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# EFFECT OF PLANTING SEASONS ON SEED YIELD AND YIELD ATTRIBUTING CHARACTERS IN MAIZE (*ZEA MAYS* L) HYBRIDS

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## SUMMARY

Four maize hybrids were subjected to various viability and vigour tests to evaluate the effect of planting season on seed yield and yield attributing characteristics during 2016-17. The results revealed that the crop grown during *rabi* season showed its superiority in yield and yield components over *kharif* season by registering maximum field emergence index (31.97), seedling establishment (78.82%), days to 50% tasseling (122), days to 50 % silking (127), number of leaves per plant (12.98), number of cobs per plant (1.42), plant height at maturity (1.80m), cob length (33.08cm), number of seeds per cob (424.08) and seed yield (99.36g/cob). Among the hybrids, maximum yield and yield attributing characters was recorded in HPQM 5 in both the seasons with maximum field emergence index (29.85), seedling establishment (75.07%), days to 50% tasseling (91.00), days to 50 % silking (94.50), number of leaves per plant (13.47), number of cobs per plant (1.52), plant height at maturity (1.81m), cob length (31.75cm), number of seeds per cob (444.38) and seed yield (112.61g/cob) whereas minimum was observed in HM 9 in both the season with field emergence index (24.10), seedling establishment (64.03%), days to 50% tasseling (87.17), days to 50 % silking (90.67), number of leaves per plant (12.08), number of cobs per plant (1.04), plant height at maturity (1.56m), cob length (25.64cm), number of seeds per cob (395.50) and seed yield (76.43g/cob). Therefore it can be concluded from the study that more yield can be achieved during *rabi* season as compared to *kharif* season, thus *rabi* season can be considered as a better option for production of quality seed in Hisar region.

**Key words :** Maize, seed quality, season, yield

Maize (*Zea mays* L) is one of the most important multipurpose food grains of the world, having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because of its highest genetic yield potential among the cereals (Guzobenli, 2010). In India, maize is emerging as third most important crop after rice and wheat. India contributes merely about 2.5 per cent in world maize production and the production of maize was 18.7 million tonnes during *kharif* 2017 and 7.02 million tonnes was recorded during *rabi* 2016-17 (Anonymous, 2017). Karnataka, Rajasthan, Andhra Pradesh Maharashtra and Uttar Pradesh are the major maize producing states which together contribute 60 per cent of area and 70 per cent of maize production in India. Maize grain is important source of protein (10.4%), fat (4.5%), starch (71.8%), vitamins and minerals like calcium, sulphur and phosphorus. Quality seed indicates the seeds of improved varieties having high genetic and physical purity, high germination rate, high vigour and free from seed borne insects and diseases. Quality seed alone accounts for 10-15% increase in production. Viability and vigor are the major determinants of the seed quality. Viability has impact on seed germination whereas germination rate and seedling establishment are influenced by the seed vigor. Different temperature regime may cause the variations in seed germination (Bosci and Kovacs, 1990). Because germination is greatly influenced by temperature and also it has impact on the supply of nutrients and availability of soil water for sustaining the growth and development of maize (Keeling and Greaves, 1990; Bosci and Kovacs, 1990). Maize is grown in wide range of environments, extending from extreme semi-arid to sub-humid and humid regions in *Kharif* (monsoon) and *rabi* (winter) seasons. In India maize is grown throughout the year but mainly as *kharif* crop with 85 per cent of the area under cultivation in the season. In North India it is primarily grown as a monsoon crop (June-October), hence its seed production in this season poses a problem in maintaining isolation from commercial crop, besides chances of obtaining poor seed quality due to occurrence of biotic stresses. Seed production in winter

(October-April) and spring-summer (February-May) season is another possibility. But sub-optimum temperatures during sowing time in winter season (November-February) hamper the field emergence and early crop growth. Besides high temperature (>40°C) and hot dry winds during flowering (April-May) in spring-summer season may also result in poor seed set, forced ripening or low seed yield and quality. Climate change is a serious challenge to crop production especially in maize, which is grown in all the seasons and throughout the year. Under climate change regime, rise in temperature have significant effect on the crop growth, flowering pattern and seed yield. Environmental factors such as temperature, relative humidity, rainfall and day length have significant influence on the flowering behavior, synchronization pattern and seed yield. It is well known fact that environmental conditions in different growing seasons have great influence in the formation and development of seed that may affect the seed quality. However, information relating to seed quality and seedling growth of maize hybrids over the growing season is limited. Keeping in view the above mentioned facts the present study is planned to evaluate the seasonal effect on seed quality of maize hybrids.

## MATERIALS AND METHODS

The study was conducted on 4 maize hybrids *viz* HQPM-1, HQPM-5, HM-8 and HM-9. The freshly harvested seeds of all four hybrids of both the seasons (*kharif* 2016 and *rabi* 2016-2017) was procured from Regional Research Station, Uchani Karnal and study was conducted in laboratory of department of Seed Science & Technology CCS Haryana Agricultural University, Hisar. Observations on field emergence index, seedling establishment (%), days to 50% tasseling, days to 50% silking, number of leaves per plant, number of cobs per plant, cob length (cm), plant height at maturity, number of seeds per cob and seed yield (g/cob) were recorded.

For field emergence index, the number of seedlings emerged were counted on each day and continued up to the seedling establishment and field emergence index also termed as the speed of emergence was calculated by the method as described by Maguire (1962).

$$FEI = \frac{\text{No. of seedlings emerged}}{\text{Day of first count}} + \cdots + \frac{\text{No. of seedlings emerged}}{\text{Day of last count } (12^{th})}$$

Seedling establishment (%) was determined by counting the total number of seedlings when the seedling emergence was completed or there was no further increase in total seedling emergence. Days to 50% tasseling was recorded as the number of days from planting to when 50% of the maize plants projected their tassels in each plot which was estimated by visual observation. Days to 50% silking was recorded as the number of days required from planting to when 50% of the maize plant showed extrusion of silks in each plot by visual observation. Total number of green leaves produced was counted in five plants and their average was taken as number of green leaves per plant. The number of cobs from the five randomly selected plants was recorded individually and the average number of cobs per plant was calculated.

Cob length (cm) was measured from the point where the ear attaches to the stem to the tip of the ear from randomly taken five plants in the plot area at crop maturity. Plant height at maturity was measured as the height from the soil surface to the base of the tassel of five randomly taken plants from the plot area at physiological maturity. Number of seeds per cob was computed as the average number of kernels of five randomly taken cobs from the plot area at crop harvest. For seed yield (g/cob) estimation all the cobs from the five randomly selected plants were taken. After the removal of sheath the grains of these five cobs were shelled manually and then weighed and average yield was calculated in grams. The factorial experiment in randomized complete block design (RBD) was conducted in three replicates and data was subjected to the statistical analysis as described by Panse and Sukhatme (1985).

The meteorological data was obtained from Department of Agrometeorology, CCS Haryana Agricultural University, Hisar which is situated at Latitude: 29°10N, Longitude 73°43E, and at an

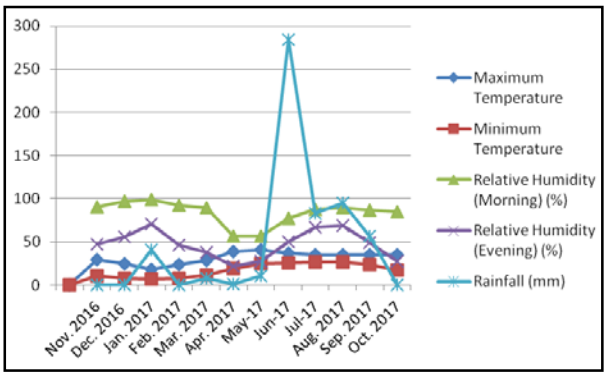


Fig. 1. Average weather data of Hisar during the experimentation season (2016-17).

TABLE 1
Effect of planting season on seed yield and yield attributing characters in maize (*Zea mays* L) hybrids

| Hybrids | Field emergence index | | | Seedling establishment (%) | | | Days to 50% tasseling | | | Days to 50% silking | | | No. of leaves/plant | | | No. of cobs/plant | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean |
| HQPM 1 | 33.25 | 23.92 | 28.59 | 79.72 (63.26) | 56.94 (48.98) | 68.33 (56.12) | 122.67 | 57.67 | 90.17 | 127.67 | 59.67 | 93.67 | 13.07 | 12.20 | 12.63 | 1.20 | 1.00 | 1.10 |
| HQPM 5 | 35.48 | 24.21 | 29.85 | 82.22 (65.06) | 67.91 (55.48) | 75.07 (60.27) | 123.67 | 58.33 | 91.00 | 128.67 | 60.33 | 94.50 | 13.67 | 13.26 | 13.47 | 1.73 | 1.30 | 1.52 |
| HM 8 | 30.62 | 22.83 | 26.72 | 76.94 (61.32) | 53.88 (47.21) | 65.41 (54.27) | 121.33 | 55.67 | 88.50 | 126.33 | 57.67 | 92.00 | 12.87 | 12.74 | 12.80 | 1.67 | 1.20 | 1.43 |
| HM 9 | 28.53 | 19.67 | 24.10 | 76.39 (61.01) | 51.67 (45.94) | 64.03 (53.48) | 120.33 | 54.00 | 87.17 | 125.33 | 56.00 | 90.67 | 12.33 | 11.83 | 12.08 | 1.07 | 1.00 | 1.04 |
| Mean | 31.97 | 22.66 | | 78.82 (62.66) | 57.60 (49.40) | | 122.00 | 56.42 | | 127.00 | 58.42 | | 12.98 | 12.51 | | 1.42 | 1.13 | |
| Range | 28.53-35.48 | 19.67-24.21 | | 76.39-82.22 | 51.67-67.91 | | 120.33-123.67 | 54.00-58.33 | | 125.33-128.67 | 56.00-60.33 | | 12.33-13.67 | 11.83-13.26 | | 1.07-1.73 | 1.00-1.30 | |
| C. D. (P=0.05) | | | | | | | | | | | | | | | | | | |
| Hybrids (H) | | 1.442 | | | 4.098 | | | 0.841 | | | 0.841 | | | 0.652 | | | 0.076 | |
| Seasons (S) | | 1.020 | | | 2.898 | | | 0.595 | | | 0.595 | | | 0.461 | | | 0.054 | |
| Interaction (H × S) | | NS | | | NS | | | NS | | | NS | | | NS | | | 0.108 | |

Values in Paranthesis are transformed values.

elevation of 210m above mean sea level. Meteorological data on temperature ($^0$C), relative humidity (%), rainfall (mm) during the crop seasons is given in Fig. 1.

## RESULTS AND DISCUSSION

The results revealed that the crop grown during *rabi* season showed its superiority in yield and yield components over *kharif* season by registering maximum field emergence index (31.97), seedling establishment (78.82%), days to 50% tasseling (122), days to 50 % silking (127), number of leaves per plant (12.98), number of cobs per plant (1.42), plant height at maturity (1.80m), cob length (33.08cm), number of seeds per cob (424.08) and seed yield (99.36g/cob). During *rabi* season field emergence index ranged from 28.53 to 35.48, seedling establishment (%) ranged from 76.39 to 82.22, days to 50% tasseling ranged from 120.33 to 123.67, days to 50 % silking ranged from 125.33 to 128.67, number of leaves per plant ranged from 12.33 to 13.67, number of cobs per plant ranged from 1.07 to 1.73, plant height at maturity ranged from 1.68 to 1.91, cob length ranged from 30.27 to 36.33cm, number of seeds per cob ranged from 398.33 to 449.50 and seed yield (g/cob) ranged from 87.67 to 119.60 while during *kharif* field emergence index ranged from 19.67 to 24.21, seedling establishment (%) ranged from 51.67 to 67.91, days to 50% tasseling ranged from 54.00 to 58.33, days to 50 % silking ranged from 56.00 to 60.33, number of leaves per plant ranged from 11.83 to 13.26, number of cobs per plant ranged from 1.00 to 1.30, plant height at maturity ranged from 1.39 to 1.72, cob length ranged from 21.01 to 27.17cm, number of seeds per cob ranged from 392.67 to 439.25 and seed yield (g/cob) ranged from 65.19 to 105.61 (Table 1 & 2). More yield in *rabi* season might be due to more plant stand, more number of leaves, more number of cob length and more number of seeds per cob associated with *rabi* maize. Higher yield in winter season can also be attributed to higher interception of photo energy and low night temperature favouring higher production of photosynthates and lower photorespiration. Comparatively lower temperature during ear initiation and silking of *rabi* maize over *kharif* maize contributed much for higher trend of yield in *rabi* over *kharif*. This might be due to increase in temperature during *kharif* season caused the decreased spikelet fertility and grain number was found to be dependent to temperature and radiation regimes during the period from ear initiation to silking (Table 1). Deshmukh *et al.* (2018) also conducted an experiment to know the effect of seasons on physical seed quality of soybean and the results revealed that most optimum off season date of planting of soybean was January 15th in summer and October 15th in Rabi season. Jitender *et al.* (2017) also observed the effect of seasons on seed quality of mungbean and reported that the quality of seeds produced during summer was better than the seeds produced during *kharif* season. Among the hybrids, maximum yield and yield attributing characters was recorded in HPQM 5 in both the seasons with maximum field emergence index (29.85), seedling establishment (75.07%), days to 50% tasseling (91.00), days to 50 % silking (94.50), number of leaves per

TABLE 2
Effect of planting season on seed yield and yield attributing characters in maize (*Zea mays* L) hybrids

| Hybrids | Plant height at maturity (m) | | | Cob length (cm) | | | No. of seeds/cob | | | Seed yield (g/cob) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean | *Rabi* | *Kharif* | Mean |
| HQPM 1 | 1.83 | 1.58 | 1.70 | 31.37 | 24.24 | 27.80 | 417.67 | 415.00 | 416.33 | 91.77 | 67.76 | 79.76 |
| HQPM 5 | 1.91 | 1.72 | 1.81 | 36.33 | 27.17 | 31.75 | 449.50 | 439.25 | 444.38 | 119.60 | 105.61 | 112.61 |
| HM 8 | 1.79 | 1.39 | 1.59 | 34.33 | 25.60 | 29.97 | 430.80 | 424.60 | 427.70 | 98.40 | 95.63 | 97.02 |
| HM 9 | 1.68 | 1.44 | 1.56 | 30.27 | 21.01 | 25.64 | 398.33 | 392.67 | 395.50 | 87.67 | 65.19 | 76.43 |
| Mean | 1.80 | 1.53 | | 33.08 | 24.50 | | 424.08 | 417.88 | | 99.36 | 83.55 | |
| Range | 1.68-1.91 | 1.39-1.72 | | 30.27-36.33 | 21.01-27.17 | | 398.33-449.50 | 392.67-439.25 | | 87.67-119.60 | 65.19-105.61 | |
| C. D. (P=0.05) | | | | | | | | | | | | |
| Hybrids (H) | | 0.090 | | | 1.167 | | | 14.039 | | | 3.215 | |
| Seasons (S) | | 0.064 | | | 0.825 | | | NS | | | 2.273 | |
| Interaction (H × S) | | NS | | | NS | | | NS | | | 4.546 | |

Values in Paranthesis are transformed values.

plant (13.47), number of cobs per plant (1.52), plant height at maturity (1.81m), cob length (31.75cm), number of seeds per cob (444.38) and seed yield (112.61g/cob) whereas minimum was observed in HM 9 in both the season with field emergence index (24.10), seedling establishment (64.03%), days to 50% tasseling (87.17), days to 50 % silking (90.67), number of leaves per plant (12.08), number of cobs per plant (1.04), plant height at maturity (1.56m), cob length (25.64cm), number of seeds per cob (395.50) and seed yield (76.43g/cob). This might be due to difference in the genetic makeup of these hybrids. Similar findings were reported in maize by BARI (2001), Islam *et al*. (2014), Basu *et al.* (2007), Taipodia and Shukla (2013). Therefore it can be concluded from the study that more yield can be achieved during *rabi* season as compared to *kharif* season, thus *rabi* season can be considered as a better option for production of quality seed in Hisar region.

## REFERENCES


Anonymous, 2017 : Department of agriculture, cooperation & farmers welfare. *Ministry of agriculture and farmers welfare.* Government of India.

BARI., 2001 : CIMMYT sub-topical intermediate yellow-QPM hybird trail. Annual report of Bangladesh Agricultural Research Institute, Joydebpur, Gazzipur. pp. 44-67.

Basu, Sudipta Bhaumik., S. P. Sharma and M. Dadlani, 2007 : Effect of season on crop growth, flowering, synchronization pattern and seed yield in the parental lines of maize (*Zea mays* L.) hybrids, *Seed Res.*, **35** : 139-147.

Bosci, J. and G. Kovacs, 1990 : Inheritance of the rate of germination and emergence at low temperatures in maize, *Acta Agronomica Hungarica*, **39** : 127-135.

Deshmukh, H. S., V. R. Shelar and M. P. Deshmukh, 2018 : Effect of sowing dates and season on physical seed quality of soybean. Journal of Pharmacognosy and Phytochemistry, **7** : 881-883.

Guzobenli, H. 2010 : Seed vigor of maize grown on the contaminated soil by cadmium, *Asian J. Plant Sci.*, **9** : 168-171.

Islam, M. K., M. S. Mahfuz, M. A. I. Sarker, S. Ghosh and A. S. M. Y. Ali, 2014 : Effect of season and environment variation on yield and yield components of hybrid maize, *Int. J. Agric. Res. Innov. Technol.*, **4** : 1-5.

Jitender, Axay Bhuker, V. S. Mor, R. C. Punia and R. Yadav, 2016 : Effect of planting season on seed quality in mungbean [*Vigna radiata* (L.) Wilczek], *Res. Environ. Life Sci.*, **9** : 1532-1535.

Keeling, P. L. and J. A. Greaves, 1990 : Effects of temperature stresses on corn-opportunities for breeding and biotechnology, *In Proceedings of the 45th Annual Corn and Sorghum Research Conference*, pp. 29-42.

Maguire, J. D. 1962 : Speed of germination-Aid in selection and evaluation for seedling emergence and vigour, *Crop Sci.*, **2** : 176.

Panse, V. G. and P. V. Sukhatme, 1985 : Statistical methods for agricultural workers, ICAR Publication, New Delhi.

Taipodia, R. and A. K. Shukla, 2013 : Effect of planting time on growth and yield of winter maize (*Zea mays* L.) after harvesting rice. *J. Krishi Vigyan*, **2** : 15-18.