate of Pakistan is uneven and almost two third of the country demonstrate arid type climate. A narrow belt of sub mountainous regions illustrate humid climate. Most of the regions in central and southern Pakistan are tremendously arid, while the northern part of the country is humid except the extreme northern mountains which are relatively dry. The mountainous region composed with lofty hills in the northern and northeastern sides experience the type of climate having similarities with temperate climate and some areas in the south experience an arid and semi-arid climate with low precipitation and high temperature (Blake, and Hartge., 1986).

The Agriculture in Pakistan depends upon water from rainfall and also melting of ice and snow and glacier ice. Monsoon is the foremost source which recharges moisture to the soil in Potohar region. The area lies between 33.00° N to 36.00° N experience semi-arid to humid climate where crop may be growing successfully. Temperature is increasing beyond its normal limits due to natural processes and also because of non-environment friendly human activities. High temperature may have negative effect on the production of crop. From sowing to wax maturity stages, water is the basic requirement of the plant after wax maturity stage there is no need of water to the plant for its growth. Climate change is influencing the socio-economic conditions particularly the population relying on agriculture. Pakistan also faces the problems like glacier melting, flash flood, drought, rising heat index and insufficient water for crops. Crop water requirement mainly depends upon climatic factor such as Air temperature, solar radiation, relative humidity, wind speed and agronomic factors like stages of the crop (Naheed, G. and Mahmood, A., 2009).

Life cycle of maize crop depends much upon water availability, the water deficit at any phonological stage i.e. vegetative, reproductive and maturity stages have different response and can damage the grain yield (Beiragi, 2011). Drought is harmful for crop growth and development. In simple words, drought is the lack of water availability. Drought stress also damages the grain yield when it occurs at reproductive stage of crop's life cycle (Ghazala N, and Arif M, 2009). During stem elongation, the development and growth of leaves and stem is so rapid that it requires sufficient amount of water, the water stress at that stage can reduce the height of plant and also affects the leaf of plant (Muchow, 1989). The most crucial time of water stress in maize crop is ten to fifteen days before and after flowering. At this stage if the water deficit occurs then the grain yield decrease two to three times more than the water deficit in another growing stage (Cakir R, 2004). Therefore, it was felt necessary; to conduct an experiment for determination of appropriate time of planting of newly introduced maize hybrids and their performance under the agro-climatic condition of Mohmand Agency and soil.

Materials and Methods

Description of the Study Area

The field experiment was conducted at Mohmand Agency Ghazi Beg Kaly (FATA, Federal Administrated Tribal Area). The site was selected on the main road about 5 kilometers away from Ghalanai, Agency head quarter. The physic-chemical properties of the site are given in Table 1. It lies between $34^{\circ} 10'$ to $34^{\circ} 43'$ north latitudes and $70^{\circ} 58'$ to $71^{\circ} 42'$ east longitudes. The climate in Mohmand agency is hot in summer season while cool in winter. The summer season commences from May and continues for 4 months till 31st August. The winter season starts from November and continue till February. The rainfall is scanty. Most of the rainfall is during winter season. The main agricultural areas in the valleys of Mohmand receive about 100 mm of average rainfall per annum. (travelguide.pk)

Soil Analysis

Soilsamples were collected at a depth of 0-15 cm with the help of soil auger from Mohmand Agency Ghazi Beg Kaly FATA, from each sub plot. The parameters were determined by analytical procedures for soil texture (*Bouyocoushydrometer* method), bulk density,particle density (Azad et al., 2004), soil pH (Nelson and Sommers, 1982) , EC (Naheed and Mahmood, 2009), Lime content (Rhoades, et al., 1989) and Organic matter in soil samples by Walkley-Black procedures as described by (McCutcheon et al., 2001).

Plant analysis

Plant Height (cm)

At physiological maturity, plant heights were recorded for each subplot by randomly measuring 20 selected plants from the base of plant to the tip of tassel and average was recorded.

Fresh biomass (kg ha⁻¹)

Three rows were harvested and the fresh biomass including the cobs was weight and the data were converted to kg ha⁻¹.

Grain yield (kg ha⁻¹)

Three rows were harvested and cobs were weight. For moisture content three cobs randomly selected in 20 plants then dry the cobs in sun light and then remove the grains from shettal, and weighted with digital balance then convert the gram weight of grains into grain yield (kg ha⁻¹) through the following formula. The moisture content was deducted from the fresh grain weight.

$$\text{Grain yield} = \frac{\text{Grain yield per three rows}}{\text{No. of rows} \times \text{row length} \times \text{R-R distance}} \times 10000$$

Results and Discussions

Soils of the area are generally medium textured to clay-loam and are low in natural fertility, Nitrogen, organic matter and Phosphorus are deficient. The soils are having pH of 7.5 to 8.5.

Plant height (cm)

Data presented in [Table-2] showed that sowing dates, varieties and interaction between sowing dates and varieties had significant effect on plant height. The tallest plants of 261cm were recorded in V3 (SB-989) followed by V8 (AZAM) and V2 (CS-200), while the smallest plants (196 cm) were recorded in V9 (BABAR). This was due to the fact that plant height is a genetically controlled factor so the height of different varieties does not remain equal. These results are in accordance with the results of Ali (1994) who also reported difference of plant height in different maize varieties. Similarly tallest plants of 259 cm were recorded in SD1 (June ist) followed by SD2 (10 June) and SD5 (13 July) while the smallest plants of 200 cm were recorded in SD3 (22 June). The interaction effect of variety x sowing date on plant height was significant, indicating that varieties differed under different sowing dates [Fig. 1]. The tallest plant of 284 cm was recorded in V3 (SB-989) when sown on SD1 (1 June) followed by V3 (SB-989) and V5 (W-888) sown on SD2 (10th June) and SD1 (June ist) respectively, while smallest plant of 151 cm was recorded in V6 (JALAL) when sown on SD4 (3 July). The results is in the conformity of Beirigi et al.(2011) who reported that positive effect of sowing dates on plant height when sowing was delayed to June.

Biological yield

Data presented in [Table-3] showed that biological yield (kg ha⁻¹) was significantly affected by sowing dates and varieties as well as by interaction between the two. Significant differences were noted among the maize varieties in biological yield. Maximum biological yield of 32839 kg ha⁻¹ was recorded in V8 (AZAM) followed by V3 (SB-989) and V6 (JALAL), while minimum biological yield of 20644 kg ha⁻¹ was recorded in V4 (IQBAL). Similarly maximum biological

yield of 35874 kg ha⁻¹ was recorded from SD1 (1 June) followed by SD2 (10 June) and SD5 (13 July), while minimum biological yield of 21487 kg ha⁻¹ was recorded from SD3 (22 June). The interaction effect of variety x sowing date on biological yield was significant, indicating that varieties differed under different sowing dates (Fig. 2). Maximum biological yield of 46668 kg ha⁻¹ was recorded in V6 (JALAL) when sown on SD1 (1 June) followed by V8 (AZAM) sown on SD2 (10 June) and SD1 (1 June) respectively, while minimum biological yield of 10000 kg ha⁻¹ was recorded in V4 (IQBAL) when sown on SD4 (3rd July). Our results are in agreement with (Ali, Z, 1994) They reported that on the first and Second sowing dates (early sowing) due to larger growth period, the appropriate use of environmental factors affecting growth, increase of the dry matter in various parts of plants, biological yield enhanced.

Grain yield

Data presented in [Table-4] showed that grain yield (kg ha⁻¹) was significantly affected by sowing dates and varieties as well as by interaction between the two. Significant differences were noted among the maize varieties in grain yield. Maximum grain yield of 4666 kg ha⁻¹ was recorded in V7 (SB-909) followed by V6 (JALAL) and V10 (SB-292), while minimum grain yield of 3382 kg ha⁻¹ was recorded in V9 (BABAR). Variation in yield revealed a diverse genetic background of varieties tested in this study. These results are in line with those of (McCutcheon et al., 2001), who reported significant differences among maize cultivars for grain yield. Similarly, maximum grain yield of 4937 kg ha⁻¹ was recorded from SD (1 June) followed by SD5 (13 July) and SD2 (10 June), while minimum grain yield of 3209 kg ha⁻¹ was recorded from SD3 (June, 22). The interaction effect of variety x sowing date on grain yield was significant, indicating that varieties differed under different sowing dates (Fig. 3). Maximum grain yield of 5861 kg ha⁻¹ was recorded in V7 (SB-909) when sown on SD4 (3 July) followed by V1 (CS-220), while minimum grain yield of kg ha⁻¹ was recorded in V8 (AZAM) when sown on SD3 (June, 22) (Ali et al., 2015) also found a significant interaction effect of sowing dates and varieties for grain yield. These results are similar with the reports of (Chaudhry and Rasul, 2004, Kamara et al., 2009, Grant et al., 1989) they had noted considerable reduction in yield and yield components when sowing was delayed.

Conclusion

The results showed that delayed sowing significantly had a negative effect on grain yield. The most suitable planting time is early June i.e. SD1 has increase plant height, grain yield and biological yield as compare to late sowing. Therefore early sowing is recommended for obtaining higher grain yield. The variety V7 (SB-909) had given high grain yield as compare to other varieties. Therefore the variety SB-909 is recommended to be sown on June 1st is for obtaining higher yield.

Authors contributions to the manuscript:

Conceived and designed the experiments: Sardar Wali, Muhammad Jamal Khan, Rafiullah, and Naveed Hasham

Performed the experiments: Sardar Wali, Rafiullah, and Naveed Hasham

Analyzed the data: Sardar Wali, Muhammad Jamal Khan, Rafiullah

Contributed reagents/materials/analysis tools: Sardar Wali, Muhammad Jamal Khan, Rafiullah, and Naveed Hasham

Wrote the paper: Sardar Wali, Muhammad Jamal Khan and Rafiullah

Literature Cited

- Ali, S, Inamullah, A, Jan, M, Din, M, Habibullah, 2015. Yield response of maize (*Zea Mayz L.*) hybrids sown on various dates during kharif in Peshawar-Pakistan. *Journal of environment sciences*, vol.5, No.1
- Ali, Z. Studies on comparative economic returns of different maize genotypes. M.Sc. Thesis, Deptt. Agron. Agri. Univ. Faisalabad. 1994.
- Anapalli SS, L Ma, DC Nielsen, MF Vigil, LR Ahuja 2005. Simulating planting date effects on corn production using RZWQM and CERES-Maize models. *Agronomy J.* 17(97): 58-71
- Azad A., G. Nasrollahi, and Z. Bitarafan. 2012. Evaluation of different planting dates effect on three maize hybrids in Koohtasht region of Iran. *International journal of science and Advanced Technology*. 2 (3):2221-8386
- Beiragi MA, SK Khorasani, SH Shojaei, M Dadresan, K Mostafavi, A Golbashy 2011. Study on Planting Dates on Growth and Yield of 18 Corn Hybrids (*Zea mayz L.*). *American Journal of Experimental Agriculture*. 1(3):110-120.
- Blake, G. R., and K. H. Hartge. "14 Particle Density." (1986).
- Cakir R., 2004: Effect of water stress at different development stages on vegetative and reproductive growth of corn. *Field Crops Research* 89 (1), 1-16.
- Chaudhry QZ, G. Rasul, 2004. Agro-climatic classification of Pakistan, *science vision* (Vol. 9, No. -2 & 3-4), (July – Dec, 2003 & Jan – Jun, 2004), page 59
- Ghazala Naheed and Arif Mahmood, 2009: Water Requirement of Wheat Crop in Pakistan. *Pakistan Journal of Meteorology*. Vol. 8(15)
- Grant F.R., Jackson B. S, Kiniry J.R, Arkin G.F, 1989: Water deficit timing effects on yield components in maize. *Agronomy Journal* 81, 61-65
- Hardman L, J.L. Gunsolus 2002. Corn growth and development and management information for replant decisions. Accessed 14 July, 2005
Available: www.Extension.Umn.edu/distribution/cropsystems/DC5700.html
- Heisey PW, G.O Edmeades, (1999). Maize production in drought-stressed environments: technical options and research resource allocation, *World Maize Facts and Trends*.
<http://travelguide.pk/gallerycitiesfatamohmandagency.php>
- Kamara Y, F Ekeleme, D Chikoye, LO Omoigui 2009. Planting date and cultivar effects on grain yield in dryland corn production. *Agron. J.* 101:91-98

- McCutcheon, J., Siegrist, H. and Rzenwncki, P. Fair field, Licking, and Perry counties~ osu extension commercial corn hybrid side by side performance trials. Special circular Ohio agriculture research and development center.(2001). (179): 54-56.
- MINFA. 2011. Ministry of Food and Agriculture, Agriculture Statistics of Pakistan.Govt. Of Pak, Economic Wing, Islamabad.
- Muchow R. C., 1989: Comparative productivity of maize, sorghum and pearl millet in a semi-arid tropical environment. II Effects of water deficits. Field Crops Research 20 207-219.
- Naheed, G. and Mahmood, A., 2009. Water requirement of wheat crop in Pakistan. Pak. J. of Meteorology, 6(11), pp.89-97.
- Namakka A, IU. Abubakar, IA. Sadik, AI. Sharifai, AH. Hassas 2008. Effect of sowing date and nitrogen level on yield and yield components of two extra early maize varieties (*Zea mays* L.) in Sudan savanna of Nigeria. J. of Agric. and Bio.Sci.
- Nelson, D.W. and L.E. Sommers. 1982. Total carbon, organic carbon and organic matter. In: AL. Page (eds) Methods of soil analysis Parts 2. 2nd Ed. AM. Soc. Agron. Inc. Madison WI USA
- Qureshi AS, M Qadir, N Heydari, H Turrall, A Javadi 2007. 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.
- Ramankutty N, JA Foley, J Norman, K McSweeney 2002. The global distribution of cultivable lands: Current patterns and sensitivity to possible climate change. Global Ecology Biogeography, 13(11): 377-392.
- Richard, L.A. 1954. Diagnosis and improvement of saline and alkali soils. USDA handbook 60. Washington DC
- Rhoades, J.D., Manteghi, N.A., Shouse, P.J. and Alves, W.J., 1989. Estimating soil salinity from saturated soil-paste electrical conductivity. Soil Science Society of America Journal, 53(2), pp.428-433.
- Shah SR, 2007. Effect of seed priming on yield and yield components of maize. MSc. (Hons.). Thesis Dept. Argon. KP Agric. Univ., Peshawar, Pakistan; pp.1-73.
- Thomas, G. W. (1996). Soil pH and soil acidity. Methods of soil analysis. Part, 3, 475-490.
- Tolera A, T Berg, F Sundstol 1999. The effect of variety on maize grain and crop residues yield and nutritive value of the stover. J Animal feed Sci Tech. 79(3):165-177

Tables and Figures

Table-1 Physico-Chemical Analysis of Soil of experimental site Muhmand Agency Ghazi Beg.

Properties	Value with Units
Texture	Silt loam
Bulk density	1.18 g cm ⁻³
Particle density	2.23 g cm ⁻³
pH (1:5 soil water extract)	7.2
EC	0.6dS m ⁻¹

Lime	9.7 %
Organic matter	0.27 %
Total Nitrogen	0.05 %
AB-DTPA extractable phosphorus	0.99 ppm
Calcium	27.4 ppm
Magnesium	3.16 ppm
Iron	0.26 ppm
Manganese	1.35 ppm
Zinc	0.31 ppm
Copper	1.86 ppm

Table 2. Plant height of different maize varieties as affected by different sowing dates and varieties

Varieties	SD1	SD 2	SD 3	SD 4	SD 5	Mean
V1	252	207	223	223	221	225c
V 2	272	224	200	234	221	230bc
V 3	284	280	270	250	221	261a
V 4	272	212	192	170	212	212d
V 5	279	202	150	210	212	211d
V 6	272	230	212	150	212	215d
V 7	223	170	214	208	221	207d
V 8	272	250	192	240	222	236b
V 9	194	220	160	190	212	196e
V 10	272	240	180	231	220	229bc
Mean	259a	224b	200e	211d	218c	222

Mean followed by different letters in each category are significantly different using LSD at $P \leq 0.05$

Sowing dates (SD) = ***

Varieties (V) = ***

SD x V = ***

Table 3. Biological yield (kg ha^{-1}) of different maize varieties as affected by different sowing dates and varieties

Varieties	SD1	SD 2	SD 3	SD 4	SD 5	Mean
V 1	33334	27667	30389	30389	26723	29701 _c
V 2	30001	26667	26667	27701	26367	27481 _d
V 3	37556	38223	31667	20001	26090	30707 _b
V 4	33334	19367	15001	10001	25512	20643 _g
V 5	40001	21667	10001	18334	26678	23336 _f
V 6	46667	33334	31034	13334	27023	30279 _{bc}
V 7	40000	16667	23445	26667	27234	26803 _d
V 8	40112	43334	20001	34367	26378	32839 _a
V 9	20945	28334	13334	16723	24001	20668 _g
V 10	36778	23112	13334	24367	25034	24525 _e
Mean	35873 _a	27837 _b	21488 _e	22189 _d	26104 _c	26698

Mean followed by different letters in each category are significantly different using LSD at $P \leq 0.05$

Sowing dates (SD) = ***

Varieties (V) = ***

SD x V = ***

Table 4. Grain yield (kg ha^{-1}) of different maize varieties as affected by different sowing dates and varieties

Varieties	SD1	SD 2	SD 3	SD 4	SD 5	Mean
V 1	5691	2649	2756	4328	3955	3876 _c
V 2	5215	2215	2246	4418	4344	3688 _d
V 3	5153	4600	4450	1853	3853	3982 _c
V 4	4812	4238	3011	3063	4238	3873 _c
V 5	5461	4479	4864	3227	3530	4312 _b
V 6	4555	4156	4671	4420	4175	4396 _b
V 7	4148	4724	4149	5861	4446	4666 _a
V 8	5242	4721	1138	2823	4120	3609 _d
V 9	4346	4284	1353	2854	4077	3383 _e
V 10	4744	4953	3454	4124	4339	4323 _b
Mean	4937 _a	4102 _b	3209 _d	3697 _c	4108 _b	4011

Mean followed by different letters in each category are significantly different using LSD at $P \leq 0.05$

Sowing dates (SD) = ***

Varieties (V) = ***

SD x V = ***

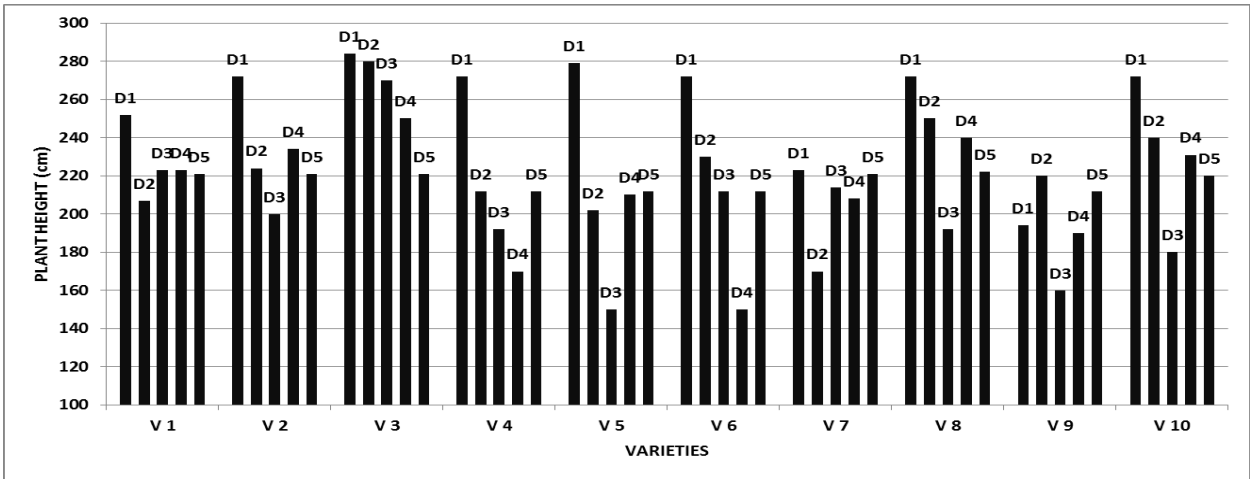


Fig.1 Interaction effect of varieties (V) and sowing dates (D) on plant height (cm) of different maize varieties.

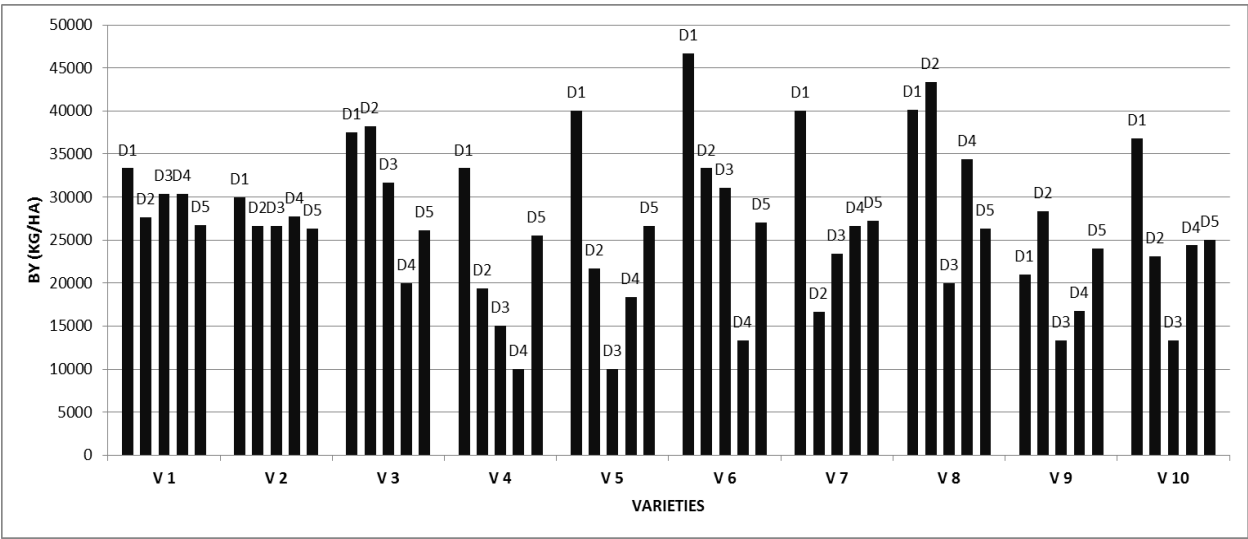


Fig.2 Interaction effect of varieties (V) and sowing dates (D) biological yield (kg ha⁻¹) of different maize varieties.

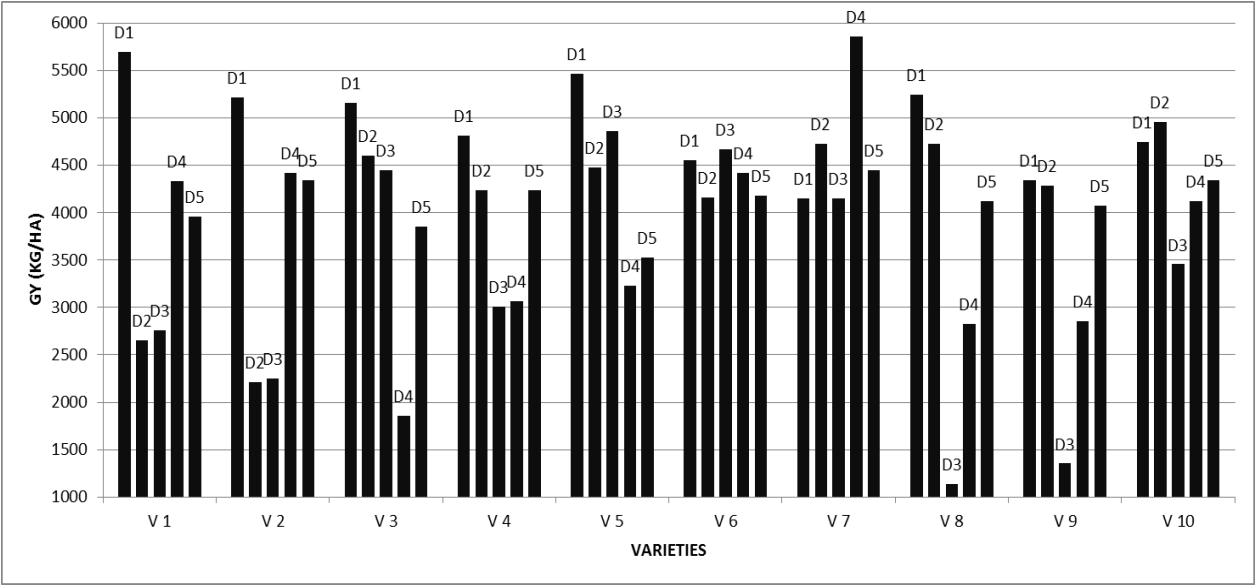


Fig. 3 Interaction effect of varieties (V) and sowing dates (D) grain yield (kg ha^{-1}) of different maize varieties.