Effect of split application of nitrogen on economics of different treatments in kharif maize

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Abstract
Studies of split application strategy of nitrogen on the economics of the kharif maize is needed to enhance the nitrogen use efficiency. The field experiment was conducted at Cotton Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Dist. Parbhani during Kharif season of 2015 to evaluate the effect of split application of nitrogen on economics 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 (T1), 75%N at sowing + 25%N at 30 DAS (T2), 50%N at sowing + 50% N at 30 DAS (T3), 25% N at sowing + 75%N at 30 DAS (T4), 25%N at sowing +50% N at 30 DAS + 25% at 60 DAS (T5), 33%N at sowing + 33%N at 30 DAS + 33% at 60 DAS (T6) and 25% N at sowing + 25% N at 30 DAS+25% at 60 DAS+25% N at 60 DAS (T7). The split application of nitrogen (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. Treatment T6 also recorded significantly the highest gross returns (51014 ₹ ha\(^{-1}\)), net returns (30530 ₹ ha\(^{-1}\)) and B:C (2.49) ratio as compare to other treatments.

Keywords: Effect, split application, nitrogen, economics of different treatments

Introduction
Many studies on split application and maize have been done, but most of the farmers don’t use split application because farmers traditionally apply nitrogen to the soil in a single pass during either the fall or in the spring before planting. However, early nitrogen application can result in significant losses due to weather factors (e.g. warm, moist soils). Research has shown that a split application of nitrogen – one application in the fall or around the time of planting and a second application after planting when there is the greatest demand for N from the crop – can reduce total nitrogen use (savings to the farmer) and/or reduce nitrogen loss to the environment (savings to society). Split and delayed basal fertilizer applications are possible strategies to improve the crop yield and reduce nutrient loss through leaching in sandy soils, but their effectiveness under high rainfall regimes to produce a maize growth response needs further investigation. The primary purpose is to adjust the nitrogen supply accordingly to the demand of a growing crop. This can improve nitrogen use efficiency. Split application reduces the risk of losses through leaching. Split application of nitrogen can increase grain yield and grain protein content. Split application is a N management strategy that will likely gain momentum in the next 5 to 10 years.

For the split application of nitrogen to be successful, the farmer has to make many decisions in the planning stage and specify the plans during the growing season. Split application is the process of matching nitrogen supply for a pre-established target yield and a given level of soil moisture, and then supplying the remaining nitrogen as moisture conditions improve. Split applications of nitrogen give producers greater flexibility in their fertilizer program. This practice minimizes the risk of placing all the nitrogen at the time of seeding. By providing nitrogen to meet the changing demands of a growing crop, producers can potentially increase nitrogen use efficiency. Split application reduces the exposure of nitrogen in saturated soils where the potential for losses such as leaching and denitrification are increased. It also reduces the amount of product a producer must handle during the busy seeding period. Finally, proper timing and placement of nitrogen may help reduce nitrous oxide emissions. Split application of nitrogen fertilizer may substantially improve corn nitrogen use efficiency, particularly during wet growing seasons.
Corn shows large responses to nitrogen (N) fertilizer application, depending on weather, soil characteristics, water supply, crop uniformity and the nutrient responses of the cultivated varieties. Globally, maize is known as “Queen” of cereals because it has the highest genetic yield potential among the cereals. Maize is also known as Drosophila of crops. It efficiently utilizes solar energy and has immense potential for higher yield, so called as “Miracle crop”. Maize ranks third in India in terms of production among cereals. 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) [11]. Split-application is an essential approach to increase the N use efficiency in crops including maize (Muthukumar et al., 2007) [2]. It improves the maize grain yield and increased the economic benefit from increased grain yield.

Materials and Methods
The experiment was conducted at Cotton Research Scheme, VNMKV, Parbhani during 2015-16. 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 and a composite soil sample was prepared and analyzed for various physiochemical properties of the soil. The soil was clayey in texture with low in available nitrogen (165.9 kg/ha), medium in available phosphorus (12.2 kg/ha) and high in available potassium (387.30 kg/ha). The soil pH, organic carbon and electrical conductivity were 7.86, 0.70% and 0.48 ds/m, respectively. Geographically Parbhani is situated at 19o16’ North latitude and 76o47’ East longitude and at 409 altitude above sea level in Marathwada division encompassed by 17o35’ to 24o40’ North latitude and 74o49’ to 78o15’ East longitude geographical boundaries. Parbhani comes under subtropical climate.

Fertilizer Application
The dose of the NPK for maize was worked out according to the present recommendation of Kargil (900M) on state level. The 100% NPK dose in kg ha⁻¹ worked out was 100:75:75 for maize crop.

Sources of Nutrients
The sources used for applying N, P and K were urea, single super phosphate (adjusted for its N content) and muriate of potash, respectively.

Treatment Application
Fertilizer application was made as per the treatments. Full dose of phosphorus and potash were applied at sowing as basal application.

Seed rate and sowing
Maize variety Kargil (900M) hybrid (Monsanto Company) was sown at the seed rate of 20 kg ha⁻¹ at inter row of 60 and plant to plant spacing of 30 cm. Shallow furrows were opened and seeds were sown manually at the depth of 5 cm.

Yield Studies
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.

Statistical analysis
The experimental data were subjected to statistical test by following Analysis of Variance Technique suggested by Panse and Sukhatme (1967) where, variance ratio (‘F’ value) was significant, critical difference (CD) values at 5% level of probability were computed for making treatment comparisons.

Economics
Gross monetary returns
On the basis of results obtained from the field experiment and prevailing market rates, the economics of various treatments were worked out.

Net monetary returns
The net monetary returns ( Rs ha⁻¹) of each treatment was worked out by deducting the mean cost of cultivation (Rs ha⁻¹) of each treatment from the gross monetary returns ( Rs ha⁻¹) gained from the respective treatments.

Benefit: cost ratio
The benefit: cost ratio of each treatment was calculated by dividing the gross monetary returns by the mean cost of cultivation.

Results and Discussion
Results on economics, yield and quality of maize as influenced by various treatments.

Effect of split application of nitrogen on total dry matter production
At 45 DAS the total dry matter production was increased by 22.27 due to split application of nitrogen i.e. T₆ (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. At harvest the dry matter production was increased by 38.42 due to split application of nitrogen i.e. T₆ (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. The total dry matter production increased continuously up to harvest. Dry matter production in between 45 DAS to at 60 DAS indicating growth period was 71.90 percent of maximum in T₆ (33% N at sowing + 33% N at 30 DAS + 33% N at 60 DAS).

It was 29.95, 32.75 and 34.81 per cent of maximum at 60, 75, 90 DAS, respectively. It also confirms the findings of several researchers like Harikrishna and Patil (2005) [12].

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. T₆ (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. 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) [4].

**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. T6 (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.

Maximum grain yield was observed in the application of nitrogen fertilizer in three splits. These results are in conformity with those recorded by Joshi and Sharif (2012) [7]. Similar results was found by Sitthaphanit et al., (2010) [9], Tadesse et al. (2013) [10], and Amanullah et al. (2009) [11].

**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. T6 (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. 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) [4].

**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. T6 (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. These results are in conformity with those recorded by Iqbal et al. (2014) [3].

**Effect of treatments on economics**

**Effect of split application of nitrogen on Gross monetary return**

The Gross monetary return was increased by 29.17 percent due to split application of nitrogen i.e. T6 (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. Similar results was found by Tadesse et al. (2013) [10].

**Effect of split application of nitrogen on net monetary return**

The net monetary return was increased by 42.84 percent due to split application of nitrogen i.e. T6 (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. The result also confirms the findings of Tadesse et al. (2013) [10].

**Effect of split application of nitrogen on Benefit: Cost Ratio**

The split application of nitrogen i.e.T6 33% N at sowing + 33%N at 30 DAS + 33% at 60 DAS recorded higher B:C ratio (2.49) followed by T5, T7, T4, T3 treatments over T1 i.e. 100% nitrogen at the time of sowing (1.93). This finding confirms to those reported by Kumar et al. (2014) [5].

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**References**