Indian Journal of Agronomy **60** (3): 476–478 (September 2015)

Research Communicaiton

Response of maize hybrids (*Zea mays*) to staggered sowing

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Received : December 2014; Revised accepted : August 2015

ABSTRACT

A field experiment was conducted at the Indian Agricultural Research Institute, New Delhi during the rainy (*kharif*) season of 2012 to study growth and yield behavior of maize (*Zea mays* L.) hybrids 'Vivek QPM 9', 'PEHM 5', 'DHM 117' and 'PMH 3' under staggered sowing (25 June, 10 July, 25 July and 10 August). Sowing on 10 July was better than 25 June, 25 July and 10 August as it recorded taller plants with higher leaf area index, dry weight/plant, cob length and cob weight. Maize hybrid 'PMH 3' recorded higher cob weight, cob length, shelling (%) and grain and stover yields than 'Vivek QPM 9', 'PEHM 5' and 'DHM 117'. Uptake of N, P and K was high at 10 July, with 'PHM 3'. Sowing on 10 July recorded higher net returns (₹ 48.1 × 10^3/ha) and benefit: cost ratio (1.78) as compared to other dates of sowing. 'PHM 3' gave the highest net returns (₹ 46.5 × 10^3/ha) and benefit: cost ratio (1.65). The highest values of N, P and K uptake were found at 10 July planting. Among the hybrids 'PMH 3' had the highest N and K uptake. For getting more yields and profit, 'PMH 3' hybrid should be planted on 10 July.

Key words **:** Maize hybrids, Staggered sowing

Maize is the third most important cereal crop after rice and wheat in India. Climate variability has a direct influence on the quantity and quality of maize production as water shortage combined with thermal stress adversely effect maize productivity. To deal with the impact of climate change, the potential adaption strategies are identifying stress resistant varieties, changing sowing dates; crop diversification, integrated farming system, *etc*. (Pathak *et al*., 2011). Optimum sowing date is important to mitigate climate change (Laux *et al*., 2010). Growing a suitable hybrid at an optimum sowing time may be better agronomic option under the water starved condition. There is need to evaluate the different maturity hybrids of maize for their growth and yield under varying sowing dates and the present investigation addresses this issue.

A field experiment was conducted during the rainy (*kharif*) season of 2012 at Indian Agricultural Research Institute, New Delhi on sandy loam texture soil, low in organic C and available N and medium in available P and K with pH 7.7. The experiment consisting of sowing dates, viz. 25 June, 10 July, 25 July and 10 August and maize hybrids, viz. 'Vivek QPM 9', 'PEHM 5', 'DHM 117' and 'PMH 3' was laid out in split-plot design having 3 replications. The sowing dates and hybrids were allocated in main and sub-plots, respectively. The crop was sown on the side of ridges made at 75 cm at intra row spacing of 20 cm. The recommended doses of N (120 kg), P_2O_5 (60 kg) and K_2O (50 kg) were applied in the form of urea, single super phosphate and muriate of potash, respectively. Half the dose of N and whole amount of P and K was applied as basal, while remaining N was applied in to two equal splits at knee height and pre-tasselling stages. $ZnSO_4$ @ 25 kg/ha was also applied as basal uniformly. The plant height, leaf area index and dry matter accumulation were measured from 5 and 3 randomly sampled plants, respectively. The yield attributes, viz. cob length, cob weight and shelling percentage were worked out from 5 randomly selected cobs. The grain yield, stover yield and uptake of N, P and K were estimated using the standard methodologies. The economics was worked out on the basis of prevailing rates of inputs and produce.

Taller plants were recorded, when hybrids were planted on 10 July compared to other sowing dates (Table 1). The LAI and dry weight/plant were significantly improved from 25 June to 10 July sowing and further delay in sowing markedly reduced LAI and dry weight/plant. The lower LAI, dry weight/plant and plant height at 25 June

Based on part of M.Sc. thesis of the first author submitted to Indian Agricultural Research Institute, New Delhi during 2013 (Unpublished)

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sowing compared to 10 July was due to dry spell of about more than week at early growth stages and delayed sowing beyond 10 July reduced these growth parameters because of reduction in vegetative growth period. At delayed sowing, reduced photo intensity and duration of light might be responsible for lowering down the crop growth. 'PMH 3' produced taller plant with higher dry weight/plant and LAI as compared to 'Vivek QPM 9', 'PEHM 5' and 'DHM 117' because of longer vegetative phase. The findings of Shah *et al.* (2012) and Moosavi *et al.* (2012) are in close conformity of the results. Early sowing date 25 June required more days to tasselling while plant with late sowing, flowered earlier and hybrids 'PMH 3' took maximum days to tassel and mature, while short duration hybrids 'Vivek QPM 9' and 'PEHM 5' completed their life cycle earlier in shorter period.

Sowing on 10 July recorded higher cob weight, cob length and shelling per cent. Early sowing on 25 June and delay in sowing up to 25 July and 10 August recorded marked reduction in the yield attributing characters. At delayed sowing reduction in LAI and dry matter accumulation due to shorter vegetative stage and poor partitioning of dry matter in sink might be responsible for lower values of yield attributes. 'PMH 3' recorded significantly higher yield attributes than others. Longer vegetative period for production of more LAI and dry-matter resulted in higher values of these parameters with 'PMH 3'. Kolo *et al.* (2012) also reported the similar findings. There was 6.9% improvement in grain yield with 10 July sowing as compared to 25 June sowing, while delayed on 25 July and 10 August significantly reduced the grain yield to the time of 11.9 and 33.1% as compared to 10 July sowing. Maize hybrid 'PMH 3' produced the maximum grain yield, which was 24.0, 15.1 and 9.0% more than that of 'Vivek QPM 9', 'PEHM 5' and 'DHM 117' respectively.

Interaction between maize hybrids and planting dates was also found significant (Table 2). Significantly maximum grain yield was produced when 'PHM 3' was planted on 10 July and lowest yield was obtained by 'Vivek QPM 9' on 25 June planting. There was an improvement in grain yield of 'Vivek QPM 9' and 'PEHM 5' hybrids up to 25 July planting probably due to the reason that these hybrids have the ability to complete their life cycle in shorter crop duration. However, in case of 'DHM 117' and 'PMH 3' delay in planting beyond 10 July markedly reduced the grain yield. This might be attributed to the fact that delay sowing squeezes the reproductive phase of development, which adversely affected grain development and hence resulted in lower grain index (Amjadian *et al.* 2013). Sowing on 25 July with 'PEHM 5' resulted in the highest yield.

'PHM 3' recorded the maximum N and K uptake,

Table 1. Effect of sowing dates and different hybrids on growth, yield, nutrient uptake and economics of maize

Treatment	Plant height at maturity (cm)	LAI (60 DAS)	Dry-matter accumulation at maturity (g/plant)	Tassel initiation (DAS)	Cob length (cm)	Cob weight (g)	Shelling (%)	Grain yield (t/ha)	Stover yield (t/ha)	Nutrient uptake (kg/ha)			Net returns ($\times 10^3$/ha)	Benefit: cost ratio
										N	P	K		
Sowing date														
25 June	179.7	4.0	96.0	62	14.7	137.1	84.0	5.4	6.7	81.4	17.0	72.8	43.8	1.67
10 July	189.5	4.2	101.8	58	16.2	145.7	85.0	5.8	7.0	87.7	17.6	76.1	48.1	1.78
25 July	183.8	3.9	92.1	54	13.9	135.9	83.6	5.1	6.6	77.3	15.5	70.2	42.8	1.76
10 August	161.6	3.4	71.0	52	10.1	99.7	78.9	3.8	6.1	60.3	11.8	61.3	27.1	1.11
SEm±	0.36	0.005	0.37	0.3	0.3	0.4	0.3	0.08	0.04	0.5	0.4	0.5	1.0	0.04
CD (P=0.05)	1.2	0.02	1.3	1.1	1.0	1.6	1.2	0.29	0.17	1.7	1.6	1.7	3.6	0.14
Hybrid														
'Vivek QPM 9'	159.1	3.6	86.2	50	12.1	122.4	81.7	4.3	5.9	67.8	15.4	63.7	33.8	1.46
'PEHM 5'	172.6	3.8	90.1	55	12.5	127.3	82.3	4.8	6.4	74.1	15.2	68.2	39.3	1.60
'DHM 117'	185.2	3.9	91.2	58	14.2	130.0	83.0	5.2	6.9	79.4	15.6	72.9	42.2	1.61
'PMH 3'	197.8	4.0	93.5	63	16.0	138.6	84.6	5.7	7.2	85.4	15.7	75.6	46.5	1.65
SEm±	4.33	0.1	0.3	2.3	0.2	0.3	0.3	0.05	0.04	0.6	0.43	0.6	0.64	0.04
CD (P=0.05)	13.66	0.5	1.1	7.4	0.6	0.9	0.8	0.16	0.11	1.8	NS	1.7	1.86	0.12

Table 2. Interaction effect of hybrids and planting dates on grain yield (t/ha)

Treatment	Hybrids			
Planting date	'Vivek QPM 9'	'PEHM 5'	'DHM 117'	'PMH 3'
25 June	4.29	4.71	5.76	6.85
10 July	4.32	5.21	6.37	7.28
25 July	4.53	5.53	5.11	5.28
10 Aug	4.14	4.08	3.71	3.58
SEm ±			0.18	
CD (P=0.05)			0.42	

which were markedly more than other hybrids, however, hybrids did not differ in respect of P uptake. Maize hybrids planted on 10 July noticed the highest values of N, P and K uptake, which were higher than remaining dates of planting (Table 1).

It was concluded that 'PMH 3' is a better hybrid for getting higher productivity when planted on 10 July under the changing rainfall pattern of the country.

REFERENCES

Amjadian, M., Farshadfar, M. and Gholipoor, M. 2013. The effects of sowing date on the yield and yield components of corn (*Zea mays* L.) cultivar, single cross 704 in Gorgan region. *Annals of Biological Research* **4**(4) : 38–44.

Bender, R.R., Haegele, J.W., Ruffo, M.L. and Below, F.E. 2013. Nutrient uptake, partitioning, and remobilization in modern, transgenic insect-protected maize hybrids. *Agronomy Journal* **105**(1) : 161–70.

Kolo, E., Takim, F.O. and Fadayomi, O. 2012. Influence of sowing date and weed management practice on weed emergence, growth, and yield of maize (*Zea mays* L.) in southern Guinea savanna of Nigeria. *Journal of Agriculture and Biodiversity Research* **1**(3): 33–42.

Laux, P., Jackel, G., Tingem, R.M. and Kunstmann, H. 2010. Impact of climate change on agricultural productivity under rainfed conditions in Cameroon-A method to improve attainable crop yields by sowing date adaptations. *Agricultural and Forest Meteorology* **150**(9): 1,258–271.

Moosavi, S.G., Mohamad, J.S. and Ali, M. 2012. Effect of sowing date and plant density on morphological traits, LAI and forage corn (Sc. 370) yield in second cultivation. *International Research Journal of Applied and Basic Sciences* **3**(1): 57–63.

Pathak, H., Saharawat, Y.S., Gathala, M. and Ladha, J.K. 2011. Impact of resource conserving technologies on productivity and greenhouse gas emission in rice–wheat system. *Greenhouse Gas: Science and Technology* **1**: 261–77.

Shah, A., Akmal, M., Asim, M., Farhatullah, Raziuddin, and Rafi, A. 2012. Maize growth and yield in Peshawar under changing climate. *Pakistan Journal of Botany* **44**(6): 1,933–938.