Original Research Article

RESPONSE OF DIFFERENT DATES OF SOWING AND FERTILITY LEVELS ON YIELD AND ECONOMICS OF *RABI* MAIZE (*Zea mays* L.)

ABSTRACT

A field experiment was conducted during *rabi* season of 2015-16 to study the performance of *rabi* maize to different date of sowing and fertility levels. The trial laid out in split plot design with four replications, assigning total 48 combinations i.e. four sowing dates (15^{th} October, 1^{st} November, 15^{th} November and 1^{st} December) in main plot and three fertility levels from urea and DAP (200-100-00, 175-87.5-00 and 150-75-00 kg NPK per ha.) in sub plots. The crop sown on 1^{st} November significantly enhanced the yields and economics then early sowing 15^{th} October and late sowing 15^{th} November and 1^{st} December while, 200-100-00 kg NPK per ha application significantly increased over 175-87.5-00 kg NPK per ha and 150-75-00 kg NPK per ha.

Key Word – Maize, Date of Sowing, Fertility levels, Economics

1. 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 C4 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 requirements compared to other hybrids (Singh *et al.,* 2010).

To augment higher crop yield per unit area, proper sowing time and inter row spacing are the most important factors. The proper sowing time exerts a marked effect on the growth and eventually the yield of a crop. Sowing of the crop at right time ensures better plant growth and also inhibits weed growth. There are evidences that optimum time of showing is one of the several cultural manipulations and play a vital role in boosting up the yield, particularly in India 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.

Environmental factors could be governed possibly by showing time which has great bearing on the realization of the yield potential of the crop. Beside weather parameters, management practices also influence the overall performance of the crop. There is need to understand the crop response to management practices in relation to weather factors, which will help in manipulating crop agronomic practices to suit in varying environmental conditions.

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 color and yield. An adequate supply of nitrogen is closelyassociated 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 are 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 it's 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

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leaves. Hence higher yield of quality protein of maize can be obtained through judicious use of nitrogen as it can along 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,photosynthesisutilization 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.

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2. MATERIALS AND METHODS

The experiment was conducted at the Cotton Research Farm, SardarkrushinagarDantiwada Agricultural University, Khedbrahma, District- Sabarkantha, State- Gujarat, PIN- 383270. In India during the winter (*rabi*) season of 2015-16. The soil of experimental field was loamy sand soil in reaction (pH 7.4) which was low in organic carbon content (0.31 %) and Available nitrogen (178.50 kg/ha), and medium in available phosphorus (30.70 kg/ha) and available potash (262.01kg/ha). The trial was laid out in Split Plot Design (SPD) with four replications assigning 48 treatment combinations of four sowing dates (15th Oct., 1st Nov., 15th Nov. and 1st Dec.) in main plots, three fertility levels through urea and DAP (200-100-00, 175-87.5-00 and 150-75-00 kg NPK per ha) in sub plot. Hybrid HQPM-1 variety of maize 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 through diammonium phosphate and urea, respectively, were applied as basal and remaining half dose of nitrogen was top dressed in two equal splits–one each at 4 leaf stage and at flowering stage was applied. Other compulsory activities viz. interculture and plant protection measures were applied as need based.

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3. RESULT AND DISCUSSION

3.1 Effect of date of sowing: Significantly higher grain yield was produced by sowing the *rabi* maize crop on 1st November (Table:1) as compared to other treatments, but it was found at par with 15th October sowing. The percent increase in grain yield by 1st November sowing was to the tune of 6.53, 11.66 and 24.36 over 1st October, 15th November and 1st December sowing. The crop sown on 1st November gave 1004 kg higher grain yield than 1st December sowing. This might be due to optimum growth period favoured by 1st November sowing. The maximum yield recorded under 1st November sowing might be due to favourable temperature resulting in better growth and development of crop which increased yield attributes *viz;* number of grains per cob, grain weight per cob and seed index (Table 2) which led to better grain production efficiency by the crop. These yield attributes were also significantly decreased by early and delay in sowing (Table 2)., Moreover, the possible reason responsible for reduction in yield under advanced and delay sowing were temperature and length of growing periods. Further, differences of environmental condition during the growing period due to different sowing time may have reduced photoassimilate production during the lag phase of late sown maize because both temperature and incident solar radiation were low at that time which may affect on biomass production and perhaps sink activity. These findings are in close agreement with the results reported by Sawhney *et al.,* (1989), Nandal and Agarwal (1991), Rahman *et al.,* (2001), Rahman *et al.,* (2008), Reddy *et al.,* (2010) Singh *et al.,* (2015) and Shaheenuzzamn*et al.,* (2015).

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Significantly higher straw yield was produced by sowing the *rabi* maize crop on 1st November (Table 1) as compared to other sowing dates. However, it remained at par with 15th October sowing. Increased in straw yield of *rabi* maize under 1st November and 15th October sowing was to the tune of 9.02, 20.45 and 3.06, 14.05 percent over 15th November and 1st December sowing respectively. Higher straw yield obtained under these treatments might be due to environmental factors like temperature, solar radiation and day light gradually diminished during October to December and favoured the growth of early sown crop than that of late sown as evident from increased value of growth attributes *viz;* plant height and basal girth (Table 1). The results are in close vicinity with the findings of Bainade*et al.,* (1987), Porwal and Jain (1999), Singh *et al.,* (2015) and Shaheenuzzamn*et al.,* (2015).

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As far as harvest index is concerned, various treatments of sowing date failed to express their significant effect; however, numerically the maximum value of harvest index (48.78 %) was noticed under 1st November sowing. The results are in consonance with those of Porwal and Jain (1999). Significantly higher protein yield was noted under treatment D_2 (1^{st} November). However, it was found at par with sowing of *rabi* maize on 15^{th} October and 15^{th} November. The protein yield increased under 1^{st} November, 15^{th} October and 15^{th} November to magnitude of 26.92, 18.02 and 12.25 percent over 1^{st} December sowing. This might be due to higher value of protein content and grain yield by 1^{st} November, 15^{th} October and 15^{th} November sowing (Table 1). The results are in closely accordance with the findings of Verma *et al.,* (2012).

Economics is the forecast consideration of the farmer's point of view while thinking a decision to adopt a new technology. The data in Table 2indicated that the highest net realization of ₹ 73371 /ha was achieved under 1^{st} November sowing, followed by 15^{th} October sowing(₹ 66302 /ha). Both these treatments also recorded higher BCR (1.96 and 1.77) value over other treatments. The minimum net realization of ₹ 52024 /ha and benefit cost ratio of 1.39 were observed by 1^{st} December sowing. This could be attributes to highergrain and straw yield recorded under early sown crop than late sown crop without any additional expenditure (Table 2). These findings are substantiated with those reported by Patel *et al.,* (1994), Porwal and Jain (1999) Singh *et al*., (2015)

3.2 Effect of fertility levels: The grain yield of *rabi* maize was significantly influenced due to different fertility levels. Application of 200-100-00 kg NPK /ha (F_3) recorded significantly the highest grain yield of *rabi* maize. The lower fertility level of treatment F_1 (150-75-00 kg NPK /ha) recorded the minimum grain yield of *rabi* maize. The treatment F_1 (150-75-00 kg NPK /ha) and F_2 (175-87.5-00 kg NPK /ha) were found equally effective with respect to grain yield. The increase in grain yield of *rabi* maize respectively over treatments F_1 (150-75-00 kg NPK /ha) and F_2 (175-87.5-00 kg NPK /ha).

The straw yield of *rabi* maize was significantly influenceddue to different fertility levels. Application of 200-100-00 kg NPK /ha (F_3) recorded significantly the highest straw yield of *rabi* maize. The increase in straw yield of *rabi* maize under treatment F_3 (200-100-00 kg NPK /ha) was to the tune of 13.93 and 11.16 percent, respectively over treatment F_1 (150-75-00 kg NPK /ha) and F_2 (175-87.5-00 kg NPK /ha). 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) 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) andMeena *et al.,* (2011) and Mathuliya*et al.,* (2014).

From the present study, it could be resulted that different fertility levels had significant effect on protein content and protein yield of *rabi* maize (Table 1). Significantly higher protein content and protein yield were recorded under treatment F_3 (200-100-00 kg NPK ha^{-1}) as compared to other treatments. However, it was found at par with treatment F_2 (175-87.5-00 kg NPK /ha). The protein yield increased under F_3 (200-100-00 kg NPK /ha) and F_2 (175-87.5-00 kg NPK /ha) treatment to the magnitude of 28.86 and 9.32 percent over treatment F_1 (150-75-00 kg NPK /ha). The higher protein content obtained by higher fertility levels might be due to optimum and regular supply of nitrogen nutrient to *rabi* maize crop for increasing growth and reproductive phase from soil and as it is integral part of protein the building blocks of plant. The higher protein yield recorded under higher fertility level F_3 (200-100-00 kg NPK /ha) might be due to higher protein content and grain yield of *rabi* maize(Table 1) as a result of higher growth and yield parameter due to higher availability of nutrients to the crop throughout the crop period. These findings are closely associated with those reported by Tank *et al.,* (2006), Arya and Singh (2001) Patel *et al.,* (2009) and Washnik*et al.,* (2012).

An application of 200-100-00 kg NPK per hectare recorded the maximum net realization of ₹ 73443/ha, and benefit: cost ratio of 1.91 it was followed by treatment F_2 (175-87.5-00 kg NPK per hectare) having net realization of ₹ 60887/ha and BCR of 1.63 (Table 2). The lowest net returns (350014/ha) and BCR value (1.54) were recorded by treatment F_1 (150-75-00 kg NPK /ha). This can be attributed due to the highest grain and straw yield recorded with the application of 200-100-00 kg NPK per hectare. These findings are in close conformity with those reported by sarma*et al.,* (2000), Patel *et al.,* (2000), Sepat and Kumar (2007b), Lakshami*et al.,* (2009), Wasnik *et al.,* (2012) andMathukiya*et al.,* (2014).

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Table: 1. Yields of *rabi* maize as influenced by date of sowing and fertility levels.

Treatments	Yields				
	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 kg/ha	4249	4700	47.4	10.0	422
F_2 : 175-87.5-00 kg/ha	4540	4817	48.4	10.1	461
F_3 : 200-100-00 kg/ha	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

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

Treatment	Yield (kg/ha)		Gross return (₹/ha)	Cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR (%)
	Grain	Straw				
Main plot: Date of sowing (D)						
D_1 : 15th October	4790	5080	103718	37416	66302	1.77
D_2 : 1st November	5125	5365	110787	37416	73371	1.96
D_3 : 15th November	4590	4929	99533	37416	62117	1.66
D_4 : 1st December	4121	4454	89440	37416	52024	1.39
Sub plot : Fertility levels (NPK kg/ha) (F)						
F_1 : 150-75-00 kg/ha	4249	4700	92481	36467	56014	1.54
F_2 : 175-87.5-00 kg/ha	4540	4817	98303	37416	60887	1.63
F_3 : 200-100-00 kg/ha	5180	5355	111808	38365	73443	1.91

4. CONCLUSION

On the basis of one year experimentation, it is concluded that the maximum grain yield, net realization and benefit: cost ratio can be achieved by sowing of *rabi* maize crop (HQPM-1) on 15th October to 1st November and fertilizing with 200-100-00 kg NPK per hectare.

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