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Effect of foliar application of nutrients on yield and economics of blackgram (*Vigna mungo* L.) under rainfed condition

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Abstract
A field experiment was carried out during *kharif* season, 2018 at Research Farm of Tirhut College of Agriculture, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar) to study the "Effect of foliar application of nutrients on yield and economics of blackgram (*Vigna mungo* L.) Under rainfed condition". The experiment was laid out in randomized block design with eight treatments and replicated thrice. Among the different foliar application of nutrients, NPK (18:18:18) @2% spray at flower initiation (T_2) recorded significantly higher gross returns (Rs 76959/ha) and net returns (Rs 47014/ha), grain yield (12.89q/ha), and straw yield (23.87 q/ha) as compared to rest of the treatments. The highest benefit: cost ratio (1.57) was recorded under foliar application of NPK (18:18:18) @2% spray at flower initiation (T_2) which was significantly superior over rest of the treatments but it was found at par with Neem coated urea @2% spray at flower initiation (T_3) and boron @0.25ppm spray at flower initiation followed by Neem coated urea @2% spray after 7 days of first spray (T_8).

Keywords: Blackgram, yield and economics

Introduction
Black gram (*Vigna mungo* (L.)) is popularly known as 'Urad bean'. It is one of the most highly prized pulse crop, cultivated in almost all parts of India. Black gram is perfect combination of all nutrients, which includes protein (25-26%), carbohydrate (60%), fat (1.5%), minerals, amino acids and vitamins. It is rich in vitamin A, B_1, B_3 and has small amount of thiamine, riboflavin, niacin and vitamin C. It contains 78% to 80% nitrogen in the form of albumin and globulin. The dry seeds are good source of phosphorus.

In India, the total area under black gram cultivation is 4.50 million hectares with a production of 2.93 million tonnes and productivity 651 kg/ha during 2016-17(Anonymous, 2017) [1]. In Bihar, the total area under black gram is 12983 hectares with a production of 11491 million tonnes and productivity of 885 kg/ha during 2016-17 (Anonymous, 2017) [2]. The yield potential of black gram is very low because of the fact that the crop is mainly grown in rainfed condition with poor management practices and also due to various physiological, biochemical as well as inherent factors associated with the crops. Apart from the genetic makeup, the physiological factors *viz.*, insufficient partitioning of assimilates, poor pod setting due to the flower abscission and lack of nutrients during critical stages at crop growth coupled with a number of pests and diseases (Mahala *et al*., 2001) [5] constitute the major constraints for the poor yield.

Foliar application is effective for the application of minor nutrients like iron, zinc, boron, copper and manganese. This is considered to be an efficient and economic method of supplementing part of nutrients requirement at critical stages.

Foliar spray of nutrients mixture with salicylic acid @100ppm at 20, 30 and 40 DAS proved to be the best treatment to improve leaf area index, leaf area duration, specific leaf weight, total dry matter accumulation and seed yield of blackgram (Amutha *et al.*, 2012) [3]. Therefore, keeping the above facts in view, the present investigation entitled "Effect of foliar application of nutrients on yield and economics of blackgram (*Vigna mungo* L.) under rainfed condition".

Material and Methods

The field experiment was conducted during *kharif* season, 2018 at the research farm of Tirhut College of Agriculture, Dholi (Muzaffarpur), a campus of the Dr. Rajendra Parsad Central Agricultural University, Pusa (Samastipur), Bihar. The experimental area falls under humid sub-tropical climatic zone, which is greatly influenced by monsoon. It is situated on the southern bank of the river *Burhi Gandak* at an altitude of 52.18 meter above mean sea level and lies at $25^0$39' N latitude and $85^0$40' E longitude. The experiment was laid out in randomized block design with eight treatments and replicated thrice. The treatment comprised as T_1-Control (water spray at flower initiation), T_2-NPK (18:18:18) @2% spray at flower initiation, T_3-Neem coated urea @2% spray at flower initiation, T_4-Neem coated urea @2% +salicylic acid @75ppm spray at flower initiation, T_5-$ZnSO_4$ @0.5% spray at flower initiation, T_6-$ZnSO_4$ @0.5% spray at flower initiation followed by Neem coated urea 2% spray 7 days after first spray, T_7-Boron 0.25ppm spray at flower initiation and T_8-Boron @0.25ppm spray at flower initiation followed by Neem coated urea 2% spray after 7 days of first spray.

A plot having uniform fertility and even topography was selected for experimental trial. The soil of experimental plot was alluvial and calcareous in nature and low in fertility status having pH-8.1, with low in available nitrogen (182.8 kg/ha), available P_2O_5 (18.82 kg/ha) and available K_2O (120.81 kg/ha). The field was given a pre sowing irrigation before field preparation to obtained proper germination and establishment of the crop. Blackgram variety 'Pant U-31' was sown in the *kharif* season of 2018 using the seed rate of 20 kg/ha. Seed was treated with fungicide, carbendazim @2g/kg of seed before sowing against fungal diseases. Plant to plant distance of 10 cm was maintained by thinning after 15 days of sowing. The recommended dose (20:40:20kg N:P_2O_5:K_2O/ha) of fertilizer was applied. The required quantity of foliar nutrients and water for each plot were calculated to prepare solution and sprayed uniformly by hand sprayer using conical shaped nozzle as per treatments.

Grain yield (q/ha)

Plot wise weight of grains after threshing, cleaning and sun drying were taken and finally converted in to quintal/hectare.

Straw yield (q/ha)

After picking the pods, the remaining portion of the plant was harvested. The straw yield was calculated after the plant was completely dried. For obtaining the final straw yield, weight of straw of the observational plants were also added in the corresponding plots. The yield was then converted into quintal/hectare.

Economics

Economic indices were worked out based on the prevailing market prices in each case. Cost of cultivation was worked out by taking into consideration all the expenses incurred in raising the crop.

Gross returns (₹/ha)

Total gross returns was worked out by multiplying the yield (grain and straw) with prevailing market price rate of grain and straw.

Net return (₹/ha)

Net return was obtained by subtracting the cost of cultivation from gross returns of the individual plot.

Benefit: Cost ratio

Benefit: Cost ratio was calculated by the following formula.

$$\text{Benefit: Cost ratio} = \frac{\text{Net return (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Result and Discussion

Effect on yield

The data on grain yield at harvest revealed that different foliar application of nutrients had significant effect on seed yield. Grain yield (12.89q/ha) and straw yield (23.87 q/ha) recorded with the application of NPK (18:18:18) @2% spray at flower initiation (T_2) was found significantly superior over other treatments. It might be due to constant supply of nutrients due to foliar spray at reproductive stage of the crop and enhanced the yield components like number of pods/plant, number of seeds/pod, pod length and 100-seed weight, which had direct influence on the grain yield. It also might be due to increased uptake of nutrients by blackgram by effective translocation of nutrients from source to reproductive area of crop. The findings are in agreement with earlier findings of Shashi Kumar *et al.*, (2013) [6] and Ramesh *et al.* (2016). The increase in straw yield directly depends on vegetative growth of the plants. Application of NPK (18:18:18) @2% spray at flower initiation recorded significant superior straw yield over other treatments. It is mainly due to the higher plant height as well as dry matter accumulation.

Effect on economics

Gross returns and net returns varied significantly due to foliar application of different nutrients. The data on gross returns revealed that foliar spray of NPK (18:18:18) @2% spray at flower initiation (T_2) recorded significant higher gross returns (Rs 76959/ha) over all other treatments. The higher gross returns in foliar spray of NPK (18:18:18) @2% spray at flower initiation (T_2) might be due to more yield of grain and straw. Net return (Rs 47014/ha) recorded significantly higher under NPK (18:18:18) @2% spray at flower initiation (T_2) over rest of the treatments. It is resultant of more yield and lower cost of cultivation. Significant highest Benefit: Cost ratio of 1.57 was worked out under NPK (18:18:18) @2% spray at flower initiation (T_2) than all other treatments, except neem coated urea @2% +salicylic acid @75ppm at flower initiation (T_4), boron @0.25ppm spray at flower initiation followed by neem coated urea 2% spray after 7 days of first spray.). Similar result of improvement in the grain yield and net income along with high benefit: cost ratio has been reported earlier by Chandrasekhar and Bangarusamy (2003) [4].

Table 1: Effect of foliar application of nutrients on grain yield and straw yield of blackgram

Treatments	Grain yield (q/ha)	Straw yield (q/ha)
T_1: Control (water spray at flower initiation)	10.05	21.02
T_2: NPK (18:18:18) @2% spray at flower initiation	12.89	23.87
T_3: Neem coated urea @2% spray at flower initiation	11.27	21.53
T_4: Neem coated urea 2% + salicylic acid @75ppm spray at flower initiation	11.83	22.35
T_5: $ZnSO_4$ @0.5% spray at flower initiation	10.59	21.20
T_6: $ZnSO_4$ @0.5% spray at flower initiation followed by Neem coated urea 2% spray after 7 days of first spray	11.48	21.95
T_7: Boron @0.25ppm spray at flower initiation	10.42	21.10
T_8: Boron @0.25ppm spray at flower initiation followed by Neem coated urea 2% spray after 7 days of first spray	11.75	22.32
S.Em±	0.34	0.49
CD (P=0.05)	1.05	1.51

Table 2: Effect of foliar application of nutrients on gross returns, net return and B:C ratio of blackgram

Treatments	Gross returns (Rs/ha)	Net return (Rs/ha)	B:C ratio
T_1: Control (water spray at flower initiation)	60486	31850	1.11
T_2: NPK (18:18:18) @2% spray at flower initiation	76959	47014	1.57
T_3: Neem coated urea @2% spray at flower initiation	67583	38876	1.35
T_4: Neem coated urea 2% + salicylic acid @75ppm spray at flower initiation	70555	41785	1.45
T_5: $ZnSO_4$ @0.5% spray at flower initiation	63545	34774	1.20
T_6: $ZnSO_4$ @0.5% spray at flower initiation followed by Neem coated urea 2% spray after 7 days of first spray	68679	39203	1.33
T_7: Boron @0.25ppm spray at flower initiation	62341	33704	1.18
T_8: Boron @0.25ppm spray at flower initiation followed by Neem coated urea 2% spray after 7 days of first spray	70264	40920	1.39
S.Em±	2075	1702	0.07
CD (P=0.05)	6356	5109	0.22

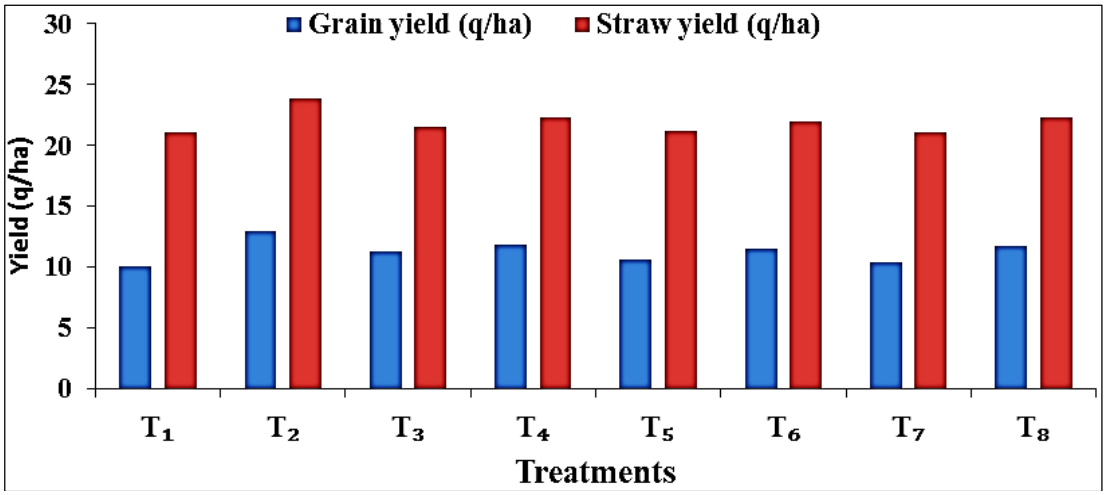

Fig 1: Effect of foliar application of nutrients on grain yield and straw yield of blackgram

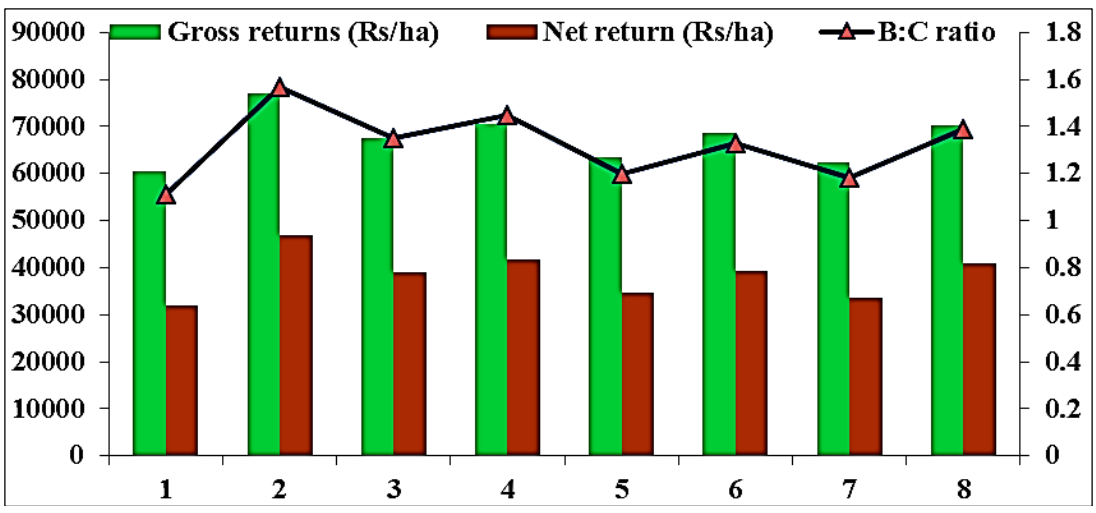

Fig 2: Effect of foliar application of nutrients on economics of blackgram

Conclusion

It can be concluded that application of NPK (18:18:18) @2% spray at flower initiation resulted in significantly higher gross returns, net returns as well as benefit: cost ratio over rest of the treatments.

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