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EFFECT OF NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF SUMMER MUNGBEAN (*VIGNA RADIATA* L.)

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ABSTRACT

A field experiment was conducted during summer season of 2012 at Muzaffarpur. Result revealed that Growth attributes were significantly higher found under application of 100 % RDF, 50% RDF + 2 % urea spray at 40 DAS. HW at 25 DAS and pendimethalin @ 1.0 kg ai ha^{-1} increased all the growth and yield attributes. Highest grain yield obtained under 100% RDF 12.60 q ha^{-1}. HW at 25 DAS recorded max. grain yield 13.50 q ha^{-1} being at par with PE pendimethalin @ 1 kg ai ha^{-1} 12.67 q ha^{-1}. Thus it can be concluded that application of 100% RDF and HW at 25 DAS proved to be better nutrient and weed management practice over other practices.

INTRODUCTION

Mungbean (*Vigna radiata* L. wilczek) is an important pulse crop of India having an excellent source of high quality protein**.** It not only plays an important role in human diet but also in improving the soil fertility by fixing the atmospheric nitrogen (Athernadeem *et al*., 2004). Its seed is more palatable, nutritive, digestible and non-flatulent than other pulses (Anjum *et al.,* 2006). Besides this, summer mungbean has special importance in intensive crop production due to its short growing period as it can be grown as a catch crop in rice-wheat cropping system. It is not only ideal for catch cropping, inter cropping and multiple cropping system but also serve as excellent cover crop to protect the soil against erosion. It is mainly utilized in making dal, curries, soup, sweets and snacks. During sprouting, there is an increase in thiamine, niacin and ascorbic acid concentration. The food values of mungbean lie in its high and easily digestible protein. The mungbean seeds contain approximately 25-28% protein, 1.0-1.5% oil, 3.5-4.5% fiber, 4.5-5.5% ash and 62-65% carbohydrates on dry weight basis.

The management of fertilizers is one of the most important factors that greatly affect the growth, development and yield of mung bean (Asaduzzaman *et al*., 2008). Nitrogen and phosphorus are both integral components of virtually all the biochemical compounds that make plant life possible. N and P are essential elements in their structural, biochemical and physiological roles contributing to crop growth (Sinclair and Vadez, 2002). Nitrogen is an important major nutrient element for plant. For legumes, it is more useful because it is the main component of amino acids as well as proteins. Adequate supply of nitrogen is essential for normal growth and yield (Mozumder *et al*., 2003). Without N it is not possible to synthesize the necessary proteins, enzymes, DNA and RNA required in virtually all plant cells for their initial development, sustained growth and functioning to support other tissues of the plant. So, deficiencies in reduced N necessarily results in less biochemical machinery to catalyze plant metabolism and to generate new cells. Consequently, nitrogen deficiencies result in decreased crop leaf area, photosynthetic assimilation and seed growth (Sinclair and Vadez, 2002).Phosphate nutrition is the basic need of legumes. In view of fact that added phosphorus get fixed in the soil, the phosphorus deficiency accounts for the major limiting factor for the growth of the legumes (Sharma *et al*., 2003). Among the soil nutrient elements, P is the second most essential nutrient after the nitrogen. Many studies have shown that application of phosphorous fertilizers generally has great impact on crop yields because its deficiency limits the response of plants to other nutrient (Akinrinde and Adigun, 2005). Phosphorus is an essential component of cell structures, mainly as nucleic acids and phospholipids (Sinclair and Vadez, 2002). It is especially critical in establishing the enzymatic machinery in energy storage and transfer, which in many cases involves membrane processes. Not surprisingly, P deficiency results in a loss in cell integrity. The bonding properties of P also make it crucial for metabolic processes that are nucleotide-based, *e.g.*, ADP, NAD and NADP, because of its unique energy-transfer properties. A general consequence of P deficiency is a decrease in the energy charge of cells (Sinclair and Vadez, 2002). Though, potassium is rarely applied to pulse crops because of high potassium content in the soil, its application regulates the utilization of other nutrients in the plant system (Thiyagarajan *et al., 2003*). Therefore, superimposition of K at different level of phosphate besides a starter dose of N may improve yield in mungbean (*vigna radiata* L., Wilczek). Sulphur is an important secondary nutrient which helps in plant growth and metabolism especially by improving activities of proteolytic enzymes and is also required for nitrogen fixation by leguminous plants. Foliar fertilization is gaining importance in plant nutrition these days. The foliar applied nutrients are more effective as compared to soil applied nutrients. Because of higher uptake efficiency, foliar supply of nutrient can increase photosynthetic efficiency by delaying the leaf senescence. The present study deals with effect of nutrient levels and weed management on growth, yield and quality of mungbean.

MATERIALS AND METHODS

A field experiment was conduct at Tirhut College of Agriculture Farm, Dholi (Muzaffarpur), a campus of Rajendra Agricultural University, pusa (Samastipur), Bihar during summer 2012 to study the effect of weed management in summer mungbean. Dholi, Pusa (Altitude of 52.18 meter above mean sea level and lies at 25°.39'N latitude and 85°.40'E longitude) is located semi-arid, sub-tropical climate with moderate rainfall, hot dry summer and cold winter. The soil of the experimental plot was alluvial and calcareous in nature, having pH 7.4, low in organic carbon (0.45%), low in available nitrogen and medium phosphorus and potassium content.

The treatment included all the possible 20 combinations four nutrient levels with main plot 100 % RDF (10-15-17-20 kg NPK, 50% RDF + 2.0% Urea spray at 40 DAS, 2% Urea spray 20 at DAS + 40 and No fertilizer and sub plot five weed management treatments. Pendimethalin @ 1.0 kg ai/ha (PE) Imazethapyr @ 50g ai/ha (20 DAS) Chlorimuron ethyl @ 4g ai/ha (PPI), Hand weeding at 25 DAS and Weedy cheek were tested in a split plot design with three replication and net plot size was 4×1.8 m. The crop was shown on 18 march, 2012 in row spacing of 30 cm using a recommended seed rate of 25 kg/ha of variety HUM-16.Chlorimuron ethyl, pendimethalin and Imazethapyr were applied as pre plant incorporation (PPI), pre-emergence and post emergence (20 DAS). The spraying was done with flat fan nozzle. Weed As per treatment, one hand weeding was done at 25 days after sowing with the help of khurpi. No weeding was done in rest of the plot. Data on weed count, weed dry matter and weed control efficiency at 20, 40 DAS and at harvest and weed index at count at harvest, using a quadrate 50×50 cm. Data on plant growth was recorded 20 and 40 DAS and at harvest and data on yield, yield attributed and economics were recorded at harvest. Plant sample was analyzed for nutrient uptake at harvest. The data were analyzed and treatments having a significant F valve, critical difference (CD) value were calculated at 5% probability level.

RESULTS AND DISCUSSION

Crop growth and development in mungbean was measured in terms of plant height, number of trifoliate leaves/plant, leaf area index and dry matter accumulation at an interval of 20 days starting from 20 days after sowing.

Plant height (cm)

Nutrient levels did not influence the plant height at 20 DAS but significant variation was observed at 40 DAS and at harvest. Maximum plant height was observed under 100 % RDF (32.52 cm) which was significantly superior to 2 % urea spray at 20 and 40 DAS (27.54 cm) and no fertilizer (28.54 cm) but was at par with 50 % RDF + 2 % urea spray at 40 DAS (31.91 cm) at harvest. This increase in plant height might be due to greater uptake of nutrients which helps in producing more protoplasm

Table 1: Growth parameters as affected by different treatments at 20 and 40 DAS

Treatments	Plant height (cm)		Number of trifoliate leaves/plant		Leaf area index		Dry matter of plant (g/plant)	
	40 DAS	at harvest	40 DAS	at harvest	40 DAS	At harvest	40 DAS	At harvest
RDF(10:15:17:20 kg NPKS/ha)	15.40	32.52	5.71	8.39	1.33	2.77	2.62	9.32
50 % RDF + 2.0 % Urea spray at 40	15.34	31.91	5.61	8.24	1.27	2.69	2.56	9.16
2 % Urea spray at 20 DAS + 40	13.50	28.54	5.19	7.41	1.07	2.28	2.22	8.2
Control (no fertilizer)	13.17	27.54	5.07	7.10	1.01	2.14	2.09	7.7
S.Em.±	0.30	0.97	0.13	0.19	0.04	0.08	0.07	0.19
C.D.(p=0.05)	1.05	0.83	0.48	0.65	0.15	0.27	0.25	0.67

Table 2: yield attributed and yield parameters as affected by different treatments

Treatments	Pods/ Plant (No.)	seeds/ pod (No.)	Grain Yield weight (g/plant)	Test (g)	Grain yield (q/ha)	Straw yield harvest (q/ha) index
RDF(10:15:17:20 kg NPKS/ha)	9.83	4.58	43.55	12.60	21.66	36.77
50 % RDF + 2.0 % Urea spray at 40DAS	9.43	4.30	42.39	12.12	21	36.51
2 % Urea spray at 20 DAS + 40 DAS	9.20	3.90	39.69	10.70	19.87	35.58
Control (no fertilizer)	9.07	3.76	39.30	9.17	17.18	34.8
S.Em.±	0.38	0.11	0.70	0.24	0.63	0.75
C.D.(p=0.05)3.38	0.38	0.39	2.43	0.83	2.19	NS

Table 3: Available nutrient in post harvest soil as influenced by different treatments

Treatments	Available nutrient in soil (kg/ha) at harvest			
	N	P	K	S
RDF(10:15:17:20 kg NPKS/ha)	199.72	17.94	129.24	31.42
50 % RDF + 2.0 % Urea spray at 40 DAS	197.78	17.39	126.87	29.81
2 % Urea spray at 20 DAS + 40 DAS	194.04	14.41	118.14	25.73
Control (no fertilizer)	193.17	13.89	117.01	25.15
S.Em. ±	1.22	0.48	1.45	0.49
C.D.(p=0.05)	4.23	1.66	5.03	1.73
Initial	182.5	16.63	122.25	26.7

Table 4: Protein content (%) as affected by different treatments

Treatments	Protein content in grain
Nutrient levels	
F_1- RDF (10:15:17:20 kg NPKS/ha)	23.01
F_2- 50 % RDF+2.0 % Urea spray at 40 DAS	22.56
F_3- 2 % Urea spray at 20 DAS + 40 DAS	22.43
F_4 - Control (no fertilizer)	21.75
S.Em. ±	0.22
C.D.(P=0.05)	0.77

and thereby enhancing rapid cell division and elongation which was exhibited in from of increase in height at recommended dose of fertilizer. Similar results were also reported due to application of 100 % RDF by Choudhary and Yadav (2011) and Sharma *et al.* (2000).

Number of trifoliate leaves plant^{-1}

Number of trifoliate leaves/plant is one of the important growth attributes because it determines leaf area index and consequently the photosynthetic efficiency of the plant. The higher number of trifoliate leaves/plant was obtained with 100 % RDF at all the stages of crop growth. However, the differences were significant only at later two stages *i.e.* at 40 DAS and at harvest but was not significant at initial stage of 20 DAS. Plots receiving 2 % urea spray at 20 DAS + 40 DAS and no fertilizer recorded the lowest number of green trifoliate leaves at almost all the stages of crop growth. It is known that nitrogen being the constituent of chlorophyll, delay leaf senescence and thereby keeps the plant green for longer period. Increasing nitrogen supply allows the leaves to remain green for longer period and in many cases increases the growing season and delays the maturity. Thus the reasons for higher number of green trifoliate leaves with application of fertilizer particulars N are clearly obvious. Lesser number of green trifoliate leaves/ plant was associated with 2 % urea spray at 20 and 40 DAS and no fertilizer was apparently due to low supply of nitrogen from the soil to plant. Finding of Yakadri *et al.* (2002) support the result of this character. As known fertilizer application in grain legumes has been found to be more conducive towards their vegetative growth which stimulated the branching efficiency consequently resulting in higher number of trifoliate leaves/plant. However, the degree of effect of applied fertiliser depends on the available soil nutrient and N fixation efficiency of the plant itself.

Leaf area index

Leaf area index did not differ significantly due to different nutrient levels at 20 DAS but significant variation was observed at 40 DAS and at harvest. Maximum leaf area index was noticed with 100 % RDF at all the stages of crop growth. Increase in leaf area index was due to favourable synthesis of growth favouring constituents in plant system due to better supply of nitrogen which resulted in enlargement of leaf area. Devlin (1971) also pointed out that nitrogen was essential constituent of protein. Thus, low nitrogen availability must cause a decrease in protein synthesis which consequently decreased cell size and especially cell division. A decrease in leaf epidermal cell size due to lack of nitrogen ultimately reduce the size of leaves. Hegde and Shrinivas (1989) also observed a higher leaf area index with increasing rate of fertilizer.

Dry matter production plant^{-1}

Dry matter accumulation/plant differed significantly due to different nutrient levels at all the stages of crop growth. Higher dry matter accumulation/plant was obtained under 100 % RDF (9.32) followed in descending order by 50 % RDF + 2 % urea spray at 40 DAS (9.16), 2 % urea spray at 20 + 40 DAS (8.20) and no fertilizer (7.70) at harvest. The photosynthetic activities of the plants are well reflected in their dry matter accumulation. An increased production of dry matter indicates the better utilization of nutrients along with better harvest of solar energy. In present investigation, nutrient application increased the rate of photosynthetic process which finally resulted in increased dry matter production by the plant at each stage of growth. Increased plant height, more number of trifoliate leaves and higher leaf area index due to application of nutrients might have resulted in increase in dry matter accumulation/plant. Increase in dry matter accumulation per meter row length due to higher nutrient level was also reported by Dean and Clark (1960). The results are also in close conformity with the findings of Choudhary and Yadav (2011).

Yield attributes and yield

Yield of a crop is the final expression of overall performance of crop *i.e.* pre and post harvest characters. These characters as known are influenced and consequently modified by various management factors in the mungbean crop. The yield/ plant depends on the number of pods/plant, pod weight/plant, pod length, number of grains/pod and test weight. In the present investigation, nutrient application favourably influenced all the yield attributing characters except number of grains/pod. Higher values of all the yield attributes was observed with the application of 100 % recommended dose of fertilizer and minimum was associated with 2 % urea spray at 20 DAS and 40 DAS and no fertilizer. Thus through the pathways of enhanced photosynthetic efficiency in the postanthesis growth of the crop, nutrient application under optimum soil moisture favourably influenced the yield contributing characters. These finding are in complete agreement with the results of many worker Sharma *et al.* (2000) and Sultana *et al.* (2009).

Pulses have special affinity for P and it is perhaps the most common factor limiting pulses production. Varieties efficient in using phosphorus appear to be also efficient in using soil nitrogen. However, responses to potassium are rarely reported and North Bihar soils are usually adequately supplied with potassium. In the present experiment, hence, both 100 % RDF and 50 % RDF + 2 % urea spray at 40 DAS maintained its superiority over 2 % urea spray at 20 and 40 DAS and no fertilizer (control), in respect of the expression of yield attributing characters like number of pods/plant, number of grains/pod, grain yield/plant and test weight of munbean. Consequently a significant increase in yield of grain was observed with application 100 % RDF (12.60 q/ha) and 50% RDF + 2 % urea spray at 40 DAS (12.12 q/ha), which was at par each other and both of them were significantly superior to 2 % urea spray at 20 and 40 DAS (10.70 q/ha) and no fertilizer (9.17 q/ha). These results are in agreement with finding of Kumar *et al.* (2003) and Sheoran *et al.* (2008)

Like grain yield, straw yield was also the outcome of growth and yield attributes like plant height, leaf area index, dry matter accumulation and other characters. In the present investigation all the growth and developmental characters were found to have been favourably influenced by nutrient levels in mungbean. The highest straw yield (21.66 q/ha) was recorded under 100 % RDF which was significantly superior over 2 % urea spray at 20 and 40 DAS (19.37 q/ha) and no fertilizer (17.18 q/ha) but was at par with 50 % RDF + 2% urea spray at 40 DAS (21.07 q/ha). This may be attributed the beneficial effect of nutrients on the vegetative growth of plant. It is known that nitrogen is an important constituent of protoplasm levels. Higher nutrient level *i. e.* 100 % RDF and 50 % RDF + 2 % urea spray at 40 DAS helped in cell multiplication and its elongation and thus resulted in significantly better growth of the plant with improvement in plant height, number of trifoliate leaves, leaf area index and dry matter accumulation and other characters. All these cumulatively increased the straw yield.

In the present investigation nutrient levels failed to cause any significant variation in the harvest index of mungbean. Though, higher harvest index was obtained with higher nutrient levels. Improved harvest index is an indication of increased physiological efficiency of the plant to metabolize the photosynthate for grain development.

Quality parameters

Significant increase in protein content of mungbean was recorded under the treatment containing 100 % RDF than no fertiliser but was at par with 50 % RDF + 2 % urea spray at 40 DAS. The increase in protein content could be assigned to increased uptake of nitrogen with increase in its application which was in turn transferred from the non grain to grain portion. Higher nitrogen content is directly responsible for higher protein content because it is a primary component of amino acids which constitutes the basis of protein. Similar results were also reported Verma *et al.* (1976), Yadav *et al.* (2002) and Chesti *et al.* (2012).

Available nitrogen was influenced significantly under different nutrient levels and weed management practices. Higher value of available nitrogen was noticed under F_1 (199.72 kg/ha) which was at par with F_2 (197.78 kg/ha) and both of them were significantly superior to F_3 (194.04 kg/ha) and F_4 (193.17 kg/ha).

Available P content in the post-harvest soil was influenced significantly by both nutrient and weed management practices. Among the nutrient levels, F_1 (17.94 kg/ha)proved significantly superior F_3 (14.41kg/ha) and F_4 (13.89 kg/ha) but was at par with F_2 (17.49 kg/ha).

The different nutrient levels significantly affected the available K content in post harvest soil. Higher available K was recorded in F_1 (129.24 kg/ha) which was significantly superior over F_3 (118.14 kg/ha) and F_4 (117.01 kg/ha) but was at par with F_2 (126.87 kg/ha).

Significant difference in available S was observed due to different nutrient levels. Maximum available S was recorded under F_1 (31.42 kg/ha) being at par with F_2 (29.81 kg/ha) and both of them were significantly superior over F_3 (25.73 kg/ha) and F_4 (25.15 kg/ha).

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