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Effect of different sowing dates and nitrogen levels on the nitrogen content and uptake of maize under temperate conditions of Kashmir

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Abstract
The present piece of research work was carried out for two consecutive years during *kharif* 2020 and 2021 to determine the effect of varying planting dates and nitrogen levels on the performance of maize composite variety Suwan-1. The experiment included three dates of sowing *viz.* S_1= 28th April (17th Standard Meteorological Week), S_2= 13th May (20th SMW) and S_3 = 28th May (22nd SMW) with four levels of Nitrogen *viz.* N_1 = 90 kg ha^{-1}, N_2 = 120 kg ha^{-1}, N_3 = 150kg ha^{-1} and N_4 = 180 kg ha^{-1} was laid out in a Factorial Randomized Block Design with three replications. The results of the experiment revealed that highest nitrogen uptake for both the years in both grain and stover was observed under first sowing date of 28th April with the combination of 150 kg ha^{-1} of nitrogen. However, nitrogen content was found to be insignificant during both years.

Keywords: Maize, nitrogen level, planting date, suwan-1

Introduction
Among the cereals, maize (*Zea mays* L.) ranks third in total world production after wheat and rice and it is a staple food in many countries, particularly in the tropics and sub-tropics. Globally maize is cultivated over an area of 180 million hectare with a production of 1050 million metric tons and productivity of 5.5 tonnes hectare^{-1} (FAO, 2018) [4]. In India maize is contributing around 24 per cent of total cereal production (Singh *et al*., 2011) [9]. It is cultivated in India over 10.3 million ha with 26.26 million tonnes production having an average productivity of 2.6 t ha^{-1} (DES, 2018-19) [3]. Maize is cultivated in all the soil types (except in sandy soil) and being a photo insensitive crop, maize has been adopted in different seasons and in different regions, with crop duration ranging from <90-130 days. Maize is used as human food (23%), poultry feed (51%), animal feed (12%), industrial (starch) products (12%), beverages and seed (1% each).

In the State Jammu and Kashmir area under maize cultivation is around 3.1 lakh hectares with the production of 52.7 lakh quintals and productivity is around 1.7 tons per hectare (DES, 2018) [3]. It is second most important crop after rice and is a staple food of some tribal population such as Gujar and Bakarwall (nomadic race). Maize is generally grown under rain fed conditions and on marginal lands particularly in hilly terrains of the Kashmir valley invariably as an intercrop with pulses. It is grown as a sole crop at an altitude range of 1850-2300 m above mean sea level. Lack of location specific varieties, senile fields, inadequate plant population, moisture stress (rain-fed cultivation), nutrient depletion, poor germination are the major issues at present that have resulted in the decline in production and productivity of maize in Kashmir.

Maize is categorized as a very exhaustive crop because of its very high demand for the nutrients specially nitrogen, phosphorus and potassium from the soil. Nitrogen is an essential component of amino acids, which are the building blocks of proteins and is also a part of the DNA molecule, so it plays a very important role in cell division and reproduction. The chlorophyll molecule also contains nitrogen. Nitrogen deficiency most often results in slow and stunted growth along with chlorosis. Most of the nitrogen taken up by plants from the soil in the forms of NO_3^-. Amino acids and proteins can only be built from NH_4^+ so NO_3^- must be reduced with split application of ammonical form of nitrogen. Nitrogen is usually applied in splits in the field to avoid various nitrogen losses. Split application fulfils the crop requirements at the time of need of the crop.

Sowing dates have a pronounced effect on the yield of maize. Maize is generally sown from last week of April to mid-week of May in lower belts of valley. However, the field may not be vacant at this appropriate time due to delay in harvesting of some rabi crops. Sowing window of Maize in Kashmir Valley may vary from one place to another especially at variable altitude. Also, late sowing results in a significant decline in yield of maize.

Material and Method

A field experiment was conducted at the experimental farm of Division of Agronomy at Faculty of Agriculture and Regional Research Station, Wadura, Sopore which is situated in the North of Kashmir about 15kms from Sopore town. The location is 1524 metres above mean sea level and situated at 34.28° N of latitude and 74.55°E longitude.

Technical Programme

Treatment details

Variety: Suwan-1

Location: SKUAST-K, Wadura

No. of factors: 02

Sowing dates

Nitrogen levels

Factor A:

Sowing dates: 03

S_1 = 28th April (17th Standard Meteorological Week)

S_2 = 13th May (20th SMW)

S_3 = 28th May (22th SMW)

Factor B:

Nitrogen levels: 04

N_1 = 90 kg/ha

N_2 = 120kg/ha

N_3 = 150kg/ha

N_4 = 180kg/ha

Other experimental details

Design: Factorial RBD

Replications : 3

Treatment combinations : 12

Main plot : Sowing dates

Sub plot : Nitrogen levels

Season : Kharif

No. of Plots : 36

Plot size : 12 m^2

Field preparation, sowing and aftercare

Fertilizer application

Fertilizer application was made as per the treatment. Full dose of phosphorus, potassium, zinc and basal dose of nitrogen were applied at the time of sowing by drilling fertilizer in crop rows about 4-5 cm below the seeds. The remaining nitrogen was given at knee high stage and tasselling as top dressing.

Seed sowing

After proper mixing of fertilizer in soil, the seed of maize were sown treatment wise at the rate of 30 kg ha^{-1} at a distance of 60 between row and row. The distance between the plants (20 cm) within the row was maintained by thinning at 10-15 days after sowing of the crop.

Irrigation

Irrigation was given to the crop as and when required depending upon the moisture availability in the soil. Great care was taken to ensure the moisture availability in the soil throughout crop growth period.

Weed management

In order to minimize weed competition, pre-emergence application of Atrazine (1 kg a.i in 1000 litre of water) followed by one hoeing and earthing up at 25 DAS was carried out.

Plant protection measures

In order to protect the plants from foliage and soil borne insect pests, Chlorpyrifos was applied @ 20 kg ha^{-1} as a preventive measure.

Plant Analysis

Plant samples collected at anthesis and at harvest were sun dried for 24-48 hours in the field and then oven dried at 60±5°C for 48-72 hours to a constant weight. The samples were ground and subsequently used for chemical analyses. The method followed for the chemical analyses are as under.

Nitrogen content

Nitrogen content of the above ground plant samples of maize collected at harvest was estimated by modified Kjeldahl's method (Jackson, 1973) [6].

Nitrogen uptake

Nitrogen uptake was calculated by multiplying the dry matter (oven dry) of plant accumulated at maturity by respective content of nitrogen.

Statistical analysis

All the data were subjected to statistical analysis by adopting appropriate method of analysis of variance as described by Cochran and Cox (1967). Wherever the F value was found significant at 5 per cent level of probability, the critical difference (CD) value was computed for comparing treatment means.

Results and Discussion

Nitrogen content at maturity

Nitrogen content of both grain and stover was analyzed at maturity and presented in the Table 1. Data revealed that nitrogen concentration in the grain and stover failed to show any significant difference at all the treatments tried and during both the years of study.

Nitrogen uptake at maturity

Nitrogen uptake (grain)

Data (Table 2) revealed that 28th April (D_1) significantly recorded highest nitrogen uptake (71.5 kg ha^{-1} and 82.4 kg ha^{-1}) than all subsequent sowing dates in both the years. Sowing date 28th April (D_1) recorded significantly higher N uptake than 13th May (D_2) and 28th May (D_3).

In case of nitrogen levels, it was recorded that the uptake of nitrogen in grain was significantly highest (75.6 kg ha^{-1} and 87.1 kg ha^{-1}) with treatment of 150 kg N ha^{-1} (N_3) than all other treatments during both the years. Application of nitrogen at the rate 150 kg N ha^{-1} (N_3) and 180 kg N ha^{-1} (N_4) were par at each other during year 2020. It was observed that

in grain statistically the lowest uptake of nitrogen (49.3 kg ha^{-1} and 55.4 kg ha^{-1}) was recorded in 90 kg N ha^{-1} (N_1).

Nitrogen uptake (Stover)

Data (Table 2) revealed that nitrogen uptake was significantly influenced by sowing dates of maize. 28th April (D_1) recorded significantly highest nitrogen uptake (68.37 kg ha^{-1} and 79.11 kg ha^{-1}) in both the years than subsequent sowing dates 13th May (D_2) and 28th May (D_3). Significantly lowest uptake was recorded by 28th May (D_3), where 13th May (D_2) was at par with 28th May (D_3).

In stover 150 kg N ha^{-1} (N_3) treatment being at par with 180 kg N ha^{-1} (N_4) had significantly higher uptake of nitrogen compared to other treatments in 90 kg N ha^{-1} (N_1) treatment significantly lowest uptake was observed.

Nitrogen uptake (Total)

Data in the (Table 2) revealed that 28th April (D_1) recorded highest N uptake (139.9 kg ha^{-1} and 161.5 kg ha^{-1}) than subsequent sowing dates in both the years. However, 28th May (D_3) recorded lowest total nitrogen uptake than other two dates i.e., 13th May (D_2) and 28th May (D_3).

Significantly high N uptake (143.7 kg ha^{-1} and 167 kg ha^{-1}) was observed at 150 kg N ha^{-1} (N_3) which was significantly higher than N level of 120 kg N ha^{-1} (N_2) and 90 kg N ha^{-1} (N_1). However, was at par with 180 kg N ha^{-1} (N_4) for year 2020

Nitrogen content in grain and stover was not influenced by sowing dates and Nitrogen levels during both the years at maturity of crop. Nitrogen uptake at maturity in grain and stover was recorded highest at 28th April (D_1) followed by 13th May (D_2) and 28th May (D_3). However lowest nutrient uptake at maturity was recorded in delayed sowing i.e, 28th May (D_3). It is due to delay in planting date resulted in less biomass and grain yield. Similar findings were reported by Girijesh *et al.*, 2011 [5] and Aderi and Ndaeyo (2011) [1].

With respect to maximum nitrogen uptake at maturity was recorded with 150 N kg ha^{-1} (N_3) during both the years. Higher uptake values with nitrogen level of 160 N kg ha^{-1} (N_3) can be attributed to higher grain, stover yield than other nitrogen treatments. The higher levels of nitrogen application resulted in more uptake of nutrients compared to other treatments might be due to higher dry matter production. Singh *et al.*, (2003) [10] reported significant increase in N-uptake with 120 kg N ha^{-1} or even more. Sepat and Kumar (2007) [8] and Singh *et al*. (2003) [10] reported that N is very important nutrient for corn as it responds to N levels upto 120 kg ha^{-1} or even more. Kostandi and Soliaman (2008) [7] studied that the increasing nitrogen rates from 30 to 60 and 90 kg/acre produced greater response on nitrogen uptake and yield.

Table 1: Effect of planting dates and Nitrogen Levels on Nitrogen content (%) at Maturity at wadura

Treatment	Nitrogen content (%) at grain maturity		Nitrogen content (%) at stover maturity	
	2020	2021	2020	2021
Planting dates				
28th April (D_1)	1.56	1.59	0.43	0.48
13th May (D_2)	1.55	1.58	0.43	0.48
28th May (D_3)	1.55	1.58	0.43	0.48
S.Em±	0.004	0.004	0.004	0.004
CD (p=0.05)	NS	NS	NS	NS
Nitrogen Levels (kgha^{-1})				
90kg (N_1)	1.55	1.58	0.43	0.48
120kg (N_2)	1.55	1.58	0.42	0.47
150kg (N_3)	1.55	1.58	0.44	0.48
180kg (N_4)	1.56	1.59	0.42	0.48
S.Em±	0.005	0.005	0.004	0.004
CD (P=0.05)	NS	NS	NS	NS

Table 2: Effect of planting dates and Nitrogen Levels on Nitrogen uptake (kg ha^{-1}) at Anthesis and Maturity at Wadura

Treatments	Nitrogen uptake (kg ha^{-1}) at grain maturity		Nitrogen uptake (kg ha^{-1}) at stover maturity		Total uptake at maturity (kg ha^{-1})	
	2020	2021	2020	2021	2020	2021
Planting dates						
28th April (D_1)	71.5	82.4	68.37	79.11	139.9	161.5
13th May (D_2)	64.4	69.3	64.93	75.80	129.3	145.1
28th May (D_3)	55.1	62.1	63.87	72.84	119.0	135.0
S.Em±	1.75	1.10	0.99	1.24	2.15	1.46
CD (p=0.05)	5.12	3.24	2.90	3.63	6.30	4.29
Nitrogen Levels (kgha^{-1})						
90kg (N_1)	49.3	55.4	62.3	71.6	111.6	127.1
120kg (N_2)	56.6	59.1	64.8	73.9	121.4	132.9
150kg (N_3)	75.6	87.1	68.1	79.9	143.7	167.0
180kg (N_4)	73.3	83.5	67.7	78.3	141.0	161.8
S.Em±	2.02	1.27	1.14	1.43	2.48	1.69
CD (P=0.05)	5.92	3.74	3.35	4.20	7.27	4.95

Conclusion

On the basis of the results emanated from present investigation conducted during *kharif* 2020 and 2021, it can be concluded that among different sowing dates early planting under 28th April with the combination of 150 kg N ha^{-1} realized significantly better nitrogen uptake both in grain and stover which ultimately resulted in higher total N uptake in maize. And thus, found better suited for temperate conditions of Kashmir.

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