Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 1097-1099
Received: 08-01-2018
Accepted: 09-02-2018

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Yield reponse of *Kharif* maize for split application of nitrogen

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Abstract
The field experiment was conducted at Cotton Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, *Parbhani*. Dist. Parbhani during *Kharif* season of 2015 to study the "Effect of split application of nitrogen on growth and yield of *kharif* maize (Zea mays.L)". The experiment was laid out in randomized block design with three replications. The treatment details of experiment factor comprised seven split application of nitrogen treatments viz.,100% Nitrogen at sowing (T_1), 75%N at sowing +25%N at 30 DAS (T_2), 50%N at sowing +50% N at 30 DAS (T_3), 25% N at sowing +75%N at 30 DAS (T_4), 25%N at sowing +50% N at 30 DAS + 25% at 60 DAS (T_5), 33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS (T_6) and 25% N at sowing + 25%N at 30 DAS+25% at 60DAS +25% N at 60 DAS (T_7). The split application of nitrogen T_6 (33%N at sowing + 33%N at 30 DAS +33% at 60 DAS) produced significantly higher grain (2950 kg ha^{-1}), stover (6332 kg ha^{-1}) and biological (9282 kg ha^{-1}) yields as compared to others.

Keywords: Cotton Research Station, Effect, of split, nitrogen on growth

Introduction
Maize is one of the most important versatile cereal crops grown in tropical and semi arid regions of the world. India ranks sixth in area and third in production and productivity among cereal crops (Anonymous, 2009). Potentiality of maize crop for its growth and development can be fully exploited by adopting suitable agronomic practices such as optimum spacing, fertilizer, soil conditions, growing season and water availability. Maize grain contains about 10 percent protein, 4 percent oil, 70 percent carbohydrate, 2.3 percent crude fibre, 10.4 percent albuminoids, 1.4 percent ash. Maize is utilized domestically for poultry and cattle feed, food, manufacturing of starch and other industrial purposes. In the last few years, good quantity of maize is also being exported from India to different countries. It is understood that with the increasing demand for value added foods and industrial requirements, from a growing economy and population, maize will hold its share as an important cereal crop.

Split application of nitrogen is one of the methods to improve nitrogen use by the crop while reducing the nutrient loss through leaching and volatilization (Tolessa *et al.*, 1994) [12]. Split-application is an essential approach to increase the N use efficiency in crops including maize (Muthukumar *et al.*, 2007) [7]. It improves the maize grain yield and increased the economic benefit from increased grain yield. The acreage for India are 9.43 million hectares, 24.35 million tonnes production and 2337 kg/ha is the productivity and for Maharashtra, 0.58 million hectares area, 1.15 million tones production and productivity 2066 kg/ha. In marathwada region, maize is cultivated on an area of 320900 hectares with the production of 256800 tonnes of grain with 688 kg ha^{-1} productivity (Anonymous, 2015). The details of material used and experimental techniques adopted during the present investigation are described in this chapter.

Materials and Methods
Experimental Site
An experiment was carried out on Experimental farm of cotton research station, Vasantrao Naik Marathwada Agriculture University, Parbhani during *kharif* season 2015.

Experimental Soil
The soil was medium deep black and well drained. The topography of the experimental field was fairly uniform and levelled. Soil samples up to 30 cm were randomly collected from different locations of field before starts of the experiments during *Kharif* -2015.

Climate and weather conditions

Geographically Parbhani is situated at 409 m mean sea level altitude 19°16' North latitude and 76°47' E longitude. Its height from mean sea level is about 879 m and distributed in 57 rainy days mostly during june to September. The winter rains are low and uncertain. Most of the rainfall is received from South-West monsoon. The precipation is assured for *Kharif* crops. The mean daily maximum temperature was 36 ^{o}c. The temperature varies from 30.8^{o}c in winter (December) to about 45^{o}c in summer (may), whereas mean minimum temperature varies from 11.9^{o}c in winter to about 24.9^{o}c in summer. The mean relative humidity ranges from 30 to 90%. Thus Parbhani has hot dry summer and cool winter. However, July, August and September months are humid. Hence Parbhani is grouped in assured rainfall zone with *Kharif* cropping pattern.

Post harvest studies

The yield contributing characters were recorded on five observational plants, from each net plot and reported on per plant basis.

Number of cobs per plant

The number of cobs of observational plants were counted and number of cobs per plant was worked out.

Grain yield per plant (g)

This was recorded by measuring the weight of grains of five observational plants of each treatments after dehusking of cobs and by working out average weight of cob.

Length of cob (cm)

This was recorded by measuring the length of cobs on the five observational plants of each treatment after dehusking of cobs and by working out averages per cob.

Diameter of cob (cm)

It was recorded by measuring the diameter of cobs on the five observational plants per treatment after dehusking the cobs and after working out averages per cob.

Weight of cob (kg ha^{-1})

Weight of cobs per plant was recorded so as to study the effect of treatments on the reproductive growth of the plant. This observation was noted from the sample plants after when it was fresh.

Number of grains per cob

Cobs of sampled from net plot were shelled separately number of grains obtained from these cobs were counted and the average number of grains per cob was recorded.

No. of grains per row

Average no of grains per row was worked out by counting the total grains from all the five observational cobs and dividing the same by total number of rows.

No. of rows per cob

The number of rows per cob were counted for the five plants sampled at harvest from net plot and their numbers were averaged and recorded separately for each plot.

Grain yield (Kg ha^{-1})

The ears obtained from all plants of net plot were sun dried. These ears were dehusked and shelled by hand sheller. The grains were dried and weighed and thus grain yield (kg) per net plot was recorded and converted into (kg) per hectare by hectare factor.

Fodder yield (Kg ha^{-1})

After removal of cobs, the weight of plants from each net plot were recorded treatment wise separately.

Cob yield (Kg ha^{-1})

The total weight of fresh cobs per plant at harvest was recorded separately and calculated as cob yield on hectare basis.

Results and Discussion

Effect of split application of nitrogen on number of cobs per plant

The number of cobs per plant were not increased due to split application of nitrogen as number of cob is a genetic parameter These results are in close conformity with those recorded by Nemati and Sharifi (2012) [8]. These results are in close conformity with those recorded by Sarafraz and Marashi (2015) [10].

Effect of split application of nitrogen on Number of rows per cob

The number of rows per cob was increased by 6.94 percent due to split application of nitrogen i.e. T_6 (33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. Maximum number of rows per cob was observed in the application of nitrogen fertilizer in three splits. These results are in close conformity with those recorded by Nemati and Sharifi (2012) [8].

Effect of split application of nitrogen on length of cob

The length of cob was increased by 25.20 percent due to split application of nitrogen i.e. T_6 (33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. Maximum length of cob was observed in the application of nitrogen fertilizer in three splits. These results are in close conformity with those recorded by Nemati and Sharifi (2012) [8].

Effect of split application of nitrogen on girth of cob

The girth of cob was increased by 23.33 percent due to split application of nitrogen i.e. T_6 (33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. Similar results was found by Hassan *et al.* (2010) [4].

Effect of split application of nitrogen on weight of stover per plant

The weight of stover per plant was observed to be increased by 28.49 percent. This might be possible due to split application of nitrogen i.e. T_6 (33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. These results are in conformity with those recorded by Joshi *et al.*, (2014) [6].

Effect of split application of nitrogen on number of grains per cob

The number of grains per cob was increased by 18.73 percent due to split application of nitrogen i.e. T_6 (33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. Maximum number of grains per cob was observed in the application of nitrogen fertilizer in three splits. These results are in close conformity with those recorded by Nemati and Sharifi (2012) [8]. Similar results was recorded by Sarafraz and Marashi (2015) [10].

Effect of split application of nitrogen on seed index (100 seed)
The seed index was increased by 12.52 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing.). Maximum seed index was observed in the application of nitrogen fertilizer in three splits. These results are in conformity with those recorded by Joshi *et al.* (2014) [6].

Effect of split application of nitrogen on grain yield per plant
The grain yield per plant was increased by 49.99 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. These results are in conformity with those recorded by Sarafraz and Marashi (2015) [10].

Effect of split application of nitrogen on weight of spindle per plant
The weight of spindle per plant was maximum by 46.94 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T1 i.e.100% nitrogen at the time of sowing.

Effect of split application of nitrogen on cob weight per plant
The cob weight per plant was increased by 46.90 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. Maximum weight per cob was observed in the application of nitrogen fertilizer in three splits. These results are in conformity with those recorded by Joshi *et al.* (2014) [6].

Effect of split application of nitrogen on grain yield
The grain yield was increased by 29.72 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing.
Maximum grain yield was observed in the application of nitrogen fertilizer in three splits. These results are in conformity with those recorded by Joshi *et al.*, (2014) [6]. It also confirms the findings of several researchers like Rizwan *et al.* (2002). Rizwan found the highest grain yield with the application of three splits. These results also recorded by Nemati and Sharif (2012) [8]. Similar results was found by Sitthaphanit *et al.*, (2010) [11], Tadesse *et al.* (2013), and Amanullah *et al.* (2009).

Effect of split application of nitrogen on stover yields
The stover yield was increased by 27.47 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. Higher stover yield was observed in the application of nitrogen fertilizer in three splits. These results are in conformity with those recorded by Joshi *et al.* (2014) [6].

Effect of split application of nitrogen on biological yield
The biological yield was increased by 28.19 percent due to split application of nitrogen i.e. T_6 (33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS) over treatment T_1 i.e.100% nitrogen at the time of sowing. These results are in conformity with those recorded by Iqbal *et al.* (2014)**.**

Acknowledgement
The author is thankful to Dr. B.V. Asewar, Chief scientist of dryland agriculture, Parbhani for providing facilities required for conducting the above experiment.

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