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EFFECT OF INTEGRATED NITROGEN MANAGEMENT ON GROWTH AND ECONOMICS OF DWARF RICE BEAN (*VIGNA UMBELLATA*) UNDER RAINFED CONDITION

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ABSTRACT

The Present investigation was conducted during *Kharif* 2021 to evaluate the effect of integrated nitrogen management on the growth and economics of dwarf rice bean (*Vigna umbellata*) under rainfed condition. According to the results, T_6 (30 kg N/ha (Urea)+ VC @5 t/ha + Neem@75kg/ha) recorded maximum in terms of plant height, number of branches per plant, fresh and dry weight of plant (g) and T_4 (20 kg N/ha (Urea)+ VC @5 t/ha + Neem@75kg/ha) remained statistically at par. As per economic point of view, T_6 (30 Kg N/ha (Urea)+ VC @5 t/ha + Neem@75Kg/ha) recorded maximum Cost of cultivation and Gross income. Whereas, T_5 (30 kg N/ha (Urea) + VC @2.5 t/ha + Neem@50kg/ha) recorded maximum net income and B:C ratio.

Key words: Economics, Growth, Integrated Nitrogen Management, Rice bean.

Introduction

Rice bean, *Vigna umbellata* (Thunb.) Ohwi and Ohashi, syn. *V.calcarata* (Roxb.) Kurz, 2n=22 (Viswanatha *et al*., 2016). It is a multifunctional legume that is sometimes overlooked and underutilised. However, in some regions of South-East Asia and India, rice bean plays a significant local role in human nutrition. Green pods and the dried seeds as pulse can both be used in culinary preparations, also it is helpful for feeding livestock. In addition, it can be cultivated as a cover crop, green manure, live fencing, or biological barriers. It is a hardy plant with broad pest and disease resistance. From the Himalayas to South China and Indonesia, this crop is indigenous to South and South East Asia. To maximise the crop's productivity, efficient nutrient management is essential. Nitrogen is one of the primary nutrients and is known to be vital for the crop's optimum growth and development. Continuous application of nitrogen through inorganic fertilizers will affect soil health and crop yield. Again, using vermicompost or neem cake alone will reduce crop production since manures are lower in nutrient content. Therefore, integrated nutrient management appears to be a feasible option for improving soil health and crop yields. The yield of black gram improved when vermicompost was combined with inorganic fertilization (Manivannan *et al*., 2009). The residual limonoid content of neem cake organic manure protects plant roots from nematodes, soil grubs, and white ants. Due to which it serves as a natural fertiliser with pesticidal properties. In integrated nutrient management, organic and inorganic fertilisers are used in combination to meet crop's nutrient needs. Better growth resulted by availability of more nutrients as a result of the combined use of organic and inorganic which led to better development of yield attributes (De *et al*., 2011). Integrated nutrient management improves soil physical, biological and chemical properties. Limited work has been done on these aspects in dwarf rice bean. Therefore, the present study was undertaken to determine the influence of integrated nitrogen management on growth and economics of dwarf rice bean.

Materials and Methods

A field experiment was conducted at the Agronomy field, College of Agriculture, Central Agricultural University, Imphal during the *kharif* season of 2021. The experimental site is located at 24°45' N latitude and 93°54' E longitudes and at an altitude of 774 meters above mean sea level. This site falls under the Eastern Himalayan Region (II) and the agroclimatic zone Subtropical Zone (NEH-4) of the state of Manipur.

The chemical analysis of soil showed that the soil is clay in texture and medium in available N (260.51 Kg/ha), Available P_2O_5 (26.10 Kg/ha) and available K_2O (232.31 Kg/ha). The experiment was set up in a Randomized Block Design with eight treatments replicated thrice. The treatments were T_1: 10 kg N/ha (Urea) + VC @2.5 t/ha + Neem @50kg/ha, T_2: 10 kg N/ha (Urea) + VC @ 5 t/ha + Neem@75kg/ha, T_3: 20 kg N/ha (Urea) + VC @2.5 t/ha + Neem@50 kg/ha, T_4: 20 kg N/ha (Urea) + VC @ 5 t/ha + Neem@75kg/ha, T_5: 30 kg N/ha (Urea) + VC @2.5 t/ha + Neem@50kg/ha, T_6: 30 Kg N/ha (Urea)+ VC @5 t/ha + Neem@75Kg/ha, T_7: VC @2.5 t/ha + Neem@50kg/ha and T_8: VC @ 5 t/ha + Neem@75kg/ha. Rice bean (Local Variety) was sown in line on July 13, 2021, with recommended spacing of 60 cm line to line and 20 cm plant to plant and a seed rate of 15 Kg/ha. The total area of the experiment was 223.2 m2. The recommended fertiliser dose of 60:20 kg PK/ha was applied uniformly to all plots in the form of single super phosphate and muriate of potash, respectively. In addition to that nitrogen through urea, vermicompost and neem were also applied as per treatments. Just before application, the necessary number of organic manures and fertilizers were individually weighed. After this all the fertilizers and organic manures of each plot were applied in the form of a continuous band in furrows and were mixed with soil. Data were collected on plant height, number of branches per plant, fresh and dry weight of plant at 30, 60, 90 DAS and at harvest, as well as the economics of dwarf rice bean was computed.

For measuring growth attributing parameters like plant height and number of branches. In each plot, five representative plants were randomly selected and tagged in order to record the observations for each treatment excluding the border rows. These five sample plants were used to obtain the average value of each character.

Five sample plants were collected from each plot's destructive sampling rows every 30 days interval from sowing until harvest to study the fresh and dry weight of plant. These plant samples were weighed to record the average fresh weight after which the samples were oven dried at 60 ± 5° until a constant dry weight was acquired. After oven drying, the samples were weighed and an average dry weight of plant was recorded in gram.

The economics of the treatments were calculated using the input costs and the income generated by the seed yield. The gross and net income as well as benefit cost ratio was computed as follows.

The cost of cultivation was figured by adding up the cost of variables such as land, ploughing, seed, irrigation, weeding, fertilizers involved or used up during the research. Labour requirement was worked out based on labours engaged for carrying out different field operations.

The total monetary value of the economic produce (seed) obtained from the crop was computed based on local prevailing market price of the product and was expressed per unit area (ha).

Gross income (Rs/ha) = grain yield (kg) × price (Rs)

The net income was calculated by deducting the total cost of cultivation for each treatment from its respective gross income.

Net income (Rs/ha) = Gross income – Total cost of cultivation

The benefit-cost ratio was computed by dividing gross returns by total cost of cultivation.

$$\text{Benefit cost ratio} = \frac{\textit{Gross returns}}{\textit{Cost of cultivation}}$$

Table 1: Plant height (cm) and No. of branches per plant of dwarf rice bean as influenced by integrated nitrogen management.

Treatments	Plant height (cm)				No. of branches per plant			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	21.13	67.27	113.10	116.73	8.43	12.30	12.20	12.13
T_2	24.30	69.90	116.40	119.33	9.93	12.90	12.83	12.77
T_3	22.23	68.20	114.27	117.63	8.93	12.57	12.43	12.37
T_4	25.00	71.17	117.00	120.47	10.40	13.10	13.00	12.90
T_5	23.00	69.23	115.90	118.67	9.43	12.70	12.67	12.53
T_6	26.80	72.47	118.60	121.63	10.90	13.30	13.20	13.17
T_7	17.80	63.17	109.20	112.53	6.53	12.57	11.40	11.33
T_8	20.47	66.03	112.23	115.07	8.00	12.13	12.03	11.90
S.Ed.(±)	2.01	0.56	1.10	0.65	0.43	0.17	0.14	0.26
CD (P=0.05)	4.31	1.21	2.35	1.40	0.92	0.37	0.29	0.55

Table 2: Plant fresh weight (g) and Plant dry weight (g) of dwarf rice bean as influenced by integrated nitrogen management.

Treatments	Plant fresh weight (g)				Plant dry weight (g)			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	41.53	179.63	201.23	204.27	17.83	43.80	48.73	51.97
T_2	44.27	182.03	204.03	207.43	20.07	46.30	51.13	54.43
T_3	42.47	180.10	202.50	205.00	18.03	44.17	49.43	52.83
T_4	45.37	183.30	205.07	208.57	21.03	47.07	52.30	55.33
T_5	43.47	181.20	203.30	206.10	19.17	45.93	50.47	53.30
T_6	46.47	184.03	206.50	209.17	22.17	48.03	53.17	56.50
T_7	37.47	175.03	197.10	200.73	13.60	39.57	44.83	47.53
T_8	40.73	178.13	200.13	203.07	16.93	42.70	47.70	50.80
S.Ed.(±)	1.12	1.62	1.47	0.89	0.88	0.51	0.61	0.70
CD (P=0.05)	2.41	3.46	3.16	1.90	1.89	1.10	1.31	1.50

Statistical analysis

The data on various variables was analysed using the analysis of variance technique. The F test was used to determine the level of significance of the various sources of variation at a 5% critical difference (CD) value.

Results and Discussion

Plant height (cm)

In relation to the height of dwarf rice bean as influenced by the various treatments, the data collected at 30, 60, 90 DAS and at harvest are shown in Table 1. Plant height increased in all the treatments as crop age advanced, and the maximum was recorded at harvest. The maximum plant height at 30 DAS was recorded in T_6, which was found to be statistically at par with T_4, T_2, and T_5 and remained significantly higher to other treatments. Similarly, at 60 DAS and at harvest, T_6 recorded highest plant height, followed by T_4. Again, at 90 DAS, T_6 recorded maximum plant height, which was statistically par to T_4 and T_2. Likewise, at all stages of observation T_7 recorded lowest plant height. This could be attributed to the combined application of organic manures and inorganic fertilizers, which increased the availability of major nutrients to plants by promoting early root growth and cell multiplication, allowing for greater absorption of other nutrients from deeper layers of soil, resulting in increased plant growth. This finding is consistent with those reported in previous studies by Chaudary *et al*., (2020), Devi *et al*., (2016) and Kamal *et al*., (2021).

Plant Fresh and dry weight per plant (g)

Data on plant fresh and dry weight (g) of dwarf rice bean recorded at 30, 60, 90 DAS and at harvest is presented in Table 2. The plant fresh weight increased with crop age, and the maximum was recorded at harvest. T_6 recorded significantly higher fresh weight at 30, 90 DAS and at harvest, which was found to be at par with T_4 and T_2, respectively. Similarly at 60 DAS, T_6 recorded maximum plant fresh weight which remained at par with T_4, T_2 and T_5. Likewise, T_6 recorded maximum plant dry weight at all stages of observation, similar to plant fresh weight and it was followed by T_4. This improvement in plant growth as expressed in terms of fresh and dry weight could be attributed to adequate nitrogen supply. Nitrogen is one of the major essential plant nutrients required for growth and it also accelerated photosynthetic rate by increasing the supply of carbohydrates to the plant, which may have increased dry matter production. These findings are supported by Biswash *et al*., (2014), Kamal *et al.*, (2021) and Raj *et al*., (2019). The lowest plant fresh and dry weight was recorded in T_7 in all four stages of observation.

Number of branches per plant

Data on number of branches per plant recorded at 30, 60, 90 DAS and at harvest is presented in Table 1, it can be observed that the mean number of branches per plant was significantly influenced by different treatments of integrated nitrogen management. The application of T_6 resulted in the highest number of branches per plant among different nitrogen management practices, and it did not differ significantly from T_4 in all sampling done at 30, 60, and 90 Das. Again, at harvest T_6 recorded maximum branches which was at par with T_4 and T_2 respectively. The treatment T_7 recorded minimum

Table 3: Economics of dwarf rice bean as influenced by integrated nitrogen management.

Treat-ments	Economics			
	Cost of cultivation	Gross income	Net income	B:C ratio
T_1	76,705	76,705	76,705	76,705
T_2	1,16,830	1,16,830	1,16,830	1,16,830
T_3	76,966	76,966	76,966	76,966
T_4	1,17,091	1,17,091	1,17,091	1,17,091
T_5	77,227	77,227	77,227	77,227
T_6	1,17,352	1,17,352	1,17,352	1,17,352
T_7	76,444	76,444	76,444	76,444
T_8	1,16,569	1,16,569	1,16,569	1,16,569

branches per plant at all four stages of recording. Application of 30 kg N/ha and 20 kg N/ha with organic manures may resulted in additional benefits due to increased availability of major nutrient nitrogen due to direct addition in the form of fertilizer. This is in conformity with findings of Biswash *et al*., (2014), Kanwar *et al*., (2017) and Kamal *et al*., (2021).

Economics

Cost of cultivation: A perusal of Table 3 showed that the highest cost of cultivation of Rs 1,17,352 /ha was seen in T_6 followed by T_4 (Rs 1,17,091 /ha). T_7 has the lowest cost of cultivation (Rs 76,444 /ha).

Gross return: From Table 3 among the different treatments with gross return were maximum for T_6 (Rs 241200 /ha) followed by T_4 (Rs 233200 /ha). T_7 has the lowest gross returns (Rs 147200/ha).

Net return: Similar to the gross return the highest net return was associated with T_5 (Rs 1,38,774 /ha) followed by T_3 (Rs 1,31,435 /ha). T_8 recorded the lowest net returns (Rs 57,432 /ha) as per Table 3

Benefit cost ratio

The highest benefit cost ratio was associated with T_5 (2.80) followed by T_3 (2.71). T_8 recorded the lowest benefit cost ratio (1.49) as seen in Table 3. Integrated nitrogen management will be adopted by the farmers only if it is economically feasible. The maximum cost of cultivation was found in T_6 followed by T_4 may be attributed to higher quantity of treatment when compared to remaining treatments. The highest gross income (Rs 241200/ha) recorded by T_6; this might be due to highest economic produce (grain yield). Highest net income (Rs 1,38,774/ha) and B:C ratio (2.80) were recorded through T_5, this might be attributed to low cost of cultivation was acquired through application of this treatment. Minimum Cost of cultivation was found in T_7 may be due to low cost of treatment as it does not have inorganic fertilizer and presence of low quantity of organic fertilizer when compared to rest of the treatments. Low Gross income (Rs 147200/ha) recoded by T_7 might be due to minimum economic produce. Minimum Net income (Rs 57,432/ha) and B:C Ratio (1.49) was recorded in T_8 may be due to High cost of cultivation.

Conclusion

From the present investigation, it can be concluded that dwarf rice bean responded well to the different treatments of integrated nitrogen management at all stages of observation in terms of growth and economics. Among the different treatments 30 Kg N/ha (Urea)+ VC @ 5 t/ha + Neem @ 75Kg/ha (T_6) can be followed as the better growth and economics were achieved through this treatment. The above results are based on the data from one season only so, further work is necessary for better confirmation of the results.

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Conflict of Interest

The authors whose names are listed certify that they have no financial interests, affiliations or relationships with any organization, company or entity that could be perceived as influencing the objectivity, methodology or interpretation of research findings presented in the article.

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