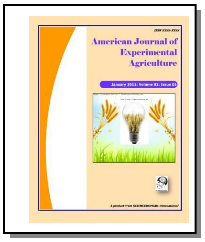

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A Study on Effects of Planting Dates on Growth and Yield of 18 Corn Hybrids (*Zea mays* L.)

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ABSTRACT

In this study 18 new corn varieties consist of 15 foreign early and mid-mature single cross hybrids and 3 Iranian commercial hybrids (KSC704, KSC647and DC370) were evaluated at two sowing date (5 and 20 June) based on RCBD with 3 replications at Khorasan Razavi Agricultural Research Centre, Mashhad, Iran on 2009. This study showed that among all hybrids, EXP1 (16.03 ton/ha) and OSSK617 (15.51 ton/ha) had the highest yields in early planting (5 June) and EXP1 (16.52 ton/ha) and KDC370 (16.22 ton/ha) produced the highest, yields in late planting (20 June). Results of this experiment also indicated that yield component such as 300 kernel weight, kernel no. per row, kernel depth and ear length were adversely affected in delay planting condition. Delay planting reduced 300- kernel weight, kernel no. per row, kernel depth and ear length. Results of cluster analysis using Wards' method divided the corn hybrids into 4 different clusters (low intra-group and high extra-group similarities). From the results of cluster analysis it is recommended to make crosses among genotypes in Clus1 (ZP434, BC582 and EXP2 hybrids) and Clus4 (ZP684, SIMON and KSC647) in breeding programmes. Classifying genotypes according to their agronomic traits with sophisticated multivariate techniques could reduce the time period and expenditure for crop improvement.

Keywords: Maize, planting date, combined analysis, cluster analysis;

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1. INTRODUCTION

Maize (*Zea mays* L.) an important cereal crop, cultivated throughout the world, is of significant importance for countries like Iran, where rapid increase in population have already out stripped the available food supplies (Golbashy et al., 2010). Genetic improvement in traits of economic importance along with maintaining sufficient amount of variability is always the desired objective in maize breeding programs (Hallauer et al., 1973). Grzesiak (2001) observed considerable genotypic variability among various maize genotypes for different traits. Ihsan et al. (2005) also reported significant genetic differences for morphological parameter for maize genotypes. This variability is a key to crop improvement (Welsh, 1981). Environmental changes associated with different sowing dates (sunshine, temperature) have a modifying effect on the growth and development of maize plants. Each hybrid has an optimum sowing date, and the greater the deviation from this optimum (early or late sowing), the greater the yield loss (Sárvári and Futó, 2000; Berzsenyi and Lap, 2001). Planting date was reported to affect the growth and yield of maize significantly. To date, the challenge for maize growers is finding the narrow window between planting too early and planting too late (Nielson et al., 2002). Farmers who plant maize early are concerned about frost, poor emergence and early plant growth. On the other hand, farmers who plant late wonder what maturity hybrids to plant and how late planting might affect the final grain yield and grain moisture (Lauer et al., 1999). Either early planting or late planting can result in lower yield because the probability exists that unfavourable climatic conditions can occur after planting or during the growing season. Norwood (2001) suggested that farmers should plant on more than one planting date in order to safeguard against unpredicted seasons. Short season hybrids can be planted early without detrimental effects on their maximum yield potential. It can also minimize the risk of obtaining immature cobs and grains or sustaining early frost damage (Hicks et al., 1993). The environmental and agronomic responses of maize hybrids determine their adaptability and influence improvements in maize production through agronomy and breeding. The importance of this research is given by the need to substantially increase the efficiency of maize production. An understanding of the environmental and agronomic responses of maize hybrids is fundamental to improving efficiency. The present study was conducted to evaluate the effects of planting date on grain yield and its component of maize hybrids and to compare the efficiency and profitability of different selection indices in selecting best genotypes and planting date.

2. MATERIAL AND METHODS

2.1 DESCRIPTION OF THE STUDY AREA

The present study was conducted to evaluate maize genotypes for genetic variability in yield and yield component and select the best planting date at the Khorasan Razavi Agricultural Research and Natural Resources Institute Mashhad, I.R. Iran.

2.2 EXPERIMENTAL METHODOLOGY

Two independent experiments were laid out in a randomized complete block design (RCBD) with three replications and 18 new corn varieties consist of 15 foreign early and mid mature single cross hybrids and 3 Iranian commercial hybrids (KSC704, KSC647 and DC370) were evaluated at two sowing dates (5 and 20 June). The name of hybrids were 1- ZP434, 2- ZP341, 3- ZP684, 4- ZP677, 5- SIMON, 6- BOLSON, 7- EXP1, 8- EXP2, 9- BC582, 10- BC666, 11- OSSK602, 12- OSSK596, 13- OSSK552, 14- OSSK659, 16- OSSK617, 17- KDC370, 18- KSC647, 19- KSC704. The hybrids were grown in two row plots with 3.15 m length and 0.75 cm spacing between rows. Two seeds per hill were planted, which were thinned to one plant per hill at 4-5 leaf stage. The plant density was 75000 plant/ha. Fertilizer was used based on soil test. Data were recorded on

10 competitive plants from each plot for yield components and grain yield (kg/ha) was calculated for the entire plot. Physiological maturity was confirmed in a study by Ma and Dwyer (2001) that related the progression of the kernel “milk line” with the decrease in moisture content during grain filling.

2.3 STATISTICAL ANALYSIS

All the collected agronomic data were statistically analyzed using ANOVA appropriate for RCBD with SAS (ver. 9.1) and SPSS (ver. 16) software. Means were compared using Duncan’s multiple range tests at 0.05 level of probability when the F values were significant (Steel and Torrie, 1984).

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 ANALYSIS OF VARIANCE FOR GROWTH AND YIELD PARAMETER TRAITS

Results of ANOVA showed significant differences among hybrids for all of traits in both sowing date ($P \leq 0.01$) (Table 1), which demonstrated existence of high diversity among hybrids studied in this research. This study showed that among all hybrids, EXP1 (16.03 ton/ha) and OSSK617 (15.51 ton/ha) had the highest yields in early planting (5 June) and EXP1 (16.52 ton/ha) and KDC370 (16.22 ton/ha) produced the highest, yields in late planting (20 June) (Table 3). Results of this experiment also indicated that yield component such as 300 kernel weight, kernel no. per row, kernel depth and ear length were adversely affected in delay planting condition (Table 1).

Delay planting reduced cob percentage (-1.73%), physiological maturity (-2.96%), total leaf number (-6.79%), 300 kernel weight (-18.94%), kernel no. per row (-1.63%), kernel depth (-15.21%) and ear length (-0.12%). However, delay planting affected plant height (20.79%), ear height (11.80%), stem diameter (12.40%) and total yield (3.23%) positively (Table 1). The percent of total yield reduction in early planting was -3.12%. The maximum ear length and kernel depth was obtained in OSSK617 hybrid in the delay planting condition (Table 3). Our results concur partly with observations made by Namakka et al. (2008) and Kamara et al. (2009) who reported that the total yield decreased with delay in sowing date. The measurement of total yield components showed that in early planting condition total yield decline was mainly due to reduction of row no. per ear. Seed weight reduction under delay planting condition might be a result of kernel depth reduction.

Combined statistical analysis of the data revealed that planting date had significant differences for plant height, 300 kernel weight, kernel depth, physiological maturity and total leaf number traits (Table 4). Planting date significantly affected both plant and ear heights. OSSK659 gave slightly lower ear position (203.03 cm) compared both Simon and ZP684. The hybrid Simon was the tallest (242.03 cm) to the other two hybrids in plant and ear height.

Table 1. Analysis of variance (Mean of Square) for different traits of corn hybrids tested under early and delay planting date conditions

Parameters	Early Planting (5 June)					Late Planting (20 June)					
	Replication	hybrid	Error	CV (%)	Mean	Replication	hybrid	Error	CV (%)	Mean	Trait variation percentage
Plant height (cm)	1287.004**	343.41**	111.38	5.21	202.47	43.78 ns	568.24**	107.87	4.24	244.58	20.79
Ear height (cm)	257.02*	352.48**	69.86	7.8	107.07	1786.28**	298.69**	52.28	6.03	119.71	11.8
Stem diameter (mm)	35.51**	6.23 ns	4.73	12.09	18.0	18.92**	3.34 ns	2.7	8.14	20.23	12.38
Leaves No.	2.21**	1.37**	0.22	3.39	14.09	1.15**	2.2**	0.19	3.32	13.13	-6.81
300 kernel weight (g)	489.82 ns	140.93 ns	190.59	15.87	86.94	574.09**	200.14*	93.89	13.75	70.47	-18.94
Row No./ear	0.068 ns	2.21**	0.33	3.68	15.7	0.5 ns	2.49**	0.41	4.05	15.85	0.95
kernel No./row	32.72*	21.6*	9.85	7.57	41.42	51.41**	18.72**	4.61	5.27	40.74	-1.64
Physiological maturity	38.35*	15.32 ns	10.66	2.33	140.03	5.72 ns	36.19**	3.66	1.4	135.88	-2.96
Ear length(cm)	1.33 ns	1.86 ns	1.12	5.53	19.18	4.62**	2.46**	0.85	4.82	19.16	-0.15
Cob percentage	10.41 ns	9.88 ns	14.18	19.69	19.11	3.82 ns	3.73**	1.22	5.8	18.78	-1.72
kernel depth (mm)	1.78*	1.01 ns	0.53	6.49	11.29	0.092 ns	0.88*	0.42	6.82	9.5	-15.85
Total yield (ton/ha)	13.96*	3.85 ns	3.5	13.26	14.12	9.27*	5.93*	2.48	10.81	14.57	3.18

***: Significant at P≤0.01 level *: Significant at P≤0.05 level ns: Not Significant*
Source: Field survey data, 2009.

Table 2. Effect of early & late planting dates on growth parameters of different corn traits

Corn traits	Plant height		Ear height		Stem diameter		leaves No.		300 kernel weight		Row No./ear	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
ZP434	197.7^{abcde}	237.7^{def}	108.1^{abcd}	108.0^{fg}	17.9^{ab}	19.3^{ab}	13.8^{cd}	12.6^{efg}	80.6^{a}	75.9^{abc}	15.3^{def}	15.9^{cd}
ZP341	211.2^{ab}	247.9^{bcd}	110.5^{abcd}	110.5^{efg}	18.8^{ab}	21.4^{a}	14.0^{bcd}	12.9^{def}	82.0^{a}	66.2^{bc}	14.7^{f}	15.8^{cde}
ZP684	213.1^{a}	263.9^{ab}	124.2^{a}	140.4^{a}	17.6^{ab}	19.3^{ab}	14.8^{ab}	14.3^{ab}	98.0^{a}	80.9^{ab}	14.9^{f}	14.4^{f}
ZP677	217.13^{a}	262.3^{abc}	116.4^{abc}	124.5^{bcd}	19.1^{ab}	20.0^{ab}	14.5^{abc}	14.2^{ab}	91.3^{a}	79.1^{ab}	15.1^{ef}	15.1^{cdef}
SIMON	214.0^{a}	270.0^{a}	120.06^{ab}	132.5^{ab}	19.6^{a}	20.6^{ab}	15.0^{a}	14.8^{a}	83.7^{a}	67.0^{bc}	16.5^{bc}	16.3^{bc}
BOLSON	202.5^{abcd}	243.5^{cde}	112.2^{abc}	125.3^{bcd}	19.9^{a}	20.6^{ab}	14.2^{abcd}	13.7^{bcd}	85.4^{a}	66.6^{bc}	15.1^{ef}	15.3^{cdef}
EXP1	208.8^{abc}	260.9^{abc}	108.8^{abcd}	125.3^{bcd}	20.6^{a}	19.5^{ab}	14.8^{ab}	14.1^{ab}	74.0^{a}	62.4^{bc}	15.8^{cdef}	15.5^{cdef}
EXP2	196.6^{abcde}	241.0^{de}	103.1^{cde}	118.6^{cdef}	15.2^{b}	19.2^{ab}	14.8^{ab}	13.8^{bc}	75.0^{a}	65.7^{bc}	18.2^{a}	18.2^{a}
BC582	204.4^{abcd}	240.0^{de}	95.8^{def}	107.9^{fg}	17.3^{ab}	17.9^{b}	13.7^{cd}	12.9^{ef}	101.2^{a}	59.8^{c}	16.1^{bcde}	16.0^{bc}
BC666	190.9^{bcde}	230.8^{def}	86.23^{f}	108.4^{fg}	17.8^{ab}	20.5^{ab}	12.6^{e}	11.9^{g}	85.7^{a}	68.0^{bc}	15.8^{cdef}	16.3^{bc}
OSSK602	189.3^{cde}	241.2^{de}	88.3^{ef}	113.3^{defg}	16.5^{ab}	20.5^{ab}	13.5^{de}	12.5^{efg}	90.7^{a}	76.3^{abc}	17.0^{b}	17.2^{ab}
OSSK596	187.9^{de}	220.1^{f}	107.6^{bcd}	115.9^{cdefg}	17.0^{ab}	19.6^{ab}	13.7^{cd}	12.2^{efg}	92.4^{a}	63.7^{bc}	15.06^{ef}	14.6^{ef}
OSSK552	199.9^{abcd}	235.6^{def}	101.3^{cdef}	116.0^{cdefg}	16.4^{ab}	20.0^{ab}	13.6^{cd}	12.1^{fg}	89.9^{a}	90.9^{a}	15.0^{ef}	14.8^{def}
OSSK659	178.9^{e}	227.1^{ef}	90.8^{ef}	104.3^{g}	16.6^{ab}	19.5^{ab}	12.7^{e}	11.9^{g}	84.6^{a}	70.5^{bc}	15.6^{cdef}	15.7^{cde}
OSSK617	207.2^{abcd}	239.4^{def}	113.1^{abc}	123.4^{bcde}	18.7^{ab}	22.4^{a}	14.2^{abcd}	12.8^{ef}	88.0^{a}	79.1^{ab}	15.8^{cdef}	15.4^{cdef}
KDC370	204.8^{abcd}	243.0^{cde}	112.5^{abc}	129.7^{abc}	19.4^{ab}	21.7^{a}	14.3	13.0^{cde}	85.9^{a}	63.8^{bc}	15.6^{cdef}	16.0^{bc}
KSC647	216.8^{a}	260.5^{abc}	111.1^{abcd}	120.6^{bcdef}	16.9^{ab}	20.9^{ab}	14.4^{abcd}	13.0^{cde}	88.9^{a}	67.6^{bc}	16.3^{bcd}	16.4^{bc}
KSC704	203.06^{abcd}	237.2^{def}	116.8^{abc}	129.7^{abc}	17.8^{ab}	20.5^{ab}	14.2^{abcd}	13.1^{cde}	87.1^{a}	63.9^{bc}	15.5^{cdef}	15.8^{cd}

T1: early planting date, T2: delay planting date. Means with similar letters in each column are not significantly different
Source: Field survey data, 2009.

Table 3: effect of early & late planting dates on yield parameters & yield of different corn traits

Corn traits	Kernel No./row		Physiological maturity		Ear length		Cob percentage		Kernel depth		Total yield	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
ZP434	39.9^{bcd}	37.9^{efg}	143.3^{a}	141.0^{ab}	19.6^{abc}	19.0^{abc}	20.6^{ab}	18.8^{bcde}	11.9^{ab}	9.6^{abcde}	15.3^{ab}	15.3^{abc}
ZP341	42.5^{abcd}	41.4^{bcde}	139.0^{abc}	134.0^{c}	19.9^{abc}	19.9^{ab}	18.9^{ab}	19.0^{bcde}	10.2^{c}	9.7^{abcde}	14.3^{ab}	14.7^{abc}
ZP684	37.0^{d}	38.2^{efg}	143.0^{ab}	133.0^{c}	18.2^{bc}	19.3^{abc}	20.6^{ab}	19.2^{bcde}	11.6^{abc}	10.0^{abcde}	13.7^{ab}	16.0^{ab}
ZP677	42.1^{abcd}	43.4^{abc}	139.6^{abc}	140.3^{b}	18.9^{abc}	19.8^{ab}	14.7^{b}	17.7^{de}	11.4^{abc}	10.2^{abc}	14.5^{ab}	15.0^{abc}
SIMON	44.1^{abc}	36.7^{g}	143.6^{a}	134.3^{c}	20.2^{ab}	18.6^{abcd}	22.5^{a}	21.3^{a}	10.6^{bc}	9.2^{abcde}	11.6^{b}	13.7^{abc}
BOLSON	41.3^{bcd}	39.7^{cdefg}	139.3^{abc}	133.6^{c}	184^{bc}	18.3^{bcd}	17.7^{ab}	18.0^{cde}	11.2^{bc}	10.0^{abcde}	15.3^{ab}	15.3^{abc}
EXP1	41.9^{abcd}	41.6^{bcde}	137.6^{abc}	134.3^{c}	18.7^{abc}	19.8^{ab}	16.7^{ab}	18.2^{bcde}	11.7^{abc}	8.9^{de}	16.03^{a}	16.5^{a}
EXP2	39.1^{cd}	39.0^{defg}	143.0^{ab}	142.6^{ab}	18.6^{abc}	17.8^{cd}	21.0^{ab}	19.9^{abc}	11.6^{abc}	8.7^{e}	14.0^{ab}	14.2^{abc}
BC582	41.2^{bcd}	41.7^{bcde}	141.6^{abc}	144.0^{a}	18.9^{abc}	18.9^{abc}	18.5^{ab}	18.2^{bcde}	12.7^{a}	10.3^{ab}	14.1^{ab}	14.7^{abc}
BC666	45.6^{ab}	42.5^{abcd}	139.0^{abc}	134.0^{c}	20.7^{a}	20.4^{a}	19.1^{ab}	18.4^{bcde}	11.1^{bc}	9.1^{bcde}	14.0^{ab}	13.2^{bc}
OSSK602	42.1^{abcd}	40.5^{bcdefg}	139.3^{abc}	135.0^{c}	19.2^{abc}	18.7^{abc}	19.0^{ab}	20.3^{ab}	10.6^{bc}	9.4^{abcde}	13.1^{ab}	13.6^{abc}
OSSK596	37.0^{d}	37.0^{fg}	136.6^{bc}	134.3^{c}	17.9^{bc}	17.0^{d}	19.2^{ab}	19.5^{abcd}	10.8^{bc}	8.9^{de}	13.8^{ab}	13.1^{bc}
OSSK552	40.0^{bcd}	41.1^{bcdef}	136.0^{c}	134.0^{c}	18.3^{bc}	18.9^{abc}	18.6^{ab}	17.6^{de}	11.1^{bc}	9.4^{abcde}	13.3^{ab}	13.7^{abc}
OSSK659	42.1^{abcd}	46.2^{a}	139.0^{abc}	135.0^{c}	19.1^{abc}	20.3^{a}	17.2^{ab}	17.9^{cde}	10.6^{bc}	9.6^{abcde}	13.0^{ab}	13.9^{abc}
OSSK617	42.7^{abcd}	41.9^{bcde}	141.3^{abc}	133.6^{c}	19.5^{abc}	20.3^{a}	20.4^{ab}	20.0^{abc}	11.5^{abc}	10.5^{a}	15.5^{a}	15.9^{ab}
KDC370	39.8^{bcd}	40.5^{bcdefg}	138.3^{abc}	135.0^{c}	19.0^{abc}	18.8^{abc}	19.2^{ab}	17.4^{de}	11.4^{abc}	9.0^{cde}	14.7^{ab}	16.2^{ab}
KSC647	39.2^{cd}	39.4^{cdefg}	140.6^{abc}	134.3^{c}	19.2^{abc}	19.2^{abc}	20.7^{ab}	18.6^{bcde}	11.5^{abc}	9.1^{bcde}	12.4^{ab}	12.3^{c}
KSC704	47.4^{a}	44.2^{ab}	140.0^{abc}	133.3^{c}	20.5^{a}	19.5^{abc}	18.5^{ab}	17.3^{e}	11.1^{bc}	10.1^{abcd}	14.8^{ab}	14.5^{abc}

T1: early planting date, T2: delay planting date. Means with similar letters in each column are not significantly different
Source: Field survey data, 2009.

Table 4. Results of combined ANOVA for different traits of foreign grain corn hybrids varieties on 2009

SOV	Df	Plant height	Ear height	Stem diameter	Leaves No.	300 kernel weight	Row No./ ear	kernel No./ row	Physio-logical maturity	Ear length	Cob percentage	Kernel depth	Total yield
Planting date	1	47871.9^{**}	4311.7^{ns}	134.6^{ns}	24.7^{*}	7328.9^{*}	0.14^{ns}	12.4^{ns}	464.5^{*}	0.01^{ns}	2.9^{ns}	79.7^{**}	5.6^{ns}
Rep (planting date)	4	665.3^{**}	1021.6^{**}	27.2^{**}	1.6^{**}	531.9^{**}	0.28^{ns}	42.07^{**}	22.03^{*}	2.9^{*}	7.1^{ns}	0.93^{ns}	11.6^{**}
Hybrids	17	830.6^{**}	590.4^{**}	6.5^{ns}	3.3^{**}	209.9^{ns}	4.47^{**}	31.4^{**}	35.5^{**}	3.3^{**}	10.9^{ns}	1.2^{**}	6.9^{**}
Planting date*Hybrids	17	81.06^{ns}	60.6^{ns}	3.05^{ns}	0.22^{ns}	131.07^{ns}	0.23^{ns}	8.8^{ns}	15.9^{*}	0.99^{ns}	2.6^{ns}	0.68^{ns}	1.03^{ns}
Error 2	68	109.6	61.07	3.7	0.2	142.2	0.37	7.2	7.1	0.99	7.7	0.48	2.9
CV		4.8	6.8	10.09	3.3	15.1	3.8	6.5	1.9	5.1	14.6	6.6	12.06

***: Significant at P≤0.01 level *: Significant at P≤0.05 level ns: Not Significant*
Source: Field survey data, 2009.

3.1.2 CORRELATION COEFFICIENTS

Correlation coefficients between the studied variables and total yield in delay planting conditions showed that kernel no. per row, kernel depth and ear length were positive and significantly correlated with total yield (data not shown). This finding was in agreement with the results of Golbashy et al. (2010). In early planting condition the highest correlations were for plant height and total yield (0.39**) and in delay planting condition for kernel depth and total yield (0.40**). The correlation between plant height and ear height in early and delay planting condition was 0.83** and 0.77** respectively; the highest of all variables studied. This finding was in agreement with the results of Shoa Hoseini et al. (2007).

Negative but non-significant correlations of total yield in delay planting condition were observed with row no. per ear and cob percentage; and other measured traits were positive correlated with total yield. The results are at par with the finding of Golbashy et al. (2009). Result of this study showed that, ear length, kernel no. per row and kernel depth could be used as an important trait for prediction of total yield under delay planting. This finding was in agreement with the results of Jafari et al. (2009) and Choucan et al. (2007) and Golbashy et al. (2010).

3.1.3 CLUSTER ANALYSIS

We also used cluster analysis (Ward's method) based on investigated traits in both early and delay planting conditions to classify different hybrids in similar classes. As it appears in Figure 1, the hybrids were classified in four groups with low intra-group and high extra-group similarities. The first clusters are small groups of only three commercial hybrids and are early mature hybrids. These groups consist of ZP434, BC582 and EXP2 hybrids respectively. The second cluster was consists of BC666, OSSK659, OSSK602, OSSK596 and OSSK552 hybrids. Hybrids of Clus3 were ZP341, BOLSON, DC370, EXP1, ZP677, OSSK617 and KSC704 hybrids. Based on the present results it was recommended to make crosses among genotypes in Clus1 and Clus4 in breeding programmes. Classifying genotypes according to their agronomic traits with sophisticated multivariate techniques can reduce the cost of time and money in crop improvement.

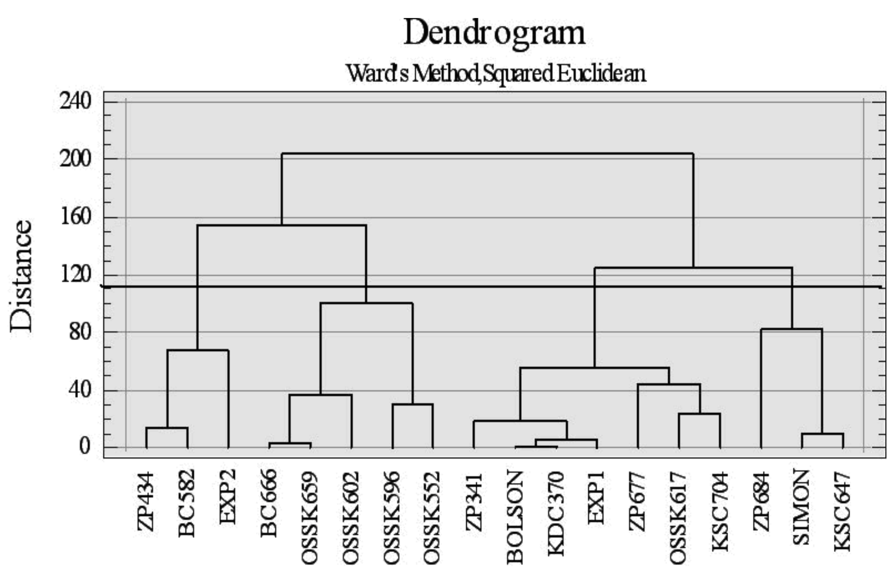

Fig. 1. Dendrogram resulted from cluster analysis (Ward's method) of hybrids based on investigated traits in both early and delay planting conditions

3.2 DISCUSSION

In this experiment, planting date had significant effects on maize hybrids yield and its components. EXP1 (16.03 ton/ha) and OSSK617 (15.51 ton/ha) hybrids were the best hybrids under early planting (5 June) condition and EXP1 (16.52 ton/ha) and KDC370 (16.22 ton/ha) showed the best behaviour under late planting (20 June) condition. This study showed that sowing date had a significant effect on plant height. 5 June planting date gave the shortest plants. Remison and Dele (1978) in Nigeria reported that lodging in maize was associated with ear and plant heights and length of basal internodes.

Finally it is concluded that total yield mainly depends upon the kernel no. per ear. This emphasized that selection based on the characters which enhance kernel number per ear will be more effective in improving yield for delay planting.
Determination of the optimum planting date for maize is very crucial for better crop yields. The study revealed that both planting date and hybrid had significant effects on grain yield and yield components of maize. The results obtained from the present experiment agree well with the finding of Estakhr and Choucan (2006) who reported that the optimum time for planting date maize under Khorasan Razavi condition was from 25 May to 15 June and high yield of maize can be obtained during this period.

Delaying sowing from 5 June to 20 June reduced the leaves No, 300 kernel weight, kernel No./row, Physiological maturity, Ear length, Ear cob percentage and kernel depth, therefore, low grain yield was obtained from this planting.

On the other hand, the hybrids varied significantly in their grain yield. Such results are in accordance with the finding of Danaie (2007) who reported that both planting date and hybrids significantly influenced total grain yield. The planting date * hybrid interaction effect was significant (Table 4), indicating that the delay planting (20 June) was more favourable in term of average mean daily temperature (23℃) than the second time (30℃). Similar results were reported by Elkarourri (1980) in Sudan that the average mean daily temperature during the highest producing period for maize was about 24.6℃ in the corn belt of the United States.

4. CONCLUSION

This study has shown that planting date had significant effects on maize hybrids yield and its components. EXP1 and OSSK617 hybrids were the best hybrids under early planting (5 June) condition and EXP1 and KDC370 showed the best behavior under late planting (20 June) condition. This experiment has shown delaying planting date reduced yield and its components (300 kernel weight, kernel No./row, Ear length, kernel depth).

In conclusion, it can be suggested that EXP1 hybrid should be grown in Khorasan Razavi Plains. The correlation analysis between agronomic traits was found to be significant between almost all the traits. Based on the present results it was recommended to make crosses among genotypes in Clus1 and Clus4 in breeding programmes. Classifying genotypes according to their agronomic traits with sophisticated multivariate techniques can reduce the cost of time and money in crop improvement.

However, stability analysis of different traits on the already established groups of the current study requires further investigations based on sufficient data that cover different years and experimental locations.

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