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Response of Mungbean (*Vigna radiata* L.) To Nitrogen and Irrigation Management

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Abstract: An experiment was conducted at the experiment field of the Department of Agronomy, Sher-e-Bangla Agricultural University; Dhaka, Bangladesh to evaluate the effect of nitrogen and irrigation managements on dry matter accumulation and yield of mungbean (*Vigna radiata* L.) cv. BARI mung-5 during the period from March to May 2006. The trial comprised of ten treatments such as T_1=No fertilizer and irrigation (control), T_2=20 kg N ha^{-1} as basal, T_3=20 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_4=30 kg N ha^{-1} as basal, T_5=30 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_6=40 kg N ha^{-1} as basal, T_7=40 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_8= 10 kg N ha^{-1} as basal and 10 kg N ha^{-1} as split +one irrigation at first flowering stage, T_9= 15 kg N ha^{-1} as basal and 15 kg N ha^{-1} as split +one irrigation at flower initiation stage and T_{10}= 20 kg N ha^{-1} as basal and 20 kg N ha^{-1} as split +one irrigation at flower initiation stage. Irrespective of treatment differences the mungbean plant as a pulse crop showed a lag phase for slow dry matter production in early growth stage (up to 40 DAS) that increase up to harvest. Application of 30 kg N ha^{-1} as basal with one irrigation at flower initiation stage (35 DAS) significantly improved dry matter accumulation. This greater dry matter production eventually partitioned to pods per plant, seeds per plant and 1000-seed weight which is get her resulted with maximum seed yield per plant (5.53 g) or per hectare (1.65 t). A functional positive relationship was observed in with pods per plant and seeds per plant.

Key words: Nitrogen · Irrigation management · Dry matter partition · Yield

INTRODUCTION

Bangladesh grows various types of pulse crops. Among them grass pea, lentil, mungbean, blackgram, chickpea, field pea and cowpea are important. Among the pulse crops, mungbean (*Vigna radiata* L.) has special importance in intensive crop production of the country for its short growing period [1]. In Bangladesh mungbean ranks third in acreage and production but ranks first in market price. Mungbean grain contains 51% carbohydrates, 26% protein, 10% moisture, 4% mineral and 3% vitamins [2]. The green plants can also be used as animal feed and its residues have capacity to improve soil fertility thus increase the productivity of land. The crop is potentially useful in improving cropping pattern as it can be grown as a catch crop and inter crop due to its rapid growth and early maturing characteristics. It can also fix atmospheric nitrogen through the symbiotic relationship between the host mungbean roots and soil bacteria and thus improves soil fertility. It may play an important role to supplement protein in the cereal-based low-protein diet of the people of Bangladesh, but the acreage and production of mungbean is steadily declining [3].

The dry period of Kharif-I is not favorable for mungbean germination. Kharif-II period is occupied by Transplanted Aman rice. Cultivation of high yielding varieties of wheat and winter rice have occupied considerable land suitable for mungbean cultivation. Beside this, low yield potentiality of these crops is responsible for declining the area and production.

The average yield of mungbean is 0.69 t ha^{-1} [3] which is very poor in comparison to mungbean growing countries in the world. There are many reasons of lower yield of mungbean. No fertilizer and irrigation managements are important. The management of fertilizer is the important one that greatly affects the growth, development and yield of this crop. Pulses although fix nitrogen from the atmosphere, there is evident that application of nitrogenous fertilizers becomes helpful in increasing the yield [4]. Nitrogen is most useful for pulse crops because it is the component of protein [5]. In Bangladesh, Kharif-I mungbean is a rainfed crop which grows on residual soil moisture. Mungbean responses favorably to added water resulting in higher yields, especially when irrigation is given at the time of flowering [6]. One or two irrigation is useful to obtain higher yields. In summer cultivation when temperature is high, relative

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humidity is low and evapo-transpiration is greater, then 3-4 irrigations may be needed to obtain higher yields of mungbean [7]. Irrigation during flowering stage helps for retention of flowers and pod development. Hence, the present study was taken to maximize the seed yield of mungbean with optimum nitrogen dose and irrigation level.

MATERIALS AND METHODS

The research work was carried out at the experiment field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from March to May 2006. The soil of the experimental plots belonged to the agro ecological zone of Madhupur Tract (AEZ-28). The experimental area is under the subtropical climate. The trial comprised of ten treatments viz. T_1=No fertilizer and irrigation (control), T_2=20 kg N ha^{-1} as basal, T_3=20 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_4=30 kg N ha^{-1} as basal, T_5=30 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_6=40 kg N ha^{-1} as basal, T_7=40 kg N ha^{-1} as basal + one irrigation at flower initiation stage, T_8=10 kg N ha^{-1} as basal and 10 kg N ha^{-1} as split +one irrigation at first flowering stage, T_9=15 kg N ha^{-1} as basal and 15 kg N ha^{-1} as split +one irrigation at flower initiation stage and T_{10}= 20 kg N ha^{-1} as basal and 20 kg N ha^{-1} as split +one irrigation at flower initiation stage The variety of mungbean used for the study was BARI mung-5. The experiment was laid out in a Randomized complete block design (RCBD) with three replications. Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) were used as a source of nitrogen, phosphorous and potassium respectively. Nitrogen was applied as per treatment and P_2O_5 and K_2O were applied as basal at the rate of 48 and 33 kg per hectare, respectively for all the plots except control one. The seeds were sown on March 1, 2006. Seeds were treated with Bavistin before sowing the seeds to control the seed borne disease. The seeds were sown in solid rows keeping 30 cm between two rows. Thinning was done at 8 days after sowing (DAS) and at 15 DAS to maintain plant population in each plot as around 333333 plants ha^{-1}. The crop field was weeded twice; first at 25 DAS and second at 45 DAS. Irrigation was done as per treatments. Ten plants from each treatment were collected to recorded data on plant height, number of branches per plant, flowers per plant, leaves per plant, leaf dry weight, stem dry weight, reproductive dry weight and above ground dry weight. Data on yield components were collected at harvested ten plants. Seed yield was collected from pre demarcated three linear lines of each plot that were sun dried properly. The weight of seeds was taken and converted the yield in ton ha^{-1}. The recorded data were statistically analyzed to obtain the level of significance using the MSTAT-computer package program. The means were separated following least significance deference (LSD) test.

RESULTS AND DISCUSSION

Irrespective of treatment differences, the dry matter accumulation in above ground plant parts was very slow at early growth stage (25 to 40 DAS), these increased progressively with time and attained maximum at maturity (Fig. 1).

Stems accounted up to 43.880%, 36.826%, 34.312%; leaves 38.982%, 37.217% 36.892% and reproductive organs 17.465%, 25.957%, 28.794% respectively of above ground dry matter at 55, 70 and 85 DAS, respectively (Table 1). Similar trend of distribution of dry matter in stems, leaves and reproduction units with time in chickpea was reported by Rahman *et al.,* [8] and Karim and Fattah [9]. Influence of different managements in dry matter accumulation of aerial plant parts was noticed after 45 DAS to 85 DAS. Treatment 30 kg N ha^{-1} as basal + one irrigation at flower intiation stage (T_5) was found significantly superior to other treatments in these accumulations. The maximum above ground dry matter (23.363g) was found at harvest (85 DAS). Significantly lowest accumulation was observed in control treatment (no fertilizer and no irrigation) at each stage. Accumulation of lower dry weights for control treatment might be due to internal nutrient and moisture stresses of plant, which caused reduction in both cell division and cell elongation and reduced carbohydrate synthesis and hence the growth was reduced [10]. Reduction in aerial plant parts dry matter due to water stress was reported by Sadasivam *et al*. [11] in mungbean ; Siowth and Kramer [12] in soybean and Hamid *et al*.[13] in mungbean.

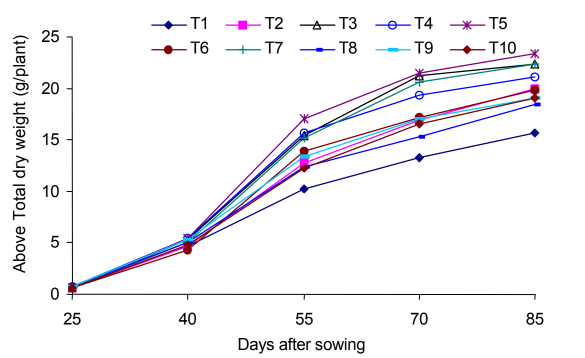

Fig. 1: Above ground dry weight of mungbean as influenced by nitrogen and irrigation

Table 1: Dry matter accumulation and its partition

	Stem dry matter(g)			Leaves dry matter(g)			Reproductive dry matter(g)			Above ground dry matter(g)		
Treatments	55 DAS	70 DAS	85 DAS	55 DAS	70 DAS	85 DAS	55 DAS	70 DAS	85 DAS	55 DAS	70 DAS	85 DAS
T_1	4.113	5.011	5.163	4.199	4.807	5.737	1.924	3.493	4.727	10.236	13.311	15.627
T_2	5.479	6.00	6.90	4.941	6.27	7.12	2.391	4.59	5.876	12.811	16.86	19.896
T_3	7.063	7.803	7.707	5.68	8.02	7.953	2.701	5.40	6.638	15.444	21.223	22.298
T_4	7.197	7.71	7.907	6.229	7.173	7.753	2.201	4.436	5.408	15.627	19.319	21.068
T_5	7.42	7.627	8.203	6.709	8.01	8.22	2.924	5.8	6.94	17.053	21.437	23.363
T_6	6.073	6.353	6.567	5.509	6.453	7.523	2.328	4.38	5.72	13.91	17.186	19.81
T_7	7.237	7.527	8.077	5.273	7.40	7.933	2.597	5.60	6.383	15.107	20.527	22.393
T_8	5.303	5.887	5.983	4.959	5.47	7.38	2.049	3.933	5.035	12.311	15.29	18.398
T_9	5.665	6.327	6.52	5.403	6.87	7.433	2.346	3.842	5.12	13.414	17.039	19.073
T_{10}	4.617	5.556	5.94	4.949	6.027	7.103	2.666	4.912	6.027	12.232	16.495	19.07
Total	60.167	65.801	68.967	53.851	66.5	74.155	24.127	46.386	57.874	138.145	178.687	200.996
Average	6.0167	6.5801	6.8967	5.3851	6.65	7.4155	2.4127	4.6386	5.7874	13.8145	17.8687	20.0996
Percent (%)	43.880	36.826	34.312	38.982	37.217	36.892	17.465	25.957	28.794	100	100	100

Effect on yield contributing characters

Table 2: Effect of nitrogen and irrigation on yield contributing characters and yield of mungbean

Treatments	No. of pods/plant	No. of seeds/pod	1000-Seed weight (g)	Yield (g/plant)	Yield (t/ha)
T_1	12.41 e	7.46	44.43	3.64 g	1.09 e
T_2	25.10 cd	8.37	45.61	4.52 b-e	1.35 b-d
T_3	38.30 b	9.17	45.27	5.11 ab	1.53 ab
T_4	25.42 cd	8.32	46.08	4.16 d-g	1.24 c-e
T_5	43.30 a	10.46	46.23	5.53 a	1.65 a
T_6	23.83 d	8.39	45.99	4.40 c-f	1.32 b-e
T_7	36.97 b	8.32	45.67	4.91 bc	1.47 a-c
T_8	25.90 cd	8.16	44.93	3.87 fg	1.16 de
T_9	27.26 cd	8.02	46.24	3.94 e-g	1.18 de
T_{10}	29.09 c	8.15	46.36	4.64 b-d	1.39 b-d
$LSD_{(0.05)}$	4.50	NS	NS	0.604	0.242
CV%	7.88	10.20	2.10	7.87	10.51

Table 2 showed that both nitrogen and irrigation level significantly influenced the number pods per plant. 30 kg N ha^{-1} as basal + one irrigation at flower initiation stage (T_5) gave significantly highest number of pods per plant. Nitrogen application at the rate of 20 kg ha^{-1} with one irrigation produced lower number of pods per plant (43.30). Increase N level or split application of N could not improve the pod production. Control (no fertilizer and irrigation) treatment produced significantly lower numbers pods plant (12.41). Probably optimum nitrogen level of soil moisture restricted flower and pod dropping, which might have contributed to more pods per plant under T_5 treatment. Biswas [14] found similar results in field bean. The reduced number of pods per plant due to water stress was also reported earlier in field bean [15]. The number of seeds per pod was not significantly affected by nitrogen and irrigation application. Number of seeds per pod of mungbean ranged from 6.46 to 10.46 due to the treatment variations. Nitrogen and irrigation variation could not improve the 1000-seed weight. It may be assumed that genetical influence was greater than the treatment effects.

Effect on yields: Significantly highest seed yield per plant (5.538 g) was produced in T_5 (30 kg N ha^{-1} as basal + one irrigation at flower initiation stage) and followed by T_3 (5.11 g). T_5 also produced significantly highest seed yield per hectare (1.65 t) and followed by T_3 (1.52 t) and T_5 (1.47 t) (Table 1).The lowest yield per plant and per hectare was recorded from control and that was 3.64 g and 1.09 ton, respectively. The seed yield per hectare obtained from T_5 was 51.38 % more than control. T_5 produced highest yield might be due to maximum production of crop characters and influenced the plant to have good production of dry matter in early stage and that eventually raised and partitioned to the reproductive units. The irrigation also helped optimum seed development. These findings agreed well with Bachchhav *et al*. [16] who found that application of 30 kg N ha^{-1} resulted in highest seed yield of mungbean. Mozumder *et al*. [17] also stated that application of 40 kg N ha^{-1} gave the highest seed yield of mungbean.

Correlation and Regression Analysis: Seed yield was significantly correlated with pods/plant (r = 0.53*) and seeds/pod (r = 0.443*).Branches/plant had positive correlation with pods/plant(r = 0.78**) and 1000-seed

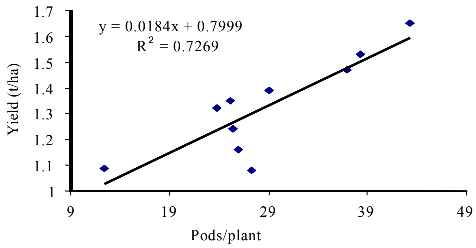

Fig. 2: Relationship between pods /plant and yield of mungbean

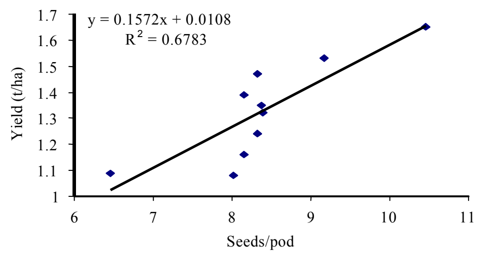

Fig. 3: Relationship between seeds/pod and yield of mungbean

weight (r = 0.508*). The relation pods per plant, seeds per pod and yield were positive and linear (R^2=0.73, R^2=0.68, respectively) (Figs. 2 and 3).

CONCLUSION

From the results, it may be concluded that mungbean gave maximum production of dry matter, yield attributes and yield when treated with 30 kg N ha^{-1} as basal and one irrigation at first flower initiation stage (35 DAS).This results could be verified further experimentation in different agro-ecological zones of Bangladesh.

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