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Effect of foliar application of nitrogen and varieties on productivity and profitability of mungbean (*Vigna radiata*) in Afghanistan

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ABSTRACT

A field experiment was conducted in 2017 at ANASTU, Afghanistan to find the productivity and profitability of foliar application of nitrogen on different varieties of mungbean (*Vigna radiata* L. Wilczek) crop. The treatments included two mungbean varieties (Mash 2008 and NM 94) and seven methods of nitrogen applications including absolute control, basal application 25 kg N/ha, one time foliar application of 2% urea at 40, 50 and 60 days after sowing (DAS), two time foliar application at 50 and 60 DAS and three time foliar application of 2% urea spray at pre flowering (40 DAS), flowering (50 DAS) and pod development (60 DAS). The results showed that the variety Mash 2008 showed significantly higher seed and stover yields, harvest index, gross and net returns, production and monetary efficiency compared to NM 94.Among the nitrogen application treatments, 3 times foliar application of 2% urea at pre flowering + flowering + pod development stages (40, 50 and 60 DAS) was most suitable treatment to get highest growth, productivity, profitability and production and monetary efficiency of mungbean. It was concluded that the 3 times foliar of 2% urea at pre flowering + flowering + pod development stages (40, 50 and 60 DAS) may be applied to the variety Mash 2008 to get highest productivity and profitability of mungbean and this combination may be recommended under the semi-arid conditions of Afghanistan.

Key words: Foliar N application, Monetary efficiency, Mungbean, Net return, Production efficiency

Mungbean (*Vigna radiata* L. Wilczek) is an important short duration pulse crop in Afghanistan (Jalali *et al.* 2017). It is widely cultivated throughout the Asia, including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Laos, Cambodia, Vietnam, Indonesia, Malaysia, south China and Argentina (Choudhary *et al.* 2015). It contains about 25% protein, which is almost three times that of cereals. It is consumed in the form of split pulse as well as whole pulse, and is an essential supplement of cereal based diet. Greengram improves soil physical properties and fixes atmospheric nitrogen. Greengram crop normally produces a large number of flowers but only a few are retained and develop into pods (Sengupta and Tamang 2015). Afghanistan is an agricultural based economy where wheat, rice, maize and pulses are major field crops. Among these, pulses constitute the main source of plant based protein for the ever rising human population. The pulses are excellent source of protein nutrition for livestock too. In developing countries like Afghanistan where protein energy mal-nutrition is a serious challenge due to cereal based dietary pattern, inclusion of pulses in staple diet could help in overcoming the crisis of malnourishment. Further, the protein obtained from pulses is comparatively cheaper than animal based protein sources, i.e. meat, egg and fish, owing to the low market prices of pulses (Jahish 2016). In Afghanistan farmers sow this crop with only one ploughing and hardly use any fertilizers and irrigation due to their poor socio-economic status and lack of know-how. As a result, the crop yield is very low (Hamim 2016). Earlier researches suggest that N nutrition of the plant during reproductive stage of pulse crop could be a yield limiting factor. This suggests that foliar fertilization during pod-fill may be a means of increasing total N input without involving the roots during this critical period. Extensive research performed during 1970-1990s on foliar fertilization at reproductive stages in soybean showed increased grain yield (Nishioka and Okumura 2008, Mondal *et al.* 2011). With this background an experiment was conducted to evaluate the performance of mungbean varieties under basal *vis-a-vis* foliar N application at different stages of crop.

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm of Afghanistan National Agricultural Sciences and Technology University (ANASTU), Kandahar, Afghanistan during April to July in 2017. Geographically, the experimental field is located in southern part of Afghanistan

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and falls between latitude ranging from 31°30' N, longitude 65°50' E and altitude 1010 m amsl. The climate of this place is tropical to sub-tropical of slightly semi-arid in nature and has hot and dry summer, moderate rainfall and little cold winter. December, January and February are usually the coldest months where the mean temperature normally falls as low as 5.1ºC (in January), whereas June to August are the hottest months, having the maximum average temperature of 31.9ºC (in July). Average normal annual rainfall of Kandahar is about 190.6 mm or 15.9 mm per month. On an average, there are 29 rainy days per year with more than 0.1 mm of rainfall or 2.4 days with a quantity of rain, snow etc. per month. The driest month is June with no rainfall or hardly receives any rainfall. January is the wettest month of the year with an average rainfall of 54 mm. During the experimental period (28 April to 28 July 2017) there was no rainfall. Even relative humidity was low and it varied between 9.1 to 23.9% in this period. During this period minimum and maximum temperature ranged between 16.1°and 41.1°C.Wind speed (mph) ranged between 7.3 to 10.4 km/h during this period.

The experiment was laid out in a factorial randomized block design with three replications. The experiment treatments comprised two mungbean varieties, viz. Mash 2008 and NM 94 in main plots and seven nitrogen application treatments, viz. N_1: Absolute control (No N application), N_2: Basal N application (25 kg/ha), N_3: 2% urea spray at pre flowering (40 DAS), N_4: 2% urea spray at flowering (50 DAS), N_5: 2% urea spray at pod development (60 DAS), N_6: 2% urea spray at flow + pod develop (50 and 60 DAS), N_7: 2% urea spray at pre flowering + flowering + pod development stage (40, 50 and 60 DAS). The crop was sown at the seed rate of 25 kg/ha on 28 April, 2017. Phosphorus at the rate of 50 kg P_2O_5/ha and potassium @30 kg K_2O/ha was applied to all plots at the time of sowing. Nitrogen was applied as per treatments. All other cultural practices were the same for all the treatments. The observations on yield, economics, production and monetary efficiency were recorded as per the standard procedures.

RESULTS AND DISCUSSION

Results showed that among both the mungbean varieties seed yield and stover yields were significantly higher in Mash 2008 as compared to NM 94 (Table 1). Mash 2008 and NM 94 gave seed yield of 1.41 t/ha and 1.32 t/ha, respectively. Among the N fertilization treatments, the seed yield was highest (1.67 t/ha) with the treatment having 3 foliar sprays of 2% urea at pre flowering + flowering + pod development stage (40, 50 and 60 DAS) and it was followed by basal N application @25 kg/ha which gave seed yield of (1.63 t/ha) and both of these treatments were statistically at par. N application through basal as well as foliar application at different stages had significantly higher seed yield than absolute control treatment. Ezzat *et al.* (2012) also reported that the foliar applied urea and micronutrients could be attributed to the stimulatory effect of these elements on better yield. Satyanarayanamma *et al.* (1996) reported that spraying of 2% urea at flowering and pod development

Table 1 Yield and profitability of mungbean varieties and foliar application of nitrogen

Treatment	Seed yield (t/ ha)	Stover yield (t/ha)	Harvest index (%)	Gross returns (*AFN/ ha)	Net returns (*AFN /ha)
Variety					
V1: Mash 2008	1.41	4.17	25.05	112468.9	82976.8
V2: NM 94	1.32	3.99	24.63	105697.1	76205.0
SEm(±)	0.02	0.03	0.31	1618.66	1618.66
CD at 5%	0.07	0.08	NS	4731.41	4731.41
Nitrogen application					
N1: Absolute control (No N application)	0.99	3.28	23.09	80417.8	51297.6
N2: Basal N application (25 kg/ha)	1.63	4.44	26.83	128129.1	97813.4
N3: 2% urea spray at pre flowering (40 DAS)	1.33	4.12	24.23	106952.8	77656.6
N4: 2% urea spray at flowering (50 DAS)	1.27	3.97	24.13	102182.6	72886.4
N5: 2% urea spray at pod development (60 DAS)	1.12	3.84	22.50	91899.9	62603.7
N6 : 2% urea spray at flowering + pod development (50 and 60 DAS)	1.55	4.37	26.22	122720.2	93248.0
N7: 2% urea spray at pre flowering + flowering + pod development stage (40, 50 and 60 DAS)	1.67	4.53	26.87	131278.6	101630.4
SEm(±)	0.05	0.05	0.58	3028.24	3028.24
CD at 5%	0.13	0.14	1.70	8851.65	8851.65
Interaction	NS	NS	NS	NS	NS

*Afghani currency, 1.0 INR=1.07AFN

stage produced the highest seed yield (1.59 t/ha). Among the 3 single foliar applications made at different times (40, 50 and 60 DAS) foliar application at early age (40 DAS), gave higher seed yield as compared to applications made at later stages (50 and 60 DAS). Foliar applications made twice (50 and 60 DAS) gave higher yield than single spray but it was lower than 3 sprays. Manivannan *et al.* (2002) reported that the foliar application of N, P and K with chelated micronutrients has increased the grain yield of blackgram. According to Patel and Patel (1994) foliar application of 1.5% urea and 0.5% DAP significantly increased the seed yield in greengram.

Like seed yield, Mash 2008 gave significantly higher stover yield (4.17 t/ha) than NM 94 (3.99 t/ha). Among the N application treatments, stover yield was highest (4.53 t/ha) at the treatment having 3 times foliar application of 2% urea at pre flowering + flowering + pod development stage (40, 50 and 60 DAS) and it was followed by basal N application @25 kg ha^{-1} which had stover yield of (4.44 t/ha) and both of these treatments were statistically *at par*. Shruthi (2013) also reported similar results in lima bean crop at Dharwad, India. Among the 3 single foliar applications made at different times (40, 50 and 60 DAS) foliar application at early age (40 DAS), gave higher stover yield as compared to applications made at later stages (50 and 60 DAS). Foliar applications made twice (50 and 60 DAS) also gave higher yield than single spray but it was lower than 3 sprays. N application through basal as well as foliar application at different stages had significantly higher weight of stover yield than absolute control. Application of water soluble phosphatic fertilizer along with FYM and biofertilizers recorded significantly superior grain yield (18 q/ha) and haulm yield (13.3 q/ha) in soybean (Kadam *et al.* 2008).The lowest stover yield (3.28 t/ha) was recorded at absolute control treatment. Interaction effects on seed yield and stover yield due to the mungbean varieties and foliar application of N was found to be non significant.

Harvest index of both the varieties (Mash 2008 and NM 94) was statistically at par (Table 1). Jalali *et al.* (2017) reported that the harvest index decreased with the application of higher nitrogen levels. However, in this experiment harvest index was highest (26.9) at the treatment having 3 times foliar application of 2% urea at flowering + pod development (50 and 60 DAS) and it was followed by 2% urea spray at flowering + pod development (50 and 60 DAS) and basal N application @25 kg/ha. Though all of these three treatments were statistically at par. N application through basal as well as foliar application at different stages had significantly higher harvest indices compared to absolute control. Interaction effects on harvest indices due to the mungbean varieties and foliar application of N was found to be non significant.

Data on economic analysis showed that among both the varieties gross and net returns were significantly higher in Mash 2008 as compared to NM 94 (Table 1). Mash 2008 and NM 94 gave gross returns of AFN 112468.9/ha (1.0 INR=1.07AFN) and AFN 105697.1/ha, respectively. Among the N application treatments, the gross returns was highest (AFN 131278.6/ ha) at treatment having 3 times foliar application of 2% urea at pre flowering + flowering + pod develop stage (40, 50 and 60 DAS) and it was followed by 2% urea spray at flowering + pod development (50 and 60 DAS) and basal N application @25 kg ha^{-1} all of these treatments were statistically at par. Gross return was significantly lower at absolute control than N application treatments and it increased with the increase in number of foliar application of N at different stages of crop. Net returns of Mash 2008 and NM 94 were AFN 82976.8 /ha and AFN 76205.0/ha, respectively. Kuttimani and Velayutham (2011) stated that foliar application of nutrient solution of DAP (2%) + sodium molybdate (0.05%) at 30 and 45 DAS in green gram resulted in reduction in cost of inputs and higher net returns. Among the N application treatments, the net returns was highest (AFN 101630.4 /ha) at treatment having 3 foliar applications of 2% urea at pre flowering + flowering + pod development stage (40, 50 and 60 DAS) and it was followed by 2% urea spray at flowering + pod development (50 and 60 DAS) and basal N application @25 kg/ha and all of these 3 treatments were statistically at par. Gupta *et al.* (2011) reported that foliar application of 2% urea at flowering and 10 days after along with biofertilizers resulted maximum net return over the control which was attributed by increased grain yield of chickpea. Net return was significantly higher than absolute control at all the treatments having foliar application of N at different stages of crop. The lowest net returns (AFN 51297.6/ha) was recorded at absolute control treatment. Interaction effects on gross returns and net returns due to the mungbean varieties and foliar application.

Data on production and monetary efficiency showed that among both the varieties production as well as monetary efficiencies was significantly higher in Mash 2008 as compared to NM 94 (Table 2). Among the N application treatments, the production efficiency was highest (18.6 kg/ha/day) at the treatment having 3 sprays of 2% urea at pre flowering + flowering + pod development stage (40, 50 and 60 DAS) and it was followed by 2 sprays of 2% urea at flowering + pod development (50 and 60 DAS) and basal N application (25 kg/ha/day) and all of these 3 treatments were statistically at par. Production efficiencies were significantly higher at the treatments having foliar application of N at different stages of crop compared to absolute control. Similarly, monetary efficiency was highest (1129.2 AFN / ha/day) at treatment having 3 foliar applications of 2% urea at pre flowering + flowering + pod development stage (40, 50 and 60 DAS) and it was followed by 2 sprays of 2% urea at flowering + pod development (50 and 60 DAS) and basal N application 25 kg/ha all of these three treatments were statistically at par. The lowest production and monetary efficiencies were recorded at absolute control treatment. Interaction effects on production and monetary efficiencies due to the mungbean varieties and foliar application of N were found to be the non-significant.

It can be concluded that the variety Mash 2008 was

Table 2 Effect of varieties and foliar application of nitrogen on production and monetary efficiency of mungbean

Treatment	Production efficiency (kg/ha/ day)	Monetary efficiency (AFN/ ha/ day)
Variety		
V_1:Mash 2008	15.7	922.0
V_2: NM 94	14.7	846.7
SEm(±)	0.26	17.99
CD at 5%	0.77	52.57
Nitrogen application		
N_1: Absolute control (No N application)	10.9	570.0
N_2: Basal N application (25 kg/ha)	18.1	1086.8
N_3: 2% urea spray at pre flowering (40 DAS)	14.8	862.9
N_4: 2% urea spray at flowering (50 DAS)	14.1	809.9
N_5: 2% urea spray at pod development (60 DAS)	12.4	695.6
N_6 : 2% urea spray at flowering + pod development (50 and 60 DAS	17.3	1036.1
N_7: 2% urea spray at pre flowering + flowering + pod development stage (40, 50 and 60 DAS)	18.6	1129.2
SEm(±)	0.50	33.65
CD at 5%	1.45	98.35
Interaction (variety × N application)		
SEm(±)	0.70	47.58
CD at 5%	NS	NS

superior to NM 94 as it showed higher productivity, profitability, production and monetary efficiencies. Among the nitrogen application treatments, 3 times foliar application of 2% urea at pre flowering + flowering + pod development stages (40, 50 and 60 DAS) was most suitable treatment to get highest growth, productivity, profitability and production and monetary efficiency of mungbean. Hence, under the semi-arid conditions of Kandahar, Afghanistan, three times foliar application of 2% urea at pre flowering + flowering + pod development stages (40, 50 and 60 DAS) may be applied in the variety Mash 2008 to get highest productivity and profitability of mungbean.

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