

## EFFECT OF NITROGEN ON GROWTH AND YIELD ON MUNGBEAN IN LOW NUTRIENT SOIL

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### Abstract

A pot experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during *kharif II* season of 2011 to investigate the growth, dry matter production and yield of mungbean genotypes under nutrient stress soil. Ten mungbean genotypes viz., IP5A-12, GK-27, IP5A-3, IP5A-5, ACC12890053, GK-63, ACC12890055, BARI Mung-6, BU mug- 4 and Bina moog- 5 and six nitrogen fertilizer levels viz., 0, 20, 40, 60, 80 and 100 kg N ha<sup>-1</sup> were included as experimental treatments. Results revealed that increasing nitrogen level in nutrient stress soil increased growth and dry matter production up to 60 kg N ha<sup>-1</sup> irrespective of genotype and thereafter decreased. Among the mungbean genotype IP5A 12 showed maximum leaf area, dry matter production and seed yield (14.22 g plant<sup>-1</sup>) in nutrient stress soil. The lowest seed yield (7.33 g plant<sup>-1</sup>) was recorded in ACC12890053 under control condition.

Keywords: Mungbean genotype, Nutrient stress, Dry matter, Seed yield.

### Introduction

Mungbean is one of the most important pulse crop in the south Asia. It is primary source of high quality, easily digestible protein and provides vitamin A, vitamin C, zinc and foliate to the predominantly vegetarian population of south Asia (Chanda, 2007).

However, yield of mungbean in south Asia is very low due to different causes like, nutrient stress, salinity, rainfall and lack of suitable variety. Among them mungbean cultivation under nutrient stress soil and also low utilization of N fertilizer, where as optimum N fertilizer enhance grain growth and development.

It is now well established that despite nitrogen fixation, N alimentation in legumes is limiting factor in terms of either quantitative (seed) or qualitative (N) yields. In fact, young plants find their initial nitrogen requirements through soil mineral nitrogen. After nodules have been established, N fixation succeeds to assimilation, reaches peak at pod developing stage and declines thereafter. Later, most of the seed filling is achieved by the redistribution of N from vegetative plant organs to the developing seeds. The beneficial effect of applied nitrogen is to retained more leaf area causing accelerated photosynthetic rate which led to

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more dry matter production and consequently higher yield per plant (Dahatonde and Nalamwar, 1996; Sushant *et al.*, 1999). Such improvement in yield components and yield of mungbean by applied nitrogen was also reported by many researchers. Patra and Bhattacharyya (1997) observed that the highest seed yield and yield components were obtained by applied urea at the rate of 25 kg N ha<sup>-1</sup>. Ashraf, (2001); Mahboob and Asghar (2002) also found that number of pods per plant, seeds per pod, 1000-seed weight were significantly affected by the application of nitrogen from 20 to 50 kg ha<sup>-1</sup>. The present study was therefore, aimed to evaluate the effect of nitrogen levels on growth, dry matter production and yield of mungbean genotypes under nutrient stress condition.

### **Materials and Methods**

The pot experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during *kharif II* (August to November) season of 2011 of AEZ 28. The experimental site was located at 24<sup>0</sup>09' N latitude and 90<sup>0</sup>26' E longitude and 8.4 m above the sea level which is characterized by subtropical climate. The physical and chemical properties of soil are presented in table 1. The soil was sandy loam having 6.9 pH, 0.538 % organic matter, 0.05%N, 0.16 mg kg<sup>-1</sup> P, 0.85 meq % K, and 0.70 mg kg<sup>-1</sup> and the Rhizobium count was 4.55 x 10<sup>8</sup> g soil. Each pot containing 12 kg soil was fertilized with 32 kg K ha<sup>-1</sup> in the form of muriate of potash and mixed thoroughly with soil

The experiment was established in pot containing 12 kg soil collected from codda bazaar which belongs in codda series. Experimental soil was fertilized 25 kg P and 32 kg K ha<sup>-1</sup> in the form of triple super phosphate and muriate of potash, respectively and incorporated thoroughly into soil. The experiment was laid out in completely randomized design (CRD) with 4 replications. There were 10 genotypes like IPSA 12, GK 27, IPSA 3, IPSA 5, ACC12890055, GK 63, ACC12890053, BUmug 4, BARI Mung 6 and Bina moog 5 and six level of nitrogen 0, 20, 40, 60, 80 and 100 kg N ha<sup>-1</sup> as treatment variable and applied at 15 days after sowing.

Seeds were sown on 31 August, 2011. For uniform germination, a light irrigation was given immediately after sowing of seeds., the plants were thinned at first trifoliolate stage and 4 plants was remained maintained for recorded growth parameter and one plants remained finally for seed yield in pot. All agronomic management and plant protection measures were kept uniform during the whole growing period of mungbean. Data on growth parameters, dry matter partitioning and yield were recorded. Leaf area were measured using automatic leaf area meter at 50% flowering stage.

**Table 1. Physical and chemical properties of the experimental soil before sowing**

Soil properties	Present value	Critical limit
Sand (%)	62.23	-
Silt (%)	21.77	-
Clay (%)	16.00	-
Soil pH	6.90	-
Textural class	Sandy loam	-
Rhizobium/g soil	4.55 x 10 <sup>8</sup>	-
Total N (%)	0.05	0.10
Available P (ppm)	0.16	8.00
Exchangeable K (meq/100g soil)	0.85	0.08
Available S (ppm)	7.00	8.00
Available B (ppm)	0.15	0.16
Available Zn (ppm)	0.25	0.50
Exchangeable Ca (meq/100g soil)	14.83	2.00
Exchangeable Mg (meq/100g soil)	1.76	0.50
CEC meq/100g soil	6.904	3-7.5
Organic matter (%)	0.536	-

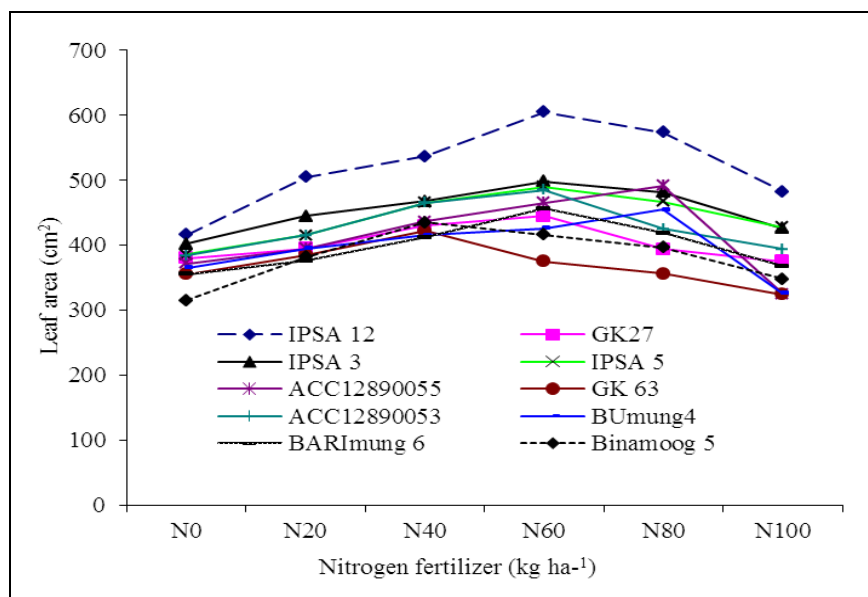
For dry matter partitioning shoots and roots were oven dried at 70<sup>0</sup> C to constant weight. Data on different parameters were subjected to statistical analysis and means compared by DMRT at 5% level of probability.

## Results and Discussion

### Leaf area

Leaf area of mungbean was increased with the increasing of N fertilizer up to 60 kg ha<sup>-1</sup> in most of the genotypes and thereafter decreased with further increase of applied nitrogen (Fig. 1). As N is constituent of enzyme and nucleic acids, it is essential for the development of new cells particularly under N deficient soil. Thus one of the obvious manifestations of N limitation is in the inhibition of leaf area development under low N environment (Sinclair and Vandez. 2002). Other authors (Gimenez *et al.*, 1994; Vos and Putten, 1998) also observed that substantial decrease in leaf area of different field crops under N deficiency condition. This is consistent with present study that the inability to generate new cells for expanding leaf area under N deficient soil. Genotypic variation in leaf area development at various N levels is conspicuous and it was the highest in

genotype, IPSA 12. This genotype maintained the highest leaf area both under deficient (416 cm<sup>2</sup>) and sufficient (605 cm<sup>2</sup>) N condition.



**Fig. 1.** Leaf area development (trifoliolate stage) of mungbean genotypes under different levels of nitrogen fertilizer.

### Dry matter accumulation

Accumulation of dry matter was increased with the increasing N levels but it peaked (at 40 or 60 kg N ha<sup>-1</sup>) of different mungbean genotypes (Fig. 2). The lowest dry matter was accumulated in plants of control treatment and lower level of N fertilizer (Fig. 2). Accumulation of lower dry matter at N deficient conditions might be due to internal nutrient stress of plant which caused reduction in cell division, cell elongation, carbohydrate synthesis and hence the growth was reduced (Karmar, 1988). These results agreed with Akhtaruzzaman (1998) in mungbean and Matsunaga *et al.* (2008) in cowpea that crops grown under lower N levels accumulated less dry matter and inhibited the crop growth. Genotypic variation in dry matter accumulation revealed that the genotype IPSA 12 grown at 60 kg N ha<sup>-1</sup> accumulated the highest dry matter (30.25 g plant<sup>-1</sup>) and it was the lowest (16.26 g plant<sup>-1</sup>) in genotype Bina Moog-5.

Considering dry matter accumulation in root, the highest (1.12 g plant<sup>-1</sup>) the genotype IPSA 12 grown under 60 kg N ha<sup>-1</sup>. Conversely, the genotype IPSA 5 accumulated more dry matter in leaves (7.93 g plant<sup>-1</sup>) and in stem (5.86 g plant<sup>-1</sup>) which are supposed to be less efficient in yield formation of mungbean.

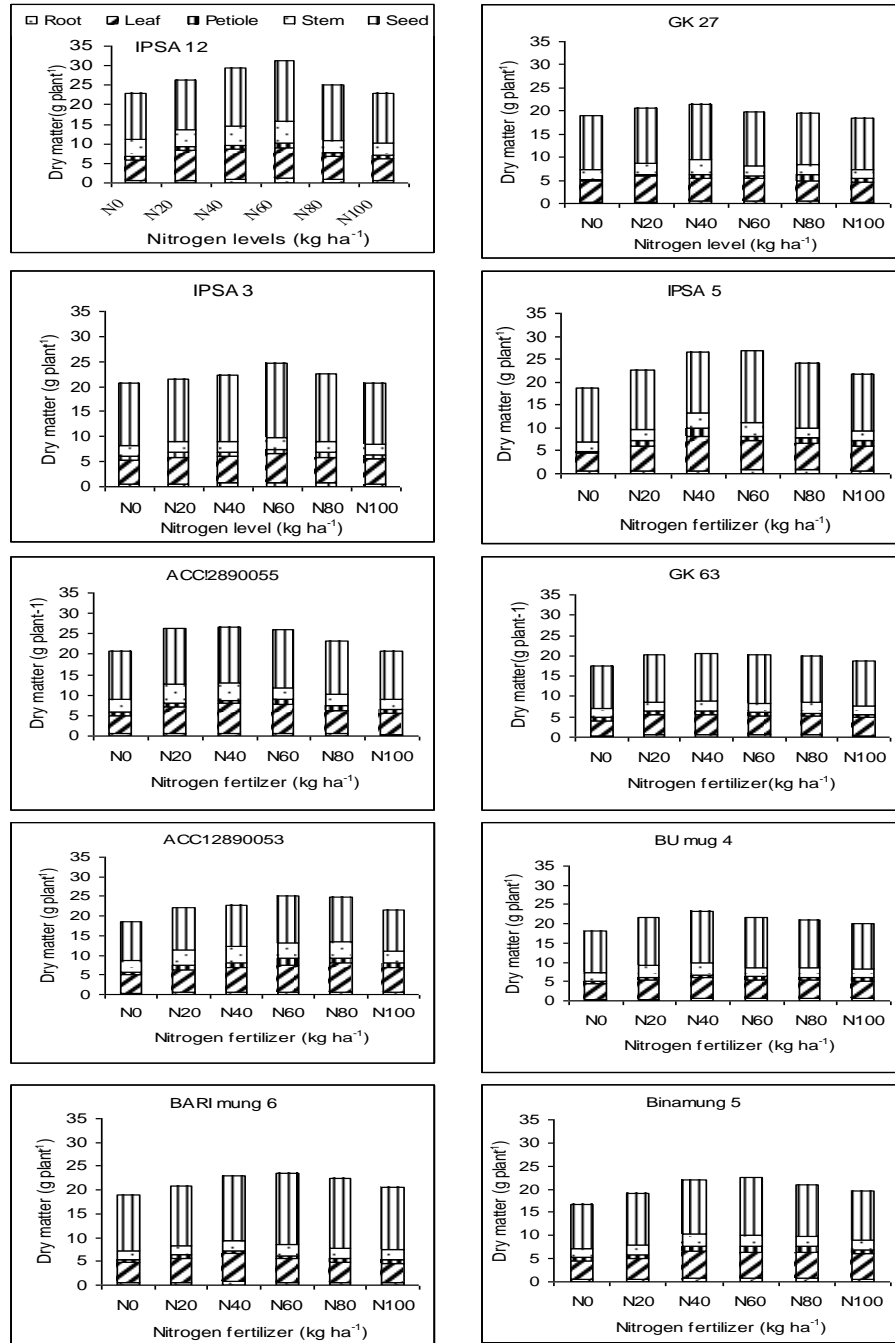
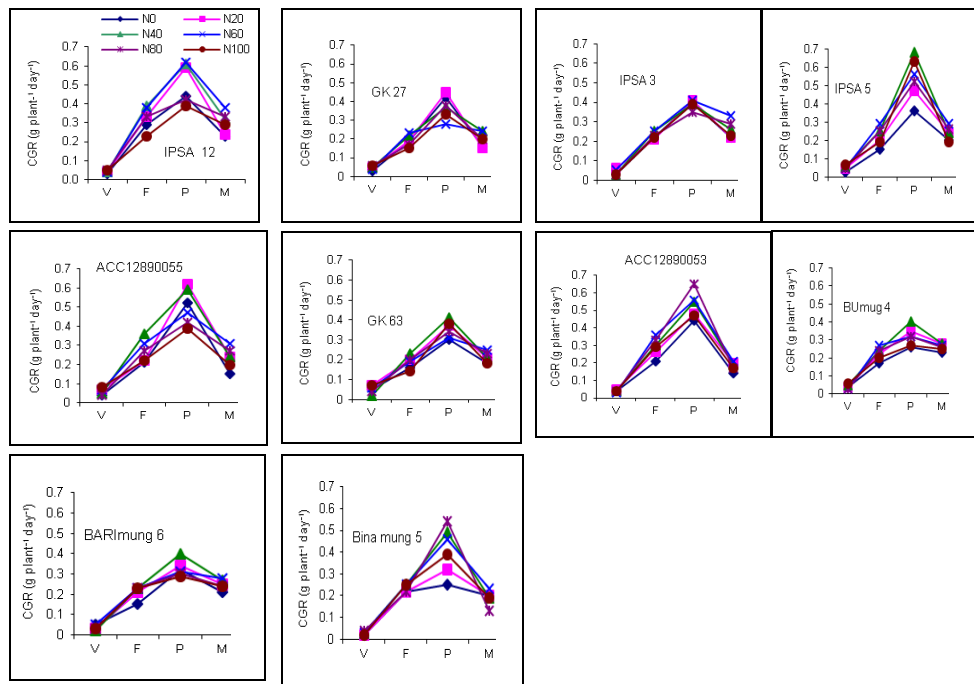


Fig. 2. Pattern of dry matter partitions (trifoliolate stage) in mungbean genotypes under different nitrogen levels.

### Crop growth

Nitrogen fertilizer influenced profoundly on crop growth rate of mungbean. Increase of nitrogen fertilizer increased crop growth rate for all the genotypes up to 60 kg ha<sup>-1</sup> and further increase nitrogen fertilizer decreased the growth rate of mungbean (Fig. 3). It might be due to immobilization of nitrogen fertilizer which did not involve in physiological activities in plant. Crop growth rates further decreased after pod development stage and it is likely that photosynthetic capacity of the plant might have decreased at this stage because of reduction of leaf area. However, the genotype IPSA 12 produced the maximum leaf area which exhibited the highest crop growth rate (0.62 g plant<sup>-1</sup> day<sup>-1</sup>).



**Fig. 3.** Crop growth rate of mungbean genotypes as affected by different nitrogen levels (V=Vegetative, F=Flowering, P=pod developing, M=Maturity).

### Pods per plant

Number of pods per plant of mungbean genotypes significantly influenced by different N levels. Increasing nitrogen level led to increase pod plant<sup>-1</sup> up to 60 kg N ha<sup>-1</sup> and thereafter decreased (Table 2). These results are in conformity with the findings of (Patra and Parner, 1991) who reported that pod per plant of mungbean increased with application of nitrogen fertilizer and excess application reduced pod number of mungbean.

There were genotypic variations in pod development in variable to N level where the genotype IPSA 12 produced the highest pods / plant at 60 kg N ha<sup>-1</sup> (30.16). The lowest number of pods (16.16) per plant was recorded in genotype GK 63 with highest N dose but it was identical with of Bina moog 5 (16.83) with 0 kg N ha<sup>-1</sup>. These results are supported by Ashraf (2001) that number of pods per plant was significantly affected by the application of N fertilizer. These means that mungbean genotypes require additional N for better pod development although it is capable to fix atmospheric N through rhizobium species living in root nodules (Anjum *et al.*, 2006).

**Table 2. Number of pods per plant of mungbean genotype as affected by nitrogen levels**

Genotype	Nitrogen level					
	N <sub>0</sub>	N <sub>20</sub>	N <sub>40</sub>	N <sub>60</sub>	N <sub>80</sub>	N <sub>100</sub>
IPSA 12	22.00cA	24.83bcA	27.50bA	30.16aA	26.16bA	22.66cA
GK 27	20.00bA	22.50abAB	23.60aB	23.50aC	22.33abB	19.66bB
IPSA 3	19.66cAB	22.16bAB	23.16bB	25.16aB	22.50bB	20.33bcB
IPSA 5	21.83bcA	25.33aA	26.33aA	27.50aB	26.00aA	23.16bA
ACC12890055	20.16cA	23.00abAB	23.16abB	25.00aB	21.66bB	20.83bcB
GK 63	18.83cB	21.33bB	21.63bC	23.33aC	22.33abB	16.16cC
ACC12890053	20.33cA	22.00bcAB	22.66bC	25.83aB	22.00bB	22.16bA
BU mug 4	19.00cAB	22.00bAB	25.16aAB	24.16aC	21.83bBC	21.00bcAB
BARI Mung 6	18.93cB	20.50bB	22.50abC	23.33aC	22.33aB	20.83bBC
Bina moog 5	16.83dC	19.83cC	23.33aB	24.83aC	21.50bB	17.66dC

Means followed by same small letter (row) and capital letter (column) did not differ significantly by DMRT at 5% level of probability.

### Seed yield

Seed yield per plant was significantly affected by genotypes and N fertilizer applications. Seed yield of mungbean varied from 7.33 g to 14.22 g plant<sup>-1</sup> (Table 3) and it was the maximum in IPSA 12 (14.22 g plant<sup>-1</sup>) grown with 60 kg N ha<sup>-1</sup> and the lowest in ACC12890053 (7.33 g plant<sup>-1</sup>) followed by Bina moog 5 under control condition. The genotype IPSA 12 also well responded (11.32 g plant<sup>-1</sup>) under control condition. There was general trend of increase in seed yield with the increase of N fertilizer but it was at par with 60 kg N ha<sup>-1</sup> and thereafter decreased the seed yield of mungbean. Among the tested mungbean genotype IPSA 12 produced highest seed yield in control condition. So, genotype IPSA 12 might be considered as suitable genotype in nutrient stress soil. These findings agreed with Biswas and Hamid (1989) and Mitra and Ghildiyal (1988) that seed yield of mungbean is limited by nitrogen supply. Application of N fertilizer

enhanced leaf area, dry matter production and yield component which consequently improved yield of mungbean genotypes.

**Table 3. Seed yield (g plant<sup>-1</sup>) of mungbean genotype as affected by nitrogen fertilizer**

Genotypes	Nitrogen level (kg ha <sup>-1</sup> )					
	N <sub>0</sub>	N <sub>20</sub>	N <sub>40</sub>	N <sub>60</sub>	N <sub>80</sub>	N <sub>100</sub>
IPSA 12	11.32Ac	11.87Ac	12.87Ab	14.22Aa	12.41Ab	10.80Ac
GK-27	10.97Ab	12.34Aa	12.80Aa	12.61Ba	11.94Ab	10.43Ab
IPSA 3	10.78Abc	11.83Ab	12.82Aa	13.32ABa	11.65Ab	10.35Ac
IPSA 5	9.60Bc	11.72Ab	12.45Aa	13.64Aa	12.36Aa	10.10Abc
ACC12890055	9.33Bc	11.90Aab	11.81Bab	12.29Ba	10.93Bb	9.87ABb
GK-63	10.06Bb	12.00Aa	12.20Ba	13.09Ba	11.99Aa	9.23ABb
ACC12890053	7.33Dcd	8.49Db	9.12Cab	9.60Ca	9.31BCab	7.95Cc
BU mug 4	8.93Bbc	10.35Bab	11.14Ba	10.85Ba	10.40Bab	9.59ABbc
BARI Mung 6	8.55Bbc	10.78Bb	11.82Bab	12.84Aa	12.40Aa	11.24Aab
Bina moog 5	7.48Dc	8.61Cb	9.31BCab	10.23Ca	9.71Cab	8.37Cbc

Means followed by same small letter (row) and capital letter (column) did not differ significantly by DMRT at 5% level of probability.

### Conclusion

The results revealed that nitrogen is necessary to ensure better growth and productivity of different mungbean genotypes under nutrient stress soil. But the genotype IPSA 12 performed better in nutrient stress soil where 60 kg N ha<sup>-1</sup> is optimum for better crop growth and development

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