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Research Communication

Influence of foliar application of nitrogen on growth and yield of mungbean (*Vigna radiata*) varieties in Kandahar region of Afghanistan

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ABSTRACT

A field experiment was conducted during April–July 2017 at the Afghanistan National Agricultural Sciences and Technology University (ANASTU), Kandahar, Afghanistan to find out the influence of 2 mungbean (*Vigna radiata* L. Wilczek) varieties viz. 'Mash 2008' and 'NM 94' and 7 methods of N applications, viz. absolute control, basal application of 25 kg N/ha, foliar application of 2% urea through single application at 40, 50 and 60 days after sowing (DAS), 2 times foliar application at 50 and 60 DAS and 3 times foliar application of 2% urea spray at pre-flowering (40 DAS), flowering (50 DAS) and pod development (60 DAS) on crop growth and productivity. The results showed that the variety 'Mash 2008' resulted superior performance in respect of plant growth and yield attributes to 'NM 94' mungbean. The findings of present study showed that the 3 times foliar of 2% urea at pre-flowering + flowering + pod development stages (40, 50 and 60 DAS) may be adopted for 'Mash 2008' variety to get the superior plant growth, yield attributes and yields of mungbean in semi-arid conditions of Afghanistan.

Key words: Foliar N application, Mungbean, Plant growth, Yield attributes

Mungbean seed has high nutritive value, having 25–28% protein, 62–65% carbohydrates, 1–1.5% oil, 3.5–4.5% fiber and 4.5–5.5% ash on dry-weight basis (Ashour *et al.,* 1994). It has numerous utilities and used primarily as a food crop because it is a major source of protein in vegetarian diets. Mungbean flour is used for making of bread mixtures and it is an important source of starch. Afghanistan has an agricultural based economy where wheat, rice, maize and pulses are the major field crops. Among these, pulses constituent the main source of plant-based protein for the ever-rising human population. The pulses are excellent source of protein nutrition for livestock too. Since protein malnutrition is a serious challenge due to cereal-based dietary pattern in Afghanistan,, inclusion of pulses in staple diet could help in overcoming the malnourishment (Jahish, 2016). Besides, mungbean crop also enriches the soil fertility because of its inherent biological nitrogen fixation mechanism. Mungbean being a deep-rooted crop, it absorbs nutrient from the subsoil and results in enriching the plough layers (Prasad and Kerketta, 1991).

Mungbean has a special importance in intensive crop production systems of Afghanistan owing to its short growing period of about 70–90 days. It is reported to be drought-tolerant and can be cultivated in low rainfall areas. Generally, mungbean is sown in warm regions of Afghanistan like Kunduz, Helmand, Kandahar, Nangarhar, Parwan, Baghlan, Laghman, Takhar, Kapisa. It is commonly cultivated as summer crop in Afghanistan, but in some regions of the country it is also sown in spring season. The average yield of mungbean in Afghanistan varies from 1.40 to 1.75 t/ha under a good agronomic management (USAID, 2007). Nitrogen (N) is a major essential plant nutrients and the successful crop production depends mainly on the availability of N in adequate amounts. Nitrogen is perhaps the single most important factor limiting the crop yields. One of the probable reasons for low yield of seed legumes in general is the high requirement of nitrogen for the formation and development of prominent seeds. To produce one unit of seeds, mungbean needs as much as 3 times more nitrogen than that needed by cereals like rice and it requires a large amount of nutrients in 2–3 phases (Trung and Yoshida, 1985). Foliar application of nutrients along with

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soil application has several advantages in supplementing the nutritional requirements of crops such as rapid and efficient response by the plants, less product needed and independence of soil conditions. Foliar nutrition designed to eliminate the problems like fixation and immobilization of nutrients. Hence, foliar nutrition is recognized as an important method of fertilization in modern agriculture. This method provides utilization of nutrients more efficiently and for correcting deficiencies rapidly especially for short-duration crops. Recently, new-generation fertilizers have been introduced exclusively for foliar feeding and fertilization (Shruthi, 2013). Foliar application of water-soluble fertilizers showed positive effect on growth, yield and quality of crops (Patel, 2011). With this background, a field experiment was conducted to evaluate the performance of mungbean varieties and foliar N application.

The field experiment was conducted during April–July 2017 at the Afghanistan National Agricultural Sciences and Technology University (ANASTU), Kandahar, (31°30' N, 65°50' E, 1,010 m above mean sea-level) in southern part of Afghanistan. The climate of this place is tropical to subtropical of slightly semi-arid in nature and has hot and dry summer, moderate rainfall and little cold winter. December to February are usually the coldest months where the mean temperature normally falls as low as 5.1^{o}C (in January), whereas June to August are the hottest months, having the maximum average temperature of 31.9^{o}C (in July). Average normal annual rainfall of Kandahar is 190.6 mm or 15.9 mm/month. On an average, there are 29 rainy days/year with more than 0.1 mm rainfall. The driest month is June with no rainfall. January is the wettest month 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 varied between 9.1 and 23.9% during this period. The minimum and maximum temperature varied between 16.1° and 41.1°C during this period.

Soil of experimental site was sandy clay loam in texture and having *p*H 8.1, available N 130.4 kg/ha, available P 26.2 kg/ha and available K 290.0 kg/ha. The experiment was laid out in a factorial randomized block design with 3 replications. The experiment treatments comprised 2 mungbean varieties, viz. 'Mash 2008' and 'NM 94' in main plots and 7 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 (days after sowing 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 flowering + pod-development (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 with seed rate of 25 kg/ha on 28 April 2017. Phosphorus and potassium were applied at the rate of 50 kg P_2O_5 kg/ha and potassium @ 30 kg K_2O/ha, respectively, to all plots at the time of sowing. Nitrogen was applied as per treatments. All other cultural practices were same for all the treatments. The observations on plant growth parameters, viz. plant height, leaf area, dry-matter accumulation, root length and weight were taken 30, 60, 90 days after sowing (DAS) and at maturity stages but data of 90 DAS were given in this paper. Data on plant growth and yield attributes were recorded as par standard procedures.

Plant height, leaf area, dry-matter accumulation, root length and its weight were significantly higher in 'Mash 2008' as compared to 'NM 94' (Table 1). Among the 3 observations at 30, 60 and 90 DAS, there was a gradual increase in growth parameters (plant height, leaf area, dry-matter accumulation, root length and its weight) with age of the crop and maximum values of those parameters were recorded at 90 DAS. Among the N application treatments at 90 DAS, plant height was the highest (53.7 cm) in the treatment having 3 time foliar application of 2% urea at pre-flowering + flowering + pod-development stage (40, 50 and 60 DAS) and it was significantly higher than absolute control as well as the treatments having single foliar application of N at different stages of crop and basal N application @ 25 kg/ha and this treatment was followed by basal N application @ 25 kg/ha. Plant-growth parameters (plant height, leaf area, dry-matter accumulation, root length and its weight) at 30 and 60 DAS were superior with basal N application @ 25 kg/ha but later at 90 DAS treatment with 3 time foliar application of 2% urea at pre-flowering + flowering + pod-development stage (40, 50 and 60 DAS) superseded this treatment in most of the parameters. Khalilzadeh *et al*. (2012) also reported that, the foliar application of urea and organic manures substantially improved the plant height of mungbean.

The treatment having 3 times foliar spray of 2% urea at pre-flowering + flowering + pod development stage (40, 50 and 60 DAS) resulted in the highest dry-matter accumulation and it was followed by 2% urea spray at flowering + pod development (50 and 60 DAS), while the dry-matter accumulation of both these treatments were statistically at par. Mondal *et al.* (2011) also reported that, foliar application of N and N plus micronutrients had significant effects on leaf area of plant. Leaf-area index (LAI) was also highest in the treatment having 3 sprays of 2% urea at pre-flowering + flowering + pod-development stage (40, 50 and 60 DAS) and it was significantly higher than the absolute control as well as the treatments having single and double foliar application of N at different stages of crop and basal N application @ 25 kg/ha. The smallest leaf area and leaf-area index (LAI) were recorded in absolute control treatment. Root dry weight was the highest with basal N application @ 25 kg/ha and it was followed 3 foliar sprays of

2% urea at pre-flowering + flowering + pod-development stage (40, 50 and 60 DAS). At 90 DAS, number of branches/plant was the highest in 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 2% urea spray at flowering + pod development (50 and 60 DAS), early foliar spray (40 DAS) and basal N application @ 25 kg/ha all of these treatments were statistically at par. Ghildiyal (1992) also reported that, the externally foliar applied N or micronutrients was a good supplement to meet N requirements of mungbean.

The maximum root length was recorded at maximum flowering stage with basal application of N @ 25 kg/ha and it was followed by 3 times foliar spray of 2% urea at pre-flowering + flowering + pod development stage (40, 50 and 60 DAS) and flowering + pod-development stage (40, 50 DAS) having 23.0 cm and 22.2 cm root lengths and all of these 3 treatments were statistically at par. The root nodule count recorded at maximum flowering stage was the highest at the treatment having basal N application @ 25 kg/ha and it was followed three times foliar application of 2% urea at pre-flowering + flowering + pod development stage (40, 50 and 60 DAS) and at early flowering stage (40 DAS), whereas both had root nodule count of 14.7 and thus were statistically at par. Basal as well as foliar application of N gave significantly higher root nodule count than the absolute control. Among the 3 treatments having single 2% urea application at 40, 50 and 60 DAS corresponding to pre-flowering, flowering and pod-development stages, superior growth parameters (plant height, leaf area, dry-matter accumulation, root length and its weight) were recorded with 2% urea spray at pre-flowering (40 DAS). These results are in line with the findings of Jalali (2016).

Yield attributes, viz. number of pods/plant, pod length, number of seeds/pod, weight of seeds/plant, 1,000-seed weight were significantly higher in 'Mash 2008' as compared to 'NM 94' (Table 2). 'Mash 2008' and 'NM 94' had 29.9 and 28.9 pods/plant respectively. Among the N fertilization treatments, the pods/plant were the highest with 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 application of N @ 25 kg/ha and both of these treatments were statistically at par. Tank *et al*. (1992) found that the mungbean with 20 kg N and 40 kg P_2O_5/ha led to significantly higher number of pods/plant over the unfertilized control. Foliar and basal application of N resulted in significantly higher number of pods as compared to the absolute control. Behera and Elamathi (2007) reported that, 2% foliar spray of DAP and NAA (40 ppm) twice at 25 and 35 days after

Table 1. Influence of foliar application of nitrogen on growth attributes of mungbean varieties (at 90 days after sowing)

Treatment	Plant height (cm)	Leaf-area index (cm^2/ plant)	Dry matter/ plant (g)	Branches/ plant	Root length (cm)*	Root nodules count/plant*
Varieties						
V_1, 'Mash 2008'	48.6	4.21	13.1	4.5	21.1	13.9
V_2,'NM 94'	46.7	4.16	12.8	4.4	20.7	13.6
SEm±	0.04	0.008	0.08	0.05	0.16	0.07
CD (P=0.05)	0.12	0.022	0.24	NS	NS	0.19
Nitrogen application						
N_1	36.7	3.4	10.8	3.0	16.1	9.9
N_2	51.5	4.6	14.3	5.1	23.4	15.0
N_3	49.0	4. 5	13.5	5.0	22.2	14.7
N_4	47.3	4.1	12.5	4.3	22.0	14.1
N_5	45.2	3.7	11.1	3.6	17.3	13.1
N_6	50.2	4.5	14.1	5.1	22.5	14.5
N_7	53.7	4.6	14.6	5.2	23.0	14.7
SEm±	0.08	0.014	0.015	0.09	0.29	0.12
CD (P=0.05)	0.22	0.042	0.44	0.25	0.85	0.36
Interaction (variety × N application)						
SEm±	0.11	0.02	0.21	0.12	0.41	0.17
CD (P=0.05)	S	S	NS	NS	NS	NS

* at maximum flowering stage

*At maximum flowering stage

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 flowering + pod development (50 and 60 DAS); N_7, 2% urea spray at pre-flowering + flowering + pod-development stage (40, 50 and 60 DAS) resulted in significantly higher pods/plant. Among the N fertilization treatments, the pod length was the highest with 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 2% urea spray at flowering + pod development (50 and 60 DAS) and basal N application @ 25 kg/ha, all these treatments being statistically at par. Foliar and basal application of N had significantly higher pod length than the absolute control. Jalali (2016) showed that pods/plant, pod length and grains/pod and grains weight/ plant were significantly affected by N fertilization. The highest number of grains/plant was seen when N was applied @ 30 kg/ha. Among the N fertilization treatments, the highest number of seeds/ pod were recorded with the treatment having 3 times foliar spray 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 treatments being statistically at par had significantly higher number of seeds/ pod than the absolute control. Mondal *et al.* (2011) also recorded significant effect of foliar applied N and micronutrients on yield attributes and yield of mungbean. The weight of seeds/plant was the highest with the treatment having 3 times foliar spray of 2% urea at pre-flowering + flowering+ pod development and it was followed by 2% urea spray at flowering + pod development (50 and 60 DAS) and basal application of N @ 25 kg/ha both of these treatments were statistically at par. Foliar and basal application of N at different stages had significantly higher weight of seeds/plant than the absolute control. Among both the varieties 1,000-seeds weight was significantly higher in 'Mash 2008' than 'NM 94'. Among the N fertilization treatments, the 1,000-seed weight was the highest 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 2% urea spray at flowering + pod-development (50 and 60 DAS) and basal N application @ 25 kg/ha and both of these treatments were statistically at par. Foliar and basal application of N at different stages had significantly higher weight of 100-seeds than the absolute control treatment. Mainul *et al*. (2014) found that, number of pods/plant differed significantly due to different N doses. Naragund *et al*. (2019) recorded superior plant growth, yield attributes and yields in greengram under the influence of integrated crop nutrition through biofertilizers compared to the control. Shruthi (2013) also recorded that application of 25 : 50 : 25 kg N : P : K/ha+ foliar application of water-soluble fertilizer (WSF) @ 19 : 19 : 19 at 0.5% for lima bean at branching, 50% flowering and pod-development stage gave significantly higher number of pods/plant, 100-seed weight, and seed yield/plant which ultimately resulted in higher seed yield. Among both the mungbean varieties, seed yield and stover yields were significantly higher in 'Mash 2008' as compared to 'NM 94' (Table 2). Among the N fertilization treatments, the seed yield was highest 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 and both of these treatments were statistically at par. Foliar and basal application of N at different stages had significantly higher

Table 2. Influence of foliar application of nitrogen on growth attributes and yields of mungbean varieties

Treatment	Pods/plant	Seeds/ pod	Pod length (cm)	Seed yield (t/ha)	Stover yield (t/ha)
Varieties					
V_1, 'Mash 2008'	29.9	7.8	7.7	1.41	4.17
V_2, 'NM 94'	28.9	7.1	7.6	1.32	3.99
SEm±	0.08	0.04	0.02	0.02	0.03
CD (P=0.05)	0.23	0.11	0.06	0.07	0.08
Nitrogen application					
N_1	22.8	6.1	6.3	0.99	3.28
N_2	31.5	8.1	8.3	1.63	4.44
N_3	30.6	7.5	7.8	1.33	4.12
N_4	29.6	7.2	7.5	1.27	3.97
N_5	28.5	7.1	7.2	1.12	3.84
N_6	31.1	8.0	8.2	1.55	4.37
N_7	31.8	8.2	8.3	1.67	4.53
SEm±	0.15	0.07	0.04	0.05	0.05
CD (P=0.05)	0.43	0.21	0.11	0.13	0.14
Interaction (variety × N application)					
SEm±	0.21	0.10	0.05	0.06	0.07
CD (P=0.05)	NS	S	NS	NS	NS

seed yield than the absolute control treatment.

It was concluded that among the mungbean varieties, plant growth, yield attributes and yields were superior in 'Mash 2008' than 'NM 94'. Plant growth, yield attributes and yields of seed and stover were superior with the N-management treatments 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 and both these treatments were statistically at par in most of the observations.

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