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EFFECTS ON GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.) SOWING IN *SPRING* SEASON

NARENDER SINGH AND M. C. KAMBOJ*

CCS HAU, Regional Research Station, Karnal-132001 (Haryana), India
**(e-mail: bagri.narender@hau.ac.in)*

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SUMMARY

A field experiment was conducted on effect of date of sowing on growth and grain yield of *spring* maize at CCS Haryana Agricultural University, Regional Research station, Karnal during the year 2015, 2016 and 2017. Seven maize hybrids namely HQPM 1, HQPM 4, HQPM 5, HM 9, HM10, HM 11 and HM 12 were tested and kept in main plots with combination of five sowing dates *viz.,* last week of January, first week of February, second week of February, third week of February and fourth week of February were kept in sub plots which were replicated thrice. The results of the trial revealed that maximum grain yield was obtained with sowing during first week of February (86.4 q/ha) followed by last week of January (82.7) and second week of February (80.9. Similar trend was observed for B: C ratio. The maximum B: C ratio was found with sowing was done during first week of February (1.9) followed by last week of January (1.8) and second week of February (1.8). Among different maize hybrids, HM 10 gave maximum grain yield (82.9 q/ha) which was significantly higher than other hybrids except HM 11(81.0 q/ha) and HQPM 4 (79.8 q/ha).

Key words: Spring maize, sowing date, hybrids, grain yield, economics

Maize is one of the most important cereal crops next to wheat and rice in the world. Globally, it is known as queen of cereals because it has the highest genetic yield potential among the cereals. At worldwide, it was cultivated on an area of 205.87 million hectares and recorded the production of 1210 million tonnes of grains with an average grain yield of 58.7 q ha^{-1}. In India, maize is grown on 9.9 million hectare area with 31.6 million tonnes of production and average grain yield of 31.3 q ha^{-1} (FAO, 2021). Presently, India ranks 4th, 7th and 6th with respect to area, production and consumption of maize at the world level (Anonymous, 2019). Rice-wheat is a major cropping system in Indo-Gangetic plains (IGP). But resistance in *phalaris minor* in wheat crop and deteriorating of soil health are the major concern in rice-wheat cropping system (Kumar *et. al,* 2021). Crop rotation or diversification is must to way out these serious problems. The *spring* maize is sown in the months of February and March after harvesting of potato and it is harvested in June. The sudden rise in temperature in the month of February during the past few years has adversely affected the grain filling in wheat. This problem can be solved by replacing late sown wheat with the *spring* maize in Haryana. In Haryana, area of maize in *kharif* season is about 6200 ha with production of about 17000 tonnes and with average productivity of 27.4 q/ha (Statistical abstract of Haryana 2019-20). But area in Haryana under *spring* maize is in increasing order which is grown on around 10000-12000 hectares with productivity of 45 q/ha (Singh *at. el.,* 2017). During *spring* season, the maize has very high yield potential and it may yield upto 100 q/ha. However in Haryana, short duration paddy-potato-spring maize is a profitable cropping system as compared to conventional rice-wheat system and it may be useful in crop diversification by replacing rice-wheat system and overcoming these prevailing issues. Maize needs less water than other cereal crops. The study carried out by Vanaja *et. al.* (2011) that maize being a C4 plants having a competitive edge over C3 plants. The C4 plants use three fold less water, allowing them to grow in conditions of drought, high temperature, and carbon dioxide limitation. It has been recognized that C4 plant species including maize have a higher optimal temperature for undertaking photosynthesis than C3 plants due to operation of a CO_2 concentrating system that inhibits Rubisco oxygenase activity. Maize gives higher yield per hectare even in a shorter period than any other food grain crop. Besides, it can be grown in any season, as it is a day-neutral crop. The favorable weather conditions for spring maize may result in gradual replacement of wheat. The farmer get good price for their produce due less moisture in grain during

spring season. The demand of maize is increasing every year due to growth in poultry industry, expansion of maize based industries and rising of contract farming. There are two starch industries *viz.,* Bharat Starch Industries, Yamunanagar and Sada Sat Corn Product Pvt. Ltd. Garhi Singha, Kurukshetra. These industries utilize approximately 200 and 75 tonnes corn grain, respectively on daily basis. Spring maize may also be more profitable as it helps in meeting the green cob demand during early summer (Verma and Mishra, 1998). There is conflict about proper time of sowing during spring season for higher productivity of different maize hybrids. Considering this issue a field trial was conducted during year 2015, 2016 and 2017 on "effect of date of sowing on growth and yield of maize cultivars in spring season.

MATERIALS AND METHODS

An field experiments on effect of date of sowing on growth and grain yield of spring maize were conducted at Regional Research Station, Karnal during the year 2015, 2016 and 2017 to work out the performance of seven maize hybrids namely HQPM 1, HQPM 4, HQPM 5, HM 9, HM10, HM 11 and HM 12 were tested with combination of five sowing dates *viz.,* last week of January, first week of February, second week of February, third week of February and fourth week of February. The sowing was done in last week of January (25th of January in 2015, 24th of January in 2016 and 28th of January in 2017), sowing was done first week of February (5th of February in 2015, 2nd of February in 2016 and 4th of February in 2017), sowing was done second week of February (12th of February in 2015, 13rd of February in 2016 and 12th of February in 2017), sowing was done in third week of February (18th of February in 2015, 16th of February in 2016 and 19th of February in 2017) and sowing was done in fourth week of February (26th of February in 2015, 27th of February in 2016 and 25th of February in 2017). The experiment was laid in split plot design replicated thrice. The soil of experimental site was clay loam in texture. The soil was alkaline (pH 8.3) in nature with electrical conductivity (EC 1:2) of 0.4 ds/mt. furthermore, the soil was low in organic carbon (0.28%) and available phosphorus (7 kg/ha), and medium in available potash (193 kg/ha). Different observations were recorded *viz.,* Plant stand at 15 DAS and at harvest, grain yield (q/ha), days to 50% tasseling, days to 50% silking, and days to maturity. Economics calculation was carried out by considering the prevailing market prices

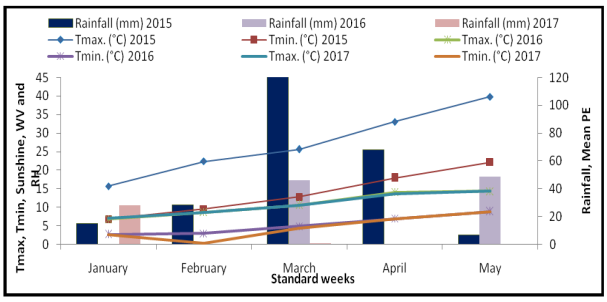

Fig. 1. Graph showing weather data during crop seasons (last week of January 2015 to last week of February 2017) at RRS, Karnal.

of inputs and outputs. The trial data were analyzed by using OPSTAT software which is available on CCS Haryana Agricultural University official site (Sheoran, 2016).

RESULTS AND DISCUSSION

The data on grain yield and economic given in table 2 reveled that highest grain yield was obtained when crop sowing was done during first week of February (86.4 q/ha) followed by last week of January (82.7) and second week of February (80.9) on three year mean basis. The results are confirmed the finding of Dahmardeh (2012) who also observed that sowing dates affected the grain yield of spring maize. Similar trend was observed for B: C and it was observed highest with sowing in first week of February (1.9) followed by last week of January (1.8) and second week of February (1.8). Year wise data on grain yield also showed similar trend (Table 1). The similar result was reported by Shrestha *et. al.* (2016) who also observed that early sowing gave maximum yield. In addition, Khanal *et. al,* (2019) also observed that crop sowing on 1st of February gave higher yield than sowing on 12th of February and 23rd of February. Sowing at optimum time is important to achieve the desired yield. Delay in appropriate sowing time leads to reduced grain yield (Buriro *et al.*, 2015). The variety HM 10 gave maximum grain yield (82.9 q/ha) which was significantly higher than other hybrids except HM 11(81.0 q/ha) and HQPM 4 (79.8 q/ha).The least grain yield was recorded in hybrid HM 12. This was due to genetic potential of different hybrids to produce yield attributes and yield (Rabbani *et. al.,* 2021). Days to 50% tasseling and silking decreased with delay in crop sowing of spring maize. The highest days for 50% tasseling (83.0) and silking (86.0) was observed when crop sowing was done at last week of January. This may be due to the fact that proper sowing time leads to increase flowering time by facilitating favorable environmental condition such as

TABLE 1
Effect of different sowing dates on grain yield on spring maize during 2015-2017

Treatments	Grain yield (q/ha)			
	2015	2016	2017	Mean
Sowing dates				
Last week of January	82.0	84.0	82.0	82.7
First week of February	85.1	88.0	86.0	86.4
Second week of February	80.2	82.2	80.2	80.9
Third week of February	74.1	76.1	70.0	73.4
Fourth week of February	70.1	72.0	56.0	66.0
CD at 5%	2.6	2.5	4.0	3.0
Hybrids				
HQPM 1	79.0	81.0	75.6	78.5
HQPM 4	80.1	82.1	77.1	79.8
HQPM 5	76.1	78.1	73.1	75.8
HM 9	76.2	78.2	73.2	75.9
HM 10	83.3	85.3	80.1	82.9
HM 11	81.5	83.3	78.3	81.0
HM 12	73.0	75.0	71.0	73.0
CD at 5%	3.9	4.0	4.0	78.5

temperature, humidity, day length (Sawan, 2018). In contrast, Kamara *et. al*., (2009) reported that delay in cultivation increases the day to flowering and the time interval between the emergence of tesseling and silking which results in decreases in dry matter production, yield, and yield components of corn grain. Among the tested hybrids, days to 50% tasseling (73.1) and silking (76.4) was observed highest with HQPM 5 which was significantly higher when compared with the rest of hybrids. These results are in close collaborations with the results of Shrestha *et.al* (2018) who also observed that plant cultivar response differently to different planting dates. Likewise, number of days to maturity will decreases with late sowing of spring maize crop and highest was observed with crop sown in last week of January (126.4). Among tested hybrids, maximum number of days to maturity was observed in HQPM 5 (123.0). Planting time in combination with relative maturity of hybrids determine the yield potential of maize in a particular environment. These two factors decide the life cycle of a crop in which the crop accumulates radiation which is positively correlated with productivity (Lindquist *et. al.,* 2005). It is accepted that early planting with a full season relative maturity has higher yield potential as compared to a late planting with a short season maturity in field crops (Richards, 1996). The longer crop life cycle permits better use of resources such as water, solar radiation, space and nutrients by the crop (Andrade *et. al*., 2000; Tsimba *et. al*., 2013; Parker *et al.*, 2016). However, yield is mainly responsive to growth and partitioning during the critical growth periods (Andrade *et al.,* 2000; Vega *et al.,* 2001), an early sowing and full season hybrid does not guarantee higher productivity as other factors also affect it such as drought, heat, and nutrient stresses (Edmeades *et. al.,* 2000). Planting time greatly affects the growth, development and productivity of maize crop as it brings changes in weather condition such as temperature, solar radiation, and humidity during crop cycle which ultimately responsible for changes in morphology, plant physiology and molecular mechanisms of plants growth and development. Thus, planting time has prime importance for crop productivity due to its effect on weather conditions.

TABLE 2
Effect of different sowing dates on grain yield, Days to 50% tasseling, Days to 50% silking, No. of Days to maturity and economics of different hybrids on mean bases of three years (2015-2017)

Treatments	Grain yield (q/ha)	Days to 50% tasseling	Days to 50% silking	No. of days to maturity	Return over variable cost (Rs./ha)	B : C
Sowing dates						
Last week of January	82.7	83.0	86.0	126.4	51031	1.8
First week of February	86.4	79.5	83..0	123.3	56269	1.9
Second week of February	80.9	71.0	72.3	120.2	48763	1.8
Third week of February	73.4	65.0	67.4	117.2	38779	1.6
Fourth week of February	66.0	58.1	61.2	114.3	30028	1.5
CD at 5%	3.0	0.3	0.3	0.6	-	-
Hybrids						
HQPM 1	78.5	72.3	75.1	121.2	45383	1.7
HQPM 4	79.8	72.4	75.3	121.0	47320	1.8
HQPM 5	75.8	73.1	76.4	123.0	42013	1.7
HM 9	75.9	70.1	73.2	118.5	42065	1.7
HM 10	82.9	72.0	75.0	120.0	51600	1.8
HM 11	81.0	72.4	75.4	121.0	49150	1.8
HM 12	73.0	68.3	71.3	118.2	37288	1.6
CD at 5%	4.0	0.4	0.4	0.4	-	-

CONCLUSION

The results of the trial concluded that the appropriate time of sowing of spring maize crop is first week of January that gave maximum grain yield and economic returns. Among different hybrids, HM 10 proved to be superior in terms of grain yield and economic returns.

REFERENCES

Andrade, F. H., M. E. Otegui, and C. Vega. 2000 : Intercepted radiation at flowering and kernel number of maize. *Agron. J.* **92** : 92-97. *doi:10.2134/agronj2000.92192x*.

Anonymous 2020 : Statistical abstract of Haryana (2019-20), Department of economic and statistical analysis, Haryana.

Barakatullah Rabbani and Ali Jawed Safdary 2021 : Effect of sowing date and plant density on yield and yield components of three maize (*Zea mays* L.) genotypes in Takhar climatic conditions of Afghanistan. *Central Asian Journal of Plant Science Innovation* **1**(2): 109-120.

Buriro, M., Bhutto, T. A., Gandahi, A. W., Kumbhar, I. A., Shar, M. U., 2015 : Effect of sowing dates on growth, yield and grain quality of hybrid maize. *J. Basic Appl. Sci.,* **11** : 553-558. https://doi.org/10.6000/1927-5129.2015.11.73

Edmeades, G. O., J. Bolanos, A. Elings, J. M. Ribaut, M. Banziger, and M. E. Westgate. 2000 : The role and regulation of the anthesis silking interval in maize. In: M. Westgate and K. Boote, editors, Physiology and modeling kernel set in maize. CSSA Spec. Publ. 29. CSSA and ASA, Madison, WI. p. 43-73. doi:10.2135/cssaspecpub29.c4.

FAO 2021 : FAOSTAT, Food Supply. Cited January 31, 2023. https://www.fao.org/faostat/en/#data/QCL/visualize.

Jiban Shrestha, Manoj Kandel and Amit Chaudhary, 2018 : Effects of planting time on growth, development and productivity of maize (*Zea mays* L.). *Journal of Agriculture and Natural Resources* **1**(1): 43-50.

Kamara, A.Y., F. Ekeleme, D. Chikoye, L.O. Omoigui, 2009 : Planting date and cultivar effects on grain yield in dryland corn production. *Agron. J.,* **101**(1): 91-98.

Lindquist, J.L., T.J. Arkebauer, D.T. Walters, K.G. Cassman and A. Dobermann. 2005 : Maize radiation use efficiency under optimal growth conditions. *Agron. J.,* **97** : 72-78.

Maddi Vanaja, S. K. Yadav, G. Archana, N. Jyothi Lakshmi, P.R. Ram Reddy,P. Vagheera, S.K. Abdul Razak, M. Maheswari, B. Venkateswarlu, 2011 : Response of C_4 (maize) and C_3 (sunflower) crop plants to drought stress and enhanced carbon dioxide concentration. Plant, Soil and Environment, **57**(5): 207-215.

Mehdi Dahmardeh, 2012 : Effects of sowing date on the growth and yield of maize cultivars (*Zea mays* L.) and the growth temperature requirements. African Journal of Biotechnology. **11**(61): 12450-12453.

Narender Singh, Preeti Sharma and M. C. Kamboj, 2017 : Maize scenario in Haryana: A brief review. *Indian Journal of Pure and Applied Bio Sciences.* **5**(6): 1616-1623.

Neeraj Kumar, R. S. Chhokar, R. P. Meena, A. S. Kharub, S. C. Gill, S. C. Tripathi, O. P. Gupta, S. K. Mangrauthia, R. M. Sundaram, C. P. Sawant, Ajita Gupta, Anandkumar Naorem, Manoj Kumar and G. P. Singh, 2021 : Challenges and opportunities in productivity and sustainability of rice Cereal cultivation system: a critical review in Indian perspective. Research communications. https://doi.org/10.1007/s42976-021-00214-5.

Parker, P. S., J. S. Shonkwiler, and J. Aurbacher, 2016 : Cause and consequence in maize planting dates in Germany. *J. Agron. Crop Sci*., **203**: 1-14.

Pukar Khanal, Rupak Karn, Pratibha Budhathoki Chhetri, Samita Karki, Shrawan Kumar Sah, 2019 : Response of maize varieties to sowing dates in inner terai region, Dang, Nepal. Malaysian journal of halal research journal (MJHR) 9, **2**(2): 27-31.

Richards, R. A. 1996 : Increasing yield potential in wheat: Manipulating sources and sinks. In: M.P. Reynolds, R. Rajaram, and A.McNab, editors, Increasing yield potential in wheat: Braking the barriers. CIMMYT, Mexico City, Mexico. p. 134-149.

Sawan, Z. M., 2018 : Climatic variables: Evaporation, sunshine, relative humidity, soil and air temperature and its adverse effects on cotton production. *Inf. Process. Agric.,* **5**(1): 134-148.

Sheoran, O. P., 2016 : Statistical analysis software at the website of CCS Haryana Agricultural University Hisar. www.hau.ernet.in.

Umesh Shrestha, Lal Prasad Amgain, Tika Bahadur Karki, Khem Raj Dahal and Jiban Shrestha, 2016 : Effect of sowing dates and maize cultivars in growth and yield of maize along with their agro-climatic indices in Nawalparasi, Nepal. *Journal of Agri Search* **3**(1): 57-62.

Vega, C. R. C., F. H. Andrade, V. O. Sadras, S. A. Uhart, and O. R. Valentinuz. 2001 : Seed number as a function of growth. A comparative study in soybean, sunflower, and maize. *Crop Sci.* **41** : 748-754.

Verma, S. S. and S. N. Mishra, 1998 : Successful cultivation of maize in summer. Indian Farmers' Digest **31**: 17-18.