Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6904

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (6):** 1292-1297 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Planting Dates and Nitrogen Levels on the Yield and Yield Components of Maize

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Received: 24.09.2018 | Revised: 30.10.2018 | Accepted: 6.11.2018

ABSTRACT

Field experiment was conducted at Sher-e-Kashmir University of Agricultural Science and Technology, Kashmir, during kharif season, 2015 and 2016 with the objective to study the growth and yield of maize under variable planting time and nitrogen levels and to simulate trends of maize production. Experiment was laid in Split-Plot design assigning three planting dates 22nd May, 30th May, 8th June to main plots and four Nitrogen Levels 80kg, 120kg, 160kg, 200kg to Sub-plots. Maximum energy was consumed in Sowing maize on 30th May with 160kg nitrogen level was 16711.72 MJ. Sowing maize on 30th May gives highest net returns of Rs. 106591.0 and 108952.5 with a B.C ratio of 2.62 and 2.67 was recorded with 160kg nitrogen level which was followed by 200kg with net returns of Rs. 103901.0 and 106244.5.As far as enery is concerned highest input was observed with nitrogen level of 200Nkha^{-1}(16711.72) As far as energy output were also observed to follow the same trend with planting on 8th June and 160 kg Nha^{-1} (115530.96 and 114334).

Key words: *Maize, Nitrogen levels, Date of sowing, Yield and Yield attributes.*

INTRODUCTION

Maize is the world's most widely grown cereal and it is ranked third among major cereal crops [3]. In the developed countries, maize is grown for animal feed and used as raw material for industrial products such as starch, glucose and dextrose[8]. Maize production requires an understanding of various management practices as well as environmental conditions that affect crop performance[6]. Of all management aspects of growing a maize crop, planting date is probably the most subject to variation because of the very great differences in weather at planting time between seasons and within the range of climates[21]. Farmers who plant maize early are concerned about frost, poor emergence and early plant growth while on other hand farmers who plant maize late are concerned about that how late planting might affect the final grain yield and grain moisture[16]. Drought occurring at flowering can lead to greater losses than when it occurs at other developmental stages[10].

Cite this article: Fayaz, A., Singh, K.N., lone, B. A. and Kumar, S., Effect of Planting Dates and Nitrogen Levels on the Yield and Yield Components of Maize, *Int. J. Pure App. Biosci.* **6(6):** 1292-1297 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6904

At very early sowing there is a high temperature which has detrimental effects like inhibits pollination, increase respiration and transpiration rates and thus limit dry matter accumulation, which in turn reduces the grain yield[12]. If sowing is delayed then the plant doesn't get the proper conditions for its growth so it results in low productivity or complete failure of the germination. Grain yield of maize decreases with the delay of sowing[20]. If a plant is planted earlier then it will give some level of productivity. Maize yield is substantially reduced by hot, dry conditions at tasseling. It is important that this growth stage be reached when there would normally be maximum chance of cloud cover and reasonable moisture[24]. Low growth yield rate in the late sown crop is mainly due to unfavorable environmental effects encountered during the reproductive phase and due to the low net assimilation rate[30].

Nitrogen plays an essential role in the growth and development of the crop. It enhances the yield of the crop. Lack of nitrogen results in stunted growth, pale yellow color, small grain size and reduced yield. It is an essential component of amino acid and protein. The growth of plant primarily depends on nitrogen availability in soil solution and its utilization by crop plants. Dry matter production and its conversion to economic yield is a cumulative effect of various physiological processes occurring during the life cycle of a plant. An increase in yield of maize with increasing rate of nitrogen has been reported[14,2]. It needs to be explored to determine the desired quantity of nitrogen fertilizer for boosting yield per unit area to avoid wasting of money by using extra quantity of this valuable material. Sanjeev *et al.*[26], reported a significant increase in grain and stover yield with the application of 240 kg N ha-1. Number of grains ear-1, 1000-seed weight, and grain weight ear-1 increased significantly with the application of 180 N ha-1 and grain yield plant-1 with the application of 240 kg N ha-1. Highest yield was produced by improved cv. Kissan by the application of 100:50 kg NP ha-1[13]. Shivay and Singh[28]. reported that highest plant height, LAI and dry matter accumulation were recorded with 120 kg N ha-1. Fedotkin and Kravtsov[7] investigated that best growth and highest yields were obtained with 240 kg N ha-1. Plant height, cob length, grains ear-1 and 1000 grain weight increased significantly with increasing N rate[9]. Similarly, Mahmood *et al.*[17], while studying the effects of different levels of N on yield and yield components of maize revealed that nitrogen had a significant effect on plant height, number of grains cob-1, 1000 grain weight and harvest index. Maximum grain yield (5.7 t ha-1) was produced when N was applied at the rate of 180 kg ha-1. Ali *et al.*[1], reported that maize treated with NP combination of 150:90 kg ha-1 produced maximum grain yield.

MATERIAL AND METHODS

The investigation was conducted at the experimental farm of Division of Agronomy at main Campus of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar Srinagar which is situated 16 Km away from city center that lies between 34.08° N latitude and 74.83° E longitude at an altitude of 1587 meters above the mean sea level. The climate is temperate type characterized by hot summers and severe wintersThe climate is temperate type characterized by hot summers and severe winters. The average annual precipitation over past twenty five years is 786 mm (Division of Agronomy, SKUAST-Kashmir) and more than 80 per cent of precipitation is received from western disturbances during winter/spring months. During crop growth period (22nd May - 4th October) Wettest months during crop growth period were September (320.6 mm) and july (101.4 mm) during 2015 and 2016, respectively. The mean maximum and minimum temperature for entire crop growth period of maize crop for 2015 was 33.5 and 20.0 ^{o}C, respectively and corresponding values for 2016 were 34.0 and 20.5 ^{o}C. The mean monthly meteorological data collected for the cropping season of 2015 and 2016 during experimental period recorded at the Meteorological observatory at Division of

Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, ShalimarThe mean monthly meteorological data collected for the cropping season of 2015 and 2016 during experimental period recorded at the Meteorological observatory at Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar.

The experiment included three dates of sowing with four nitrogen levels was laid out in split plot design with three replications assigning three planting dates 22nd May (D_1), 30th May(D_2), 8th June (D_3) to main plots and four nitrogen levels 80kg (N_1),120kg (N_2),160kg (N_3), 200kg (N_4) to sub-plots. Certified seed of maize variety "C_4" was used in the experiment. It has vigorous medium tall plants with a tendency to bear 2 cobs plant^{-1}. Cobs are long with conical cylindrical ears. Grains are flint type with orange yellow colour.All necessary management practices were carried out as per standard recommendation for maize crop. All vegetative and reproductive parameters were recorded. Plant height, , total number of leaves plant-1, Functional leaves plant-1, straw yield (qha^{-1}) were measured during vegetative period. Data on different yield parameters such as cob length, were measured with measuring scale, and counted total grain cob^{-1}, and finally grains yield (qha^{-1}), straw yield (q ha^{-1}), and biological yield (qha^{-1}) were weighed with electrical balance. The crop was harvested manually at full maturity. The harvested crop of the plot was bundled separately, tagged properly and bring to the clean threshing floor. The seeds and straw weight for each plot were recorded after sun drying an weighed. Cobs were de-husked, dried, shelled and weighed with electric balance. The data were analyzed statistically using the analysis of variance (ANOVA) technique with the help of MSTAT-C (Gomez & Gomez, 1984) and Microsoft excel program, and mean differences were adjusted by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Yield attributes

The number of cobs plant^{-1} and grains cob^{-1} were significantly influenced by different date of sowing and nitrogen levels (Table 1). During both years significantly higher cob length, and grains per cob were recorded in 30th May (D_2) followed by 15th May (D_1). This may due to more production of biomass and better partitioning of dry matter to cob and more number of days taken to anthesis and maturity. However minimum yield attributing characters were recorded in 8th June (D_3). This is due to delay in sowing reduces the growth duration, LAI, dry matter production[31]. The results are in conformity with the findings of Cantarero[4].There was an increasing trend was observed in all the yield attributes with increasing nitrogen level. Similar trend of yield attributes were reported by Dawadi and Sah[5]. Maximum number of cobs plant-1, grains row-1grains cob-1were obtained with 160 kg N ha^{-1}followed by 200 kg N ha-1and corresponding lowest values were recorded with 80kgNha^{-1}(Table 1).This might be due to proper translocation of sugar and starch in the grain by nitrogen fertilization.A similar result was also reported by Shakarami and Rafiee[27], and Pandey *et al*.[22].The higher degree of infertility under lower(80 kg N ha^{-1}) application might be attributed to poor development of sinks and reduced translocation of photosynthates. Under nitrogen stress conditions there may be big chance to asynchronous flowering and seed infertility, thus reduction in the number of seeds cob^{-1}. Gungula *et al*.[11] reported that there will be more synchrony in flowering with higher nitrogen, thus reducing the rate of infertility during grain filling period. In agreement with the results of the present study, increased in thousand grain weight has been reported with increase in nitrogen levels[19,5].

Grain yield, Stover yield and Harvest index

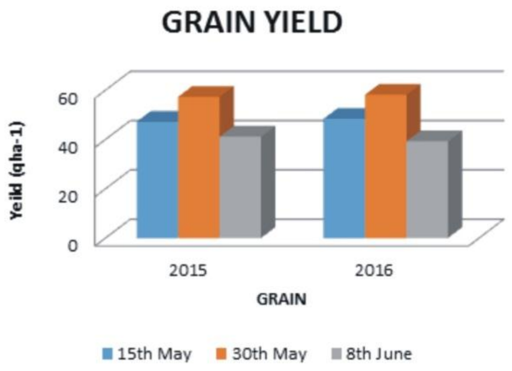
The difference in yield index components such as grain yield, stover yield, biological yield and harvest index due to planting date was significant. Highest grain yield was recorded in planting date 30th May (D_2) 57.29 and 58.10 q ha^{-1} during 2015 and 2016 respectively over

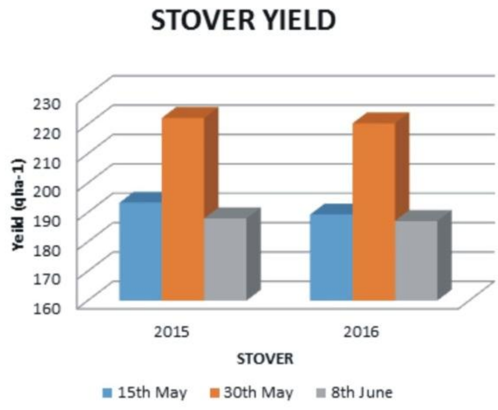
15th May (D_2) 47.21 and 48.34 and 8th June (D_3) 41.11 and 39.21. Grain yield decreased by delayed sowing. Lowest grain yield was recorded in 8th June (D_3) 41.11 and 39.21 during both the years. Stover yield, biological yield and harvest index recorded were also higher in 30th May (D_2) followed by 15th May (D_1) during both the years. Higher stover yield and biological yield at 15th May (D_1) and 30th May (D_2) can be attributed to higher growth attributes like dry matter accumulation, LAI and longer growth duration. Similar results were recorded by several workers Zhang *et al*.[32], Khan *et al*.[15], Hernandez and Soto. This leads to enhancement in the time of vegetative phase due to low temperature in 2013, which contributing higher dry matter accumulation at anthesis. However at later stage temperature was relatively higher in 2016 resulting congenial conditions for higher yield

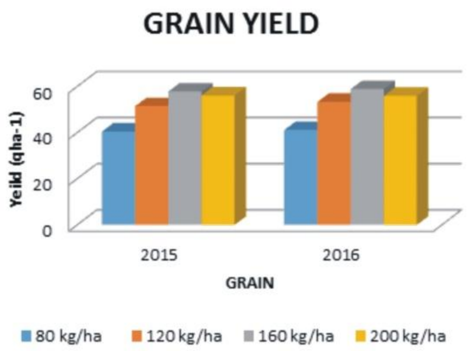
Grain yield, stover yield and harvest index were significantly influenced by nitrogen level (Table 1). Effect of nitrogen management practices on grain and stover yield and its component analysis helps in estimating the relative harvest index. There was significant increase in grain and stover yield of maize with increase in nitrogen dose. Maximum grain yield of maize i.e. 58.88 and 57.82 q ha^{-1}andstover yield 223.45 and 222.02 q ha^{-1}during 2015 and 2016 was obtained with the application of higher dose of nitrogen The increase in maize grain and stover yield with increasing nitrogen dose was mainly due to its better contribution towards different yield contributing characteristics like higher functional leaves, LAI, dry matter accumulation and other attributing characters. Rizwan *et al.*[25], also reported that the grain and stover yield in maize increased when nitrogen was applied in splits(1/3 at sowing+1/3 at first irrigation+1/3 at knee high stage). The same results were observed by Mungai *et al.*[18], who found that application of nitrogen in two splits gave significantly more maize yield than farmers practice. Parmar and Sharma[23] also reported that there was significant increase in maize grain yield, with increase in N dose and this could be attributed to improved growth, better availability of nutrients at vital growth period and synthesis of carbohydrates and their translocation. Singh *et al.*[29], observed that grain and stover yield of maize increased significantly from 26.7 to 57.1 qha^{-1} when nitrogen level was increased from 0 to 150 kg N ha^{-1}

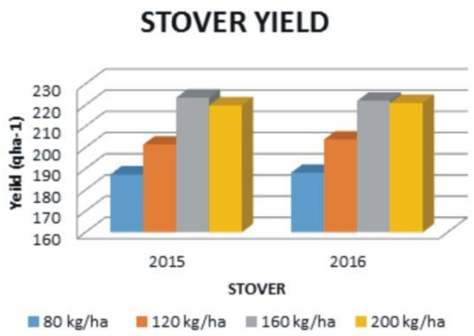
Table 1: Effect of planting dates and Nitrogen Levels on the yield and yield attributes of maize

Treatments	Cob Length (cm)		Grains per cob		Grain yield (q ha^{-1})		Stover yield (q ha^{-1})		Biological yield (q ha^{-1})		Harvest index (%)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Planting dates												
15th May- 20th May (D_1)	12.06	13.31	318.22	321.34	47.21	48.34	193.34	189.32	240.55	237.66	19.62	20.33
30th May-5th June (D_2)	13.70	14.91	356.43	368.46	57.29	58.10	222.22	220.35	279.51	270.45	20.49	21.48
15th June-20th June (D_3)	10.74	9.03	342.34	250.65	41.11	39.21	188.01	187.11	229.12	226.32	17.94	17.32
SEm±	0.71	0.66	4.68	7.61	3.54	4.73	3.28	4.93	11.21	12.34	2.10	1.87
CD ($p \leq 0.05$)	2.11	2.06	12.13	21.91	10.62	14.19	9.84	14.79	33.63	37.02	6.30	5.61
Nitrogen Level												
N=80kg	9.01	10.59	255.12	250.14	40.46	41.11	187.23	188.11	227.69	229.22	17.76	17.93
N=120kg	12.34	11.12	333.12	348.21	51.47	53.34	201.34	203.77	252.81	256.11	20.35	20.82
N=160kg	14.21	14.42	363.33	370.39	57.82	58.88	223.45	222.02	280.27	280.90	20.63	20.96
N=200kg												
SEm±	0.19	0.17	4.40	7.36	3.43	4.16	3.79	3.20	10.61	11.23	0.66	0.72
CD ($p \leq 0.05$)	0.56	0.51	13.25	21.17	10.29	12.48	11.37	9.61	31.83	33.69	2.06	2.12









CONCLUSION

Based on the present study, it may be concluded that sowing Maize on 30th May and application of 160 kg N ha^{-1} could be considered for obtaining higher yield of maize cv.C_4.

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