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Growth, yield attributes and quality of summer greengram (*Vigna radiata* L.) as influenced by nitrogen and irrigation levels

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Abstract

A field experiment was conducted at the experimental field of Directorate of Seed Research, Mau, U. P. during summer season, 2011 to evaluate the effect of irrigation and nitrogen applications on growth, yield and quality of green gram (*Vigna radiate* L.) cv. HUM 12. Result showed that 20 kg N ha^{-1} as basal and 20 kg N ha^{-1} as split + one irrigation at flower initiation gave maximum plant m^{-2}, plant height, number of branches $plant^{-1}$ and number of trifoliate leaves $plant^{-1}$ followed by 15 kg N ha^{-1} as basal and 15 kg N ha^{-1} as split + one irrigation at flower initiation and 10 kg N ha^{-1} as basal and 10 kg N ha^{-1} as split + one irrigation at flower initiation and lowest in control. The seed yield of green gram significantly higher over control due to increasing the number of pods $plant^{-1}$ (43.4), pod length (10.4 cm), number of seeds pod^{-1}(10.5), test weight (46.3 g), yield per plant (5.60 g) and seed yield (16.6 q h^{-1}). The highest germination percentage, vigour index, nitrate and nitrite reductase activity were observed with 20 kg N ha^{-1} as basal and 20 kg N ha^{-1} as split + one irrigation at flower initiation (100.0). The maximum seedling dry weight was recorded with application of 10 kg N ha^{1} as basal and 10 kg N ha^{-1} as split + one irrigation at first flower initiation stage (156.0) which was on par with 40 kg N ha^{-1} as basal.

Key words: Summer greengram, nitrogen, irrigation, growth, yield, quality.

In India, presently farmers grow more than a dozen of pulses. Among them chickpea, pigeon pea, urdbean, greengram, lentil, fieldpea, lathyrus are important. Among the *kharif*/ summer pulse crops, green gram (*Vigna radiata* L.) has special importance in intensive crop production of the country for its short growing period (Ahmed *et al*., 1978). India is the largest producer and consumer of pulses in the world contributing around 25-28% of the total global production. The country grows a variety of pulse crops, such as chickpea, pigeonpea, greengram, blackgram, dry peas and lentils under a wide range of agro-climate conditions. The total pulse production is 17.2 million tonnes from 24.8 million ha area (Anonymous, 2012) which is all times high and is the only exception year majority of which falling under rainfed, resource poor and harsh environments frequently prone to drought and other abiotic stress condition. Pulses are least preferred by farmers because of high risk and less remunerative than cereals; consequently, the production of the pulses is significantly low to meet the demand of pulses. Majority of Indian population is vegetarian, pulses are cheap and best source of protein for Indian diet. It contains 20-25 per cent protein, which is more than two times of cereals. India importing about 3 million tonnes and the future demand of pulses by 2015 will be 27.0 million tonnes (Singh, 2011). The green plants can also be used as animal feed and its residues have the capacity to improve the physical, chemical and biological properties of soil thus increase the productivity of land. It can also fix atmospheric nitrogen through the symbiotic relationship between the host

mungbean roots and soil bacteria and thus improves soil fertility. Greengram occupies an area of 2.89 million hectare with the production of 1.10 million tonnes and productivity of 381 kg ha^{-1}. Farmers grow this crop not as a principal crop but as a bonus crop, mixed with other crops on marginal lands and that too without manuring. By the introduction of numerous short duration varieties in greengram it had been feasible to introduce greengram in multiple cropping systems for increasing pulse production. Summer cultivation of greengram is being pushed to adjust between the time left after the harvesting of *rabi* and sowing of *kharif* crops, where incidence of diseases and pests are relatively low and also the vacant land is efficiently utilized without affecting the main crops.

Greengram is a legume crop, it responds well to added nitrogen to overcome its lag phase and it influences nutrient uptake by promoting root growth and nodulation. Nitrogen enhances the uptake of other nutrients and increasing nitrogen content in the crop which increases protein content of greengram. Greengram responses favourably to irrigation especially, when irrigation is given at the time of flowering resulting in higher yields (Miah and Carangal, 1981). In summer season when temperature is high, relative humidity is low and evapo-transpiration is greater and 3 to 4 irrigations may be needed to obtain higher yields of greengram (Lal and Yadav, 1981). Irrigation during flowering stage helps for retention of flowers and pod development. Therefore, present investigation was undertaken to determine the nitrogen and irrigation application for getting higher seed yield and quality parameters of summer greengram in eastern U.P.

Materials and Methods

The field experiment was conducted during the summer season (March-May) 2011 at the research farm of Directorate of Seed Research, Kushmaur, Mau (U.P). Experimental field was clay soil and calcareous in nature, with pH 8.8 and low in soil organic carbon (0.38), EC 1.690 dS/m and analyzing medium in available nitrogen (243.0 kg ha^{-1}), phosphorus (10.80 kg ha^{-1}) and potassium (250.0 kg ha^{-1}) contents. The experiment was laidout in a randomized complete block design with three replications. The experiment comprised of ten treatments *viz.*, T_1 = 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 mungbeen used for the study was HUM 12 with spacing of 30× 10 cm and sowing was done on 26th February, 2011. The seed rate of greengram 30 kg ha^{-1}. Urea, SSP and MOP were used as a source of nitrogen, phosphorus & potassium respectively. Nitrogen as per treatment was applied through urea (46 % N). A uniform dose of 40 kg P_2O_5 and 20 kg ha^{-1} sulphur through SSP (16% P_2O_5) and sulphur (90%) respectively, were applied to all the treatments except control. Seeds were treated with carbendazim before sowing of seeds to control the disease. Thinning was done at 10 DAS and at 20 DAS to maintain the plant population in each plot. The crop field was weeded twice-Ist at 25 DAS and IInd at 45 DAS. Irrigation was done as per the treatment. One hundred seeds were put for germination in three replication, using top of the paper method (ISTA, 1999). Vigour index of the seeds was assessed based on germination percentage; seedling length and seedling dry weight as suggested by Abdul-Baki and Anderson (1973). For determination of the seedling dry weight, ten normal seedlings from each replicate of the germination test were selected at random and kept for oven drying, overnight at 80^{0}C temperature (ISTA, 1990). The nitrate reductase activity, which is the key enzyme in nitrogen metabolism is known to be regulated by various environmental factors apart form its own substrate, nitrate. The nitrate reductase at 21 DAS in leaves was assayed according to the method of Jaworski (1971). Activity of nitrite

reductase was assayed according to the method Ferari and Varner (1970). 10 plants from each treatment were collected to record data on plants per m^2, plant height, number of branches per plant and number of trifoliate leaves per plant. Data on yield attributing parameters were collected at harvested 10 plants and data were statistically analyzed.

Results and Discussion

Effect on growth parameters

Nitrogen plays an important role in the vegetative growth and development of plant. Similarly, number and time of irrigation also gave same result as nitrogen. Different dates of irrigation gave significant difference in plant population in field condition in summer greengram variety HUM-12 (Table 1). The highest plant population and plant height was recorded with treatment T_{10} which gave maximum plant population (48.5) followed by treatment T_9 (47.2) and lowest plant population was observed in control (33.5). Other treatments showed similar result in plant population and there was no significant difference in all the treatments. Plant height is directly proportional to the available nitrogen present in the soil. Nitrogen has direct effect on the plant growth that's why the treatment having maximum doses of nitrogen in the maximum plant height. Moisture level also plays an important role in the plant height. Irrigation at flower initiation stage gave rejuvenate in the moisture in soil and maintained plant growth and thus maximum height were maintained. Result showed that maximum number of branches plant^{-1} was observed in treatment T_{10} (7.6) followed by treatment T_9 (7.3) and treatment T_8 (7.0). Lowest number of branches plant^{-1} was obtained in control (T_1). There is no significant changes in rest of the treatment with respect to number of branches plant^{-1}. The maximum number of trifoliate leaves plant^{-1} was observed in treatment T_{10} (27.2) followed by treatment T_9 (26.1) and treatment T_8 (26.0) (Table 1). Similar result was also observed by Hamid *et al.* (1990). While minimum number of trifoliate leave was recorded in control (18.5) Number of leaves & size of trifoliate was directly proportional to the irrigation numbers. An increase in nitrogen levels increase in the number of leaves & its size. Irrigation at initial stage gave acceleration in the plant growth and total count of leave number.

Effect on yield attributing parameters

Both irrigation and nitrogen levels significantly influenced the no. of pods plant^{-1}. Treatment T_5 gave significantly maximum no. of pods plant^{-1}. Nitrogen application @ 20 kg ha^{-1} as basal with one irrigation at flower initiation stage produced less number of pods plant^{-1} (43.4). The lowest no. of pods plant^{-1} was recorded in control (Table 2). The results are in agreement with the findings of Mozumder *et al*. (2003) and Asaduzzaman *et al.* (2008). Probably optimum nitrogen level and soil moisture restricted flower and pod dropping, which might have contributed to more pods plant^{-1} under 30 kg N as basal with one irrigation at flower initiation stage (T_5) treatment. The maximum pod length was recorded with T_5 (10.4 cm) followed by T_6 (10.0 cm), while smallest pod length recorded in control (7.8 cm). At lower nitrogen level, a drastic reduction in the pod length was recorded. Application of 30 kg of nitrogen as basal dose and one irrigation at flower initiation stage gave higher pod length. One irrigation at pre flowering stage was found to be enough to give maximum number of seeds per pod^{-1}. The maximum test weight was record in treatment T_{10} (46.5) having 30 kg N ha^{-1}, and one irrigation at flower stage followed by T_5 (46.3) while, minimum was observed in control. Similar results have been observed by Biswas (2001) and Mozumder *et al.*, (2003). Significantly highest seed yield plant^{-1} (5.6 g) was produced in T_5 and followed by T_3 (5.2 g). It was observed that all parameters affected by different doses of nitrogen, time and frequency of irrigation. The treatment T_5 significantly recorded highest seed yield (16.6 q ha^{-1}) followed by T_3 (15.4 q ha^{-1}) against control (11.0 q ha^{-1}) respectively. Similar results have been reported by Mozumder *et al.*, 2003. T_5 treatment produced highest yield might be due to maximum production of yield attributes and production of highest dry matter in early stage and that eventually raised and partitioned to the

Table 1. Effect of nitrogen and irrigation on morphological characters of greengram

Treatment	Plant population m^{-2}	Plant height (cm)	Number of branches $plant^{-1}$	Number of trifoliate leaves $plant^{-1}$
T_1	33.5	51.3	4.9	18.5
T_2	35.4	55.6	5.9	20.2
T_3	36.2	57.7	6.0	21.5
T_4	44.0	60.6	6.3	22.1
T_5	45.0	62.3	6.6	22.6
T_6	45.1	64.2	6.6	24.3
T_7	46.0	64.8	6.8	24.7
T_8	46.7	67.5	7.0	26.0
T_9	47.2	69.2	7.3	26.5
T_{10}	48.5	70.6	7.6	27.2
SEm ±	0.68	0.92	0.20	1.04
CD (P=0.05)	2.01	2.75	0.61	3.09

Table 2. Effect of nitrogen and irrigation on yield attributes and yield of greengram

Treatments	No. of pods/plant	Length of pod (cm)	No. of seeds pod^{-1}	Test weight (g)	Yield (gram/$plant^{-1}$)	Yield (q ha^{-1})
T_1	12.5	7.8	7.5	44.5	3.7	11.0
T_2	25.2	10.2	8.4	45.7	4.6	13.6
T_3	38.4	10.4	9.2	45.3	5.2	15.4
T_4	25.5	10.2	8.4	46.2	4.2	12.5
T_5	43.4	10.4	10.5	46.3	5.6	16.6
T_6	23.8	10.0	8.4	46.0	4.5	13.3
T_7	37.1	10.3	8.4	45.8	5.0	14.8
T_8	26.0	10.3	8.2	45.0	3.9	11.9
T_9	27.4	10.3	8.2	46.4	4.0	12.0
T_{10}	29.2	10.3	8.3	46.5	4.7	14.0
SEm ±	1.03	0.61	0.58	2.25	0. 56	1.20
CD (P=0.05)	3.06	1.81	1.73	6.69	1.65	3.57

Table 3. Effect of nitrogen and irrigation on germination and other quality attributes in summer greengram

Treatment	Germin-ation %	Root length (cm)	Shoot length (cm)	Seedling dry weight (mg)	Vigour index I	Vigour index II	Nitrate reductase (OD)	Nitrite reductase (OD)
T_1	91.0	9.0	23.4	134.0	2948	12.20	0.846	0.785
T_2	93.0	10.1	24.2	143.0	3190	13.30	0.875	0.854
T_3	94.0	12.1	24.6	146.0	3450	13.72	0.876	0.866
T_4	95.0	12.7	24.8	145.0	3553	13.63	0.884	0.866
T_5	93.0	12.6	25.3	149.0	3515	13.87	0.889	0.852
T_6	95.0	14.4	25.6	156.0	3800	14.83	0.912	0.873
T_7	94.0	13.8	25.6	155.0	3704	14.57	0.900	0.878
T_8	97.0	13.6	25.8	156.0	3822	15.13	0.954	0.907
T_9	98.0	14.4	24.6	150.0	3822	14.70	0.954	0.864
T_{10}	100.0	13.6	25.9	155.0	3940	15.51	0.982	0.895
SEm ±	1.43	0.89	0.82	1.63	118.09	1.002	0.003	0.003
CD (P=0.05)	4.24	2.64	2.45	4.83	350.84	2.979	0.010	0.009

reproductive units. The results have supported by findings of Dhanjal *et al*. (2000).

Effect on quality parameters

Application of 20 kg N ha^{-1} as basal and 20 kg N ha^{-1} as split with one irrigation at flower initiation stage has recorded maximum germination in T_{10} (100%) followed by T_9 (98%) & T_8 (97%) while, lowest in treatment T_2, T_5 (93%) and control (91%). 40 kg N ha^{-1} as basal and 15 kg N ha^{-1} as basal & 15 kg N ha^{-1} as split + one irrigation at flower initiation stage (T_6 &T_9) gave significantly highest root length (Table 3). However, lower root length was observed in control (9.0 cm). The maximum shoot length was recorded in T_{10} & T_8 (25.9 & 25.8 cm, respectively) treatments followed by T_6 & T_7 (25.6 cm), T_5 (25.3 cm), T_4 (24.8 cm), T_9 & T_3 (24.6 cm), and T_2 (24.2 cm). Significantly lowest shoot length was observed in control (23.4 cm). The highest seedling dry weight was observed in T_6 & T_8 (156.0 mg) followed by T_7 & T_{10} (155.0 mg), T_9 (150.0 mg), T_5 (149.0 mg), T_3 (146.0 mg), T_4 (145.0 mg) and T_2 (143.0 mg) while lowest seedling dry weight was recorded in control (134.0 mg).

The data recorded on vigour index I clearly shows that highest was observed in T_{10} (3940) followed by T_9 (3822), T_8 (3822), T_6 (3800), T_7 (3704), T_4 (3553), T_5 (3515), T_3 (3450) and T_2 (3190). While, lowest vigour index I was obtained in control (2948.40 g). The maximum vigour index II was observed in T_{10} (15.51 mg) treatment followed by T_8 (15.13 mg), T_6 (14.83 mg), T_9 (14.70 mg), T_7 (14.57 mg) respectively. However, lowest vigour index II was obtained in control (12.19 mg). Nitrate reductase activity is the indicator of nitrate assimilation in growing seedling. The data clearly revealed that maximum nitrate reductase enzyme activity was observed in T_{10} (0.982) treatment followed by T_8, T_9, T_6, T_7, T_5 and T_4. However, minimum enzyme activity was observed in control (0.846). The maximum nitrite reductase enzyme activity was observed in T_{10} (0.895) treatment followed by T_8, T_7, T_6, T_3, T_4 and T_9. Treatment T_3, T_4, T_2 and T_5 were recorded statistically at par. However, minimum nitrite

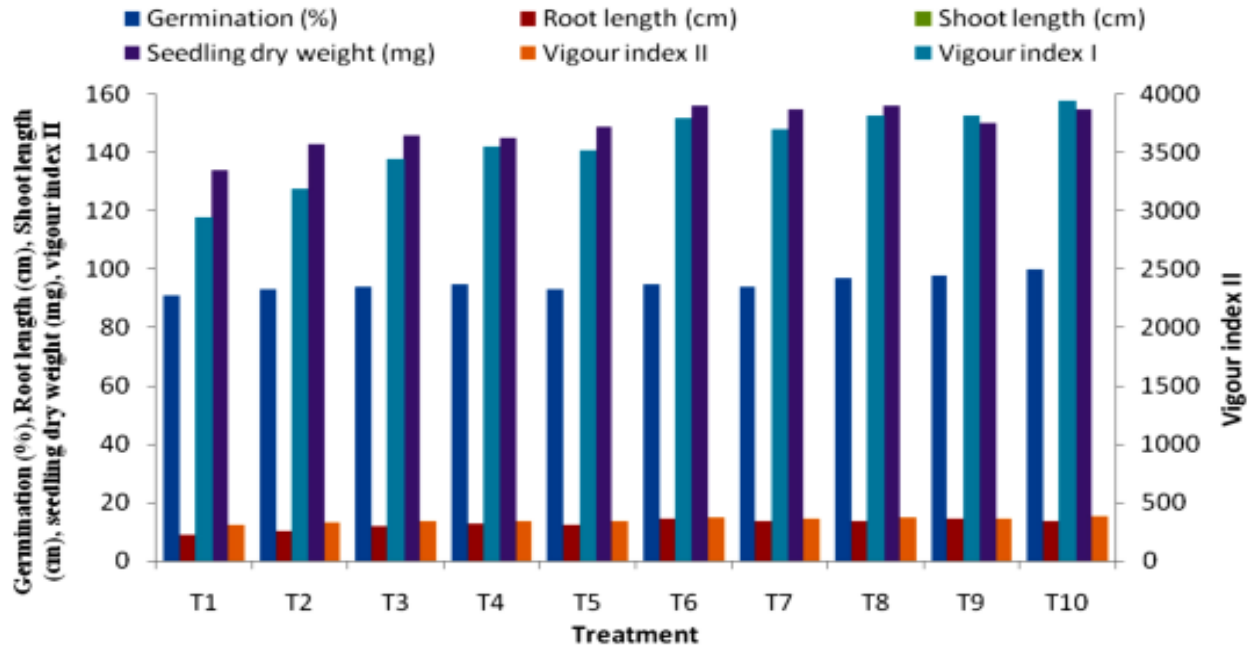

Fig. 1. Effect of germination percentage, root length, shoot length, seedling dry weight, vigour index I and II on greengram

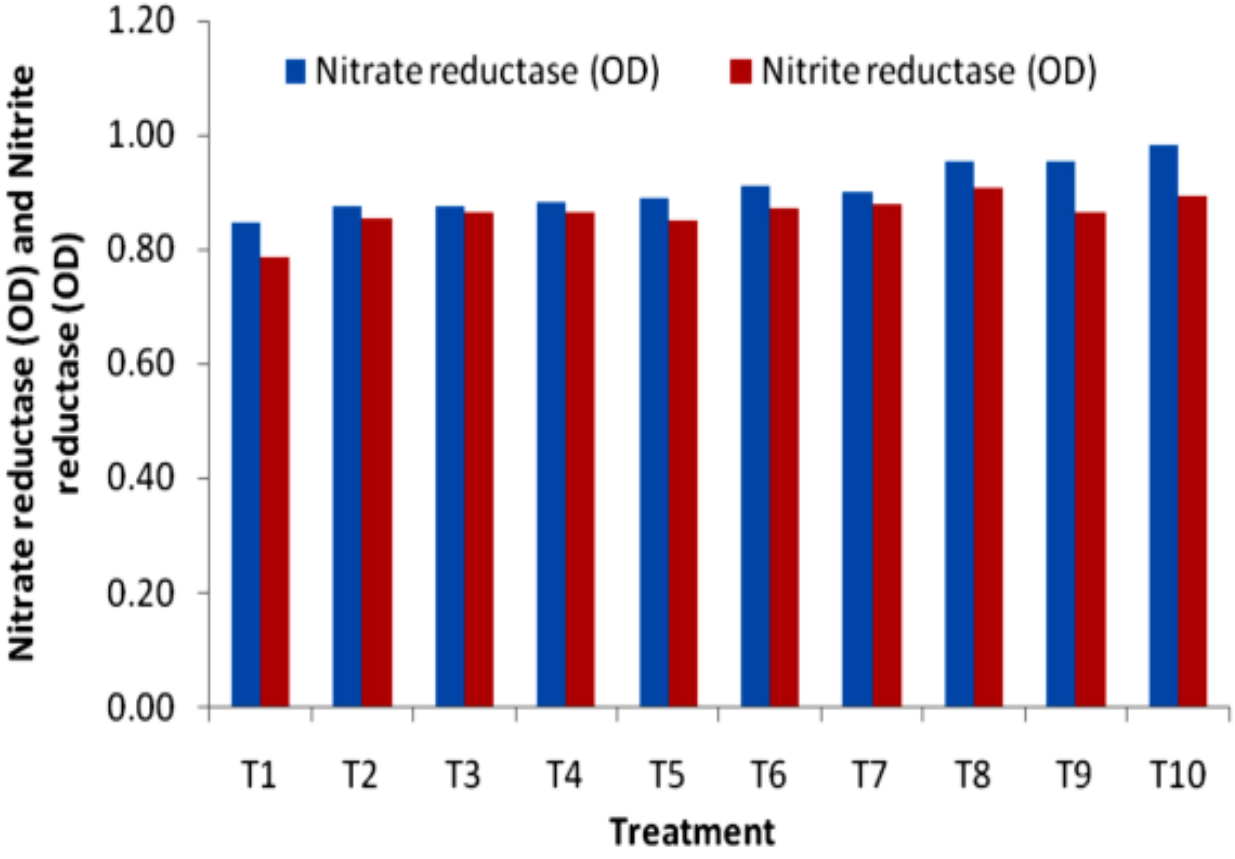

Fig. 2. Effect of nitrate reductase and nitrite reductase activity on greengram

reductase enzyme activity was obtained in control (0.785). Based on one year data it can be concluded that for higher seed yield and quality parameters, the summer green gram may be fertilised with 30 kg N ha^{-1} as basal and irrigate once at flower initiation stage in rice-wheat cropping system of eastern-UP.

References

Abdul-Baki, A. and Anderson, J.D. 1973. Vigour determination in Soybean seed by multiple criteria. *Crop Sci.* **13** : 630-633.

Ahmed, M.A.Q. Shaikh, A.I. Khan and Kaul. 1978. Evaluation of local, exotic and mutant germplasm of mungbean for varietal characters and yield in Bangladesh. *Sabrao J.* **10** : p. 48.

Asaduzzaman, M., F.M. Karim, M.J. Ullah and Hasanuzzaman, M. 2008. Response to nitrogen and irrigation managements of mungbean (*Vigna radiata*). Am-Euras. *J. Sci. Res.* **3** : 40-43.

Biswas, D.C. 2001. Effect of irrigation and population density on growth and productivity of field bean *(Phaseolus vulgaris). MS Thesis, Bangabandhu Shiekh Mujibur Rahman Agri. Univ., Gazipur-1706.*

Dhanjal, R.O. Prakash and Ahlawat, I.P.S. 2000. Response of spring green gram to dates of sowing. *Ann. Agric. Res.* **21** : 570-576.

Economic Survey, 2012-13, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, New Delhi

Ferrari, T.E. and Varner, J.E. 1970. Control of nitrate reductase activity in barley aleurone layers. *Proc. Nat. Acad. Sci. U.S.A.* **65** : 720-736.

Hamid, A.F. Kubota, W. Agata and Morokuma, M. 1990. Photosynthesis, transpiration, dry matter accumulation and yield performance of Mungbean plant in response to water stress. *J. Fac. Agr. Kyushu Univ.* **35** : 81-92.

Jawasi, E.G. 1971. Nitrate reductase assay in intact plant tissue. *Biochemical and Biophysical Res. Commun.* **43** : 1274-1279.

Lal, S. and Yadav, D.S. 1981. Raise short duration pulses during summer. *Ind. Farm.* **30** : 3-5.

Miah, M.Z.I. and Carangal, V.R. 1981. Yield of 10 mungbean cultivars evaluated in intensive rice based cropping system. *Intl. Rice Res. Newsl.* **6** : p. 27.

Mozumder, S.N., Salim, M., Nazrul., M.I. and Zaman, M.M. 2003. Effect of *Bradyrhizopus inoculums* at different nitrogen levels on summer mungbean. *Asian J. Pl. Sci.* **2** : 817-822.

Singh, J. 2011. Present agricultural scenario and future prospects in India: An overview, *Pratiyogita Darpan,* pp. 1549-1551.