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RESPONSE OF *RABI* MAIZE (*ZEA MAYS* L.) TO DIFFERENT DATES OF SOWING AND FERTILITY LEVELS

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Abstract: A field experiment was conducted during *rabi* season of 2015-16 to study the response of *rabi* maize to different dates of sowing and fertility levels. The trial was laid out in split plot design with four replications, assigning twelve treatment combinations i.e. four sowing dates (15th October, 1st November, 15th November and 1st December) in main plot and three fertility levels (200-100-00, 175-87.5-00 and 150-75-00 kg NPK per ha.) in sub plots. The crop sown on 1st November significantly enhanced the growth and grain yield than early sowing 15th October and late sowing 15th November and 1st December while, application of 200-100-00 kg N: P_2O_5 :K_2O per ha significantly increased grain yield over 175-87.5-00 kg NPK per ha and 150-75 kg N: P_2O_5 per ha.
Keywords: *Rabi* maize, Sowing dates, Phosphorus, fertility levels.

Introduction

Among the cereals, maize (*Zea mays L.*) ranks third in total world food production after wheat and rice and it is the staple food in many countries, particularly in the tropics and sub-tropics. Maize is considered as the "Queen of Cereals". Being a C_4 plant, it is capable to utilize solar radiation more efficiently even at higher radiation intensity.

The most popular variety of quality protein maize HQPM-1 having slow initial growth and there after vigorous growth, it has high nitrogen requirement compared to other hybrids (Singh *et al.,* 2010).

To augment higher crop yield per unit area, proper sowing time is the most important factor. Sowing of the crop at right time ensures better plant growth and also inhibits weed growth. There are evidences that optimum time of sowing is one of the several cultural manipulations and play a vital role in boosting up the yield, particularly in Indian sub continent where the optimum time of sowing varies to great extent due to widely varying agro-climate conditions. Though, optimum time of sowing is decided by several factors, fluctuation in temperature during the growing season play a vital role.

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Among the primary nutrients, nitrogen though an expensive input is very important as it is intimately involved in the process of photosynthesis and directly reflected in the total dry matter production. It is also associated with vigorous vegetative growth, deep green colour and yield. An adequate supply of nitrogen is closely associated with growth and development of plants. Nitrogen is the most important input for realizing protein yield of any crop as requirement of nitrogen is the highest among all the essential plant nutrients as this nutrient is most limiting under Indian condition. It plays an important role in plant metabolism by virtue of being an essential constituent of structural component of the cell and much diverse type of metabolically active compounds. It is also a constituent of chlorophyll, which is important for the harvest of solar energy. Nitrogenous fertilizer therefore, forms a basic input for obtaining high yield. Nitrogen being an integral part of protoplasm and an essential constituent of plant tissues, its normal application quickly shows beneficial effect by increasing leaf greenness plant development. Maize is an exhaustive crop requires a regulated and assured supply of nutrients particularly nitrogen throughout its growing period right from seedling stage to grain filling stage. Demand of plants for nitrogen is more than any other nutrient and it is noticed that its deficiency at any stage of growth, especially at tasseling and silking stage, may lead to small, shriveled grains and virtual crop failure. Nitrogen deficiency is characterized by stunted and spindly plant growth with yellowing of green foliage particularly the lower leaves. Hence higher yield of quality protein of maize can be obtained through judicious use of nitrogen as it can alone contributes 45-60 % crop yield (Das *et al.,* 2010)

Phosphorus is a fascinating plant nutrient. It is involved in a wide range of plant processes from permitting cell division to the development of a good root system and for ensuring timely and uniform ripening of the crop. It is most needed by young fast growing tissues and performs a numbers of functions related to growth, development, photosynthesis and utilization of carbohydrates. In maize crop, phosphorus helps in development of all phases. It shows its deficiency mainly at the seedling stage, though it is needed most after flowering stage.

Materials and methods

The experiment was conducted at the Cotton Research Farm, Sardarkrushinagar Dantiwada Agricultural University, Khedbrahma, District- Sabarkantha, Gujarat, 383270. During the winter (*rabi*) season of 2015-16. The soils of experimental field was loamy sand in texture having low in organic carbon content (0.31 %), available nitrogen (178.50 kg/ha), medium in available phosphorus (30.70 kg/ha) and available potash (262 kg/ha). The trial was laid out in Split Plot Design (SPD) with four replications assigning 12 treatment combinations of four sowing dates (15th Oct., 1st Nov., 15th Nov. and 1st Dec.) in main plots, three fertility levels N:P_2O_5:K_2O (200-100-00, 175-87.5-00 and 150-75-00 kg per ha) in sub plot. Maize hybrid HQPM 1 was sown according to the dates decided in the treatment, maintaining 75 cm row-to-row and 20 cm plant-to-plant distance with the seed rate of 20 kg per ha at 2.5 cm depth. Full dose of phosphorus and half dose of nitrogen as per treatment were applied through diammonium phosphate and urea, respectively as basal and remaining half dose of nitrogen was top dressed in two equal splits each at four leaf stage and at flowering stage. Other cultural operations viz. and plant protection measures were applied as need based.

Result and discussion

Effect of date of sowing

Growth attributes viz. plant height at 45 DAS and at harvest of *rabi* maize and basal girth did not differ significantly due to different dates of sowing (Table 1). However, numerically higher plant height at 45 DAS and at harvest and basal girth were recorded on 1st November sowing. The taller plants were recorded in the month of October and November sowing might be due to favourable temperature provided to maize crop in comparison to rest of the sowing time.

Various yield attributes *viz.,* number of grains per cob, grain weight per cob, grain and straw yield were significantly influenced under varying sowing date(Table 2 and 3). While, number of cobs per plant and cob length did not differ significantly due to different dates of sowing. However, numerically higher number of cobs per plant and cob length of *rabi* maize were recorded by 1st November sowing. It might be due to favourable temperature resulting the better growth and development of crop. The results are in close proximity with findings of Singh *et al.,* (1987) and Shaheenazzamn *et al.,* (2015).

Effect of fertility levels

Data presented in table 1 revealed that the higher values of plant height (at 45 DAS and at harvest) and basal girth were recorded under treatment F_3 (200-100-00 NPK kg/ha) might be due to optimum levels of N and P_2O_5, a component of fertility management affected on crop growth seems to be due to maintaining congenial nutritional environment of plant system on account of their greater availability from soil media, which might have resulted in greater synthesis of amino acid, proteins and growth promoting substances, which seems to have enhance the meristematic activity and increased cell division and their elongation. Further application of N & P might have increased interception, absorption and utilization of radiant energy which in turn increased photosynthesis and there by Plant height and basal girth. The present findings are within the close vicinity of these represented by Kumar and Singh (2000), Singh *et al.,* (2003), Patel *et al.,* (2009) and Wasnik *et al.,* (2012).

Yield attributes and yield viz., cob length, number of grains per cob, grain weight per cob and seed index (Table 2 and 3) were significantly influenced by various fertility levels. Whereas, number of cobs per plant did not differ significantly due to different fertility levels. However, numerically the maximum number of cobs per plant were noted under application of 200-100-00 kg NPK /ha. The results are closely related with findings of Tyagi *et al.,* (1998), Singh *et al.,* (2000), Singh *et al.,* (2003) and Tank *et al.,* (2006). Different fertility levels failed to express their significant effect on harvest index. The increase in grain and straw yield under higher fertility level might be due to fact that higher level of nitrogen and phosphorus led to adequate supply of nutrients to the plant resulting in better growth and yield attributes (Table 1 and 2) which in turn led to better physiological process and movement of photosynthates to sink which ultimately resulted in higher economic yield. The results are in close proximity with the findings of Subbian *et al.,* (1991), Mishra *et al.,* (1994), Tyagi *et al.,* (1998), Singh *et al.,* (2000), Tank *et al.,* (2006), Sepat and kumar (2007a), Paramasivam *et al.,* (2011) and Meena *et al.,*(2011) and Mathuliya *et al.,* (2014).

On the basis of the results, it is concluded that the for getting higher grain and straw yield of *rabi* hybrid maize (HQPM 1) it should be sown between 15th October to 1st November and fertilizing with 200 kg N and 100 kg P_2O_5 / ha under North Gujarat climatic conditions.

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Table 1: Growth and growth attributes of *rabi* maize as influenced by date of sowing and fertility levels

Treatments	Growth and growth attributes				
	Plant population (No of plants/ha)		Plant height (cm)		Basal girth (cm)
	At initial	At harvest	At 45 DAS	At harvest	
Main plot : Date of sowing (D)					
D_1 : 15th October	54869	46269	104.2	203.8	6.7
D_2 : 1st November	55403	46536	10707	206.0	6.8
D_3 : 15th November	54403	45936	102.4	201.6	6.6
D_4 : 1st December	53736	45602	98.2	196.6	6.3
S.Em.±	1640	1460	3.90	7.44	0.18
C.D. at 5 %	NS	NS	NS	NS	NS
C. V. (%)	10.40	10.99	10.80	12.76	9.46
Sub plot : Fertility levels (NPK kg/ha) (F)					
F_1 : 150-75-00	53129	44602	92.2	190.9	6.0
F_2 : 175-87.5-00	54643	45936	101.0	202.2	6.5
F_3 : 200-100-00	56043	47669	116.2	213.0	7.3
S.Em.±	1007	873	2018	4.27	0.11
C.D. at 5 %	NS	NS	6.37	12.47	0.33
D x N (Interaction)	NS	NS	NS	NS	NS
C. V. (%)	7.38	7.57	8.46	8.46	6.90

Table 2: Yield attributes of *rabi* maize as influenced by date of sowing and fertility levels.

Treatments	Yield attributes				
	Cobs/ plant (No.)	Cob length (cm)	Grains/ cob (No.)	Grain weight/ cob (g.)	Seed index (g.)
Main plot : Date of sowing (D)					
D_1 : 15th October	1.51	18.8	358.17	96.38	26.91

D_2 : 1st November	1.57	19.3	376.81	100.04	27.08
D_3 : 15th November	1.45	18.5	338.19	92.71	26.79
D_4 : 1st December	1.42	17.8	324.89	88.29	26.63
S.Em.±	0.07	0.49	11.18	2.61	0.99
C.D. at 5 %	NS	NS	35.76	8.34	NS
C. V. (%)	16.31	9.20	11.08	9.56	12.77
Sub plot : Fertility levels (NPK kg/ha) (F)					
F_1 : 150-75-00	1.42	17.3	330.42	87.52	25.86
F_2 : 175-87.5-00	1.50	18.5	350.88	94.66	27.02
F_3 : 200-100-00	1.56	20.0	367.25	101.13	27.67
S.Em.±	0.04	0.27	5.29	1.57	0.49
C.D. at 5 %	NS	0.78	15.45	4.57	1.42
D x N (Interaction)	NS	NS	NS	NS	NS
C. V. (%)	10.71	5.75	6.06	6.64	7.25

Table 3: Yields and quality of *rabi* maize as influenced by date of sowing and fertility levels

Treatments	**Grain yield (kg/ha)**	**Stover yield (kg/ha)**	**Harvest index (%)**	**Protein content (%)**	**Protein yield (kg/ha)**
Main plot : Date of sowing (D)					
D_1 : 15th October	4790	5080	48.5	10.2	491
D_2 : 1st November	5125	5365	48.8	10.3	528
D_3 : 15th November	4590	4929	48.1	10.2	467
D_4 : 1st December	4121	4454	47.9	10.1	416
S.Em.±	162.64	130.32	1.31	0.30	19.79
C.D. at 5 %	520.32	416.93	NS	NS	63.32
C. V. (%)	12.10	9.11	9.38	10.29	14.42
Sub plot : Fertility levels (NPK kg/ha) (F)					
F_1 : 150-75-00	4249	4700	47.4	10.0	422
F_2 : 175-87.5-00	4540	4817	48.4	10.1	461
F_3 : 200-100-00	5280	5355	49.1	10.5	544
S.Em.±	129.20	91.10	0.95	0.15	13.01
C.D. at 5 %	377.10	265.91	NS	0.45	37.98
D x N (Interaction)	NS	NS	NS	NS	NS
C. V. (%)	11.10	7.35	7.88	6.03	10.95