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Effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.)

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Abstract

A study was conducted in moong bean to investigate the effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.) at Agronomy field Faculty of Agricultural Sciences and Allied Industries Rama University, Mandhana, Kanpur (Uttar Pradesh), India during kharif season 2025. The experiment was carried out in randomized block design with three replications in various permissible combinations with organic and inorganic fertilizers viz., RDF, vermicompost, rhizobium PSB on moongbean (*Vigna radiata*). It is concluded that for obtaining highest yield in moong bean (*Vigna radiata* L.) during kharif season, application of 100%RDF+(2.5t/ha) VC+ Rh +PSB (Treatment 9) recorded higher plant stand/population, plant height (cm), no. of trifoliate leaves per plant, no. of branches/ plant, dry matter accumulation/plant in gram, crop growth rate, relative growth rate, total number of nodules per plants was observed in treatment 100%RDF+(2.5t/ha) VC+ Rh +PSB.

Keywords: INM, growth parameters and moongbean

Introduction

Moong bean is one most ancient & extensively grown legume crop of India, also known as green gram, poor man's meat and Marvel of Nature (Shrikant, 2010) [10]. It's belonged to Fabaceae family and it has a chromosome count of $2n=22$. India is centre of origin of mungbean. It is self – pollinated crop and cultivated during the Kharif, rabi (in southern India) and summer season. Moong bean is crucial to Indian agriculture because its have short growth duration and its ability to adapt to various agro-climatic conditions. Worldwide, moongbean is cultivated over an area on roughly 7.3 million hectares, yielding approximately 5.3 million tonnes. The average yield is about 721 kg/ha (0.72 t/ha). Key mungbean-producing nations consist of India, Myanmar, China, Indonesia, Thailand, Kenya, and Tanzania. Although it is extensively cultivated, the productivity is still quite low, suggesting considerable potential for enhancement through the use of superior varieties and better agronomic methods (Nair *et al.*, 2020; World Veg, 2022) [14]. India is the world's largest producer of pulses. A staple of the Indian cuisine, pulses provide over 30% of the daily required amount of protein. With a productivity of 817 kg/ha, India, the world's greatest producer and consumer of pulses, generated 23.2 million tons of pulses from 29.34 million hectares of land (Agriculture statistics 23-2024) [11]. There is almost little chance of expanding the land used for pulse growing in India. As per the AICRPR's Annual Report (2022-23) in India moongbean is cultivated on approximately 5.5 million hectares with a production of 3.17 million tonnes and productivity of about 570 kg/ha. India produce 54% of the world's moong bean and accounts for 65% of its production (Anon 2020). In India leading states of moong cultivation are Rajasthan, Madhy Pradesh and Maharashtra. Its contains almost 3.19 million hectares area with 3 million total production and average productivity of 940kg/ha and Rajasthan contribute 11.75 lakh tonnes from 23.32 lakh hectare with average productivity of 503kg/ha (GOI,2023-24) [13]. Regarding Kharif pulses, the primary Rajasthan plays a significant role in Mung bean cultivation, accounting for 46% of the area and production. and 45%, respectively with Madhya Pradesh (9% and 14%), Maharashtra (9% and 8%), Karnataka (9% and 6%), Odisha (5% and 4%), Bihar (5% and 4%), Tamil Nadu (4% and 3%), Gujarat (3%and 4%), Andhra Pradesh (3% for each), and Telangana (2% for each) (IIPR, 2022) [4]. production and productivity of 2.01 million tons and 467

kg/ha, respectively, mung beans are grown on over 20.35 lakh hectares in India, accounting for 9.41% of all pulse production (Agriculture statistics 23-2024) ^[1]. In Uttar Pradesh, moongbean is an important pulse crop grown mainly during the Zaid and kharif seasons. The crop is cultivated on approximately 0.20–0.25 million hectares, with a total production of about 0.10–0.15 million tonnes. The average productivity in the state ranges between 500–600 kg/ha, which is slightly below the national average due to factors such as limited adoption of improved varieties, poor nutrient management, and biotic/abiotic stresses (Directorate of Economics & Statistics, GOI, 2023; ICAR-IIPR, 2023) ^[1, 3]. INM system technique employs a well-balanced mix of inorganic fertiliser and organic manure to improve soil fertility and crop yield. INM consequences have given way to grow mungbean using various sources of nutrients i.e. inorganic (chemical fertilizers) and organic (Vermicompost) nutrient sources along with biofertilizers like Rhizobium and PSB. It intended to achieve four major goals viz., to maintain soil productivity, to ensure sustainable production, to prevent degradation of the environment and to reduce expenditure on the chemical fertilizers. It boosts productivity while reducing the amount of chemical fertilisers needed for cultivation, which results in consistent crop production and increased availability of both major and minor nutrients (Rautaray *et al.*, 2003) ^[9].

Materials and Methods

The present study, titled "Effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.)" was conducted at the Department of Agronomy, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur (U.P.), Kanpur during the 2025. Geographically, this region falls under sub-tropical climate and it is situated at 26°47' N latitude, 82°12' E longitude and at an indo gangetic alluvial of eastern Uttar Pradesh in India. The annual rainfall of this region is about 1100 mm in which 85 per cent received during monsoon (mid June to end of September). The winter months are cold and dry and occasional frost occurring during the period. The temperature starts during from the month of February onwards and continues to rise up to June. The hot winds blow from South-West to North-East during summer. It was laid out in a Randomized Block Design (RBD) with nine treatments and three replications, each plot measuring 4.5 m × 3m=12m². The experiment was comprised of nine treatments viz., T₁Control, T₂ 50% RDF, T₃ 100%RDF, T₄ 50%RDF+RH+PSB, T₅ 50%RDF+(2.5t/ha) VC, T₆50%RDF+(2.5t/ha) VC+ Rh +PSB, T₇ 100%RDF+ Rh +PSB, T₈ 100%RDF+ 2.5t/ha) VC and T₉ 100%RDF+(2.5t/ha) VC+ Rh +PSB. Munbean variety 'local' was sown on 15th June 2025 at 30 × 10 cm spacing with a seed rate of 20 kg/ha, following recommended irrigation and plant protection practices, with fertilizers applied basally and organic manures incorporated three weeks before sowing. Observations were recorded on growth parameters (plant population, plant height (cm), number of trifoliate leaves plant⁻¹, number of branches per plant, plant dry weight (g plant⁻¹), nodules plant⁻¹, crop growth rate (g/m²/day), relative growth rate (g/g/day) and Total number of nodules per plants. Data recorded on different aspects of growth parameters were tabulated and subjected to statistical analysis as per Gomez and Gomez, (1976).

Results and Discussion

The plant stand/population (at 20 DAS & Harvesting) of moong bean as influenced by INM is presented in Table 1. The Plant stand/population (at 20 DAS & Harvesting) of moong bean was significantly influenced by INM at 20 DAS and harvest while. At

initial stage (20 DAS and at harvest), it was seen that the effect of different treatments on Plant stand/population (at 20 DAS & Harvesting) was significant. The initial Plant stand/population (at 20 DAS & Harvesting) was maximum (75.65 and 71.72) in T₉ (100%RDF+(2.5t/ha) VC+ Rh +PSB) and minimum (56.27 and 50.44) in T₁ (Control). These results closely align with the findings presented by Singh and Yadav (2022) ^[12], who noted the highest plant population in chickpea when utilizing an integrated approach that included RDF, vermicompost, Rhizobium, and PSB. Comparable results were also documented by Yadav *et al.* (2025) ^[15], where the combined application of vermicompost and biofertilizers significantly enhanced the initial plant population and crop establishment in chickpea. Additionally, studies by Meena and Ram (2014) ^[7] provided further evidence, indicating that integrated nutrient management, which incorporated RDF, FYM/vermicompost, Rhizobium, and PSB, led to improved growth parameters and crop stand due to increased nutrient availability and enhanced soil fertility. Subsequent research by Singh *et al.* (2026) ^[11] also reported similar positive effects of integrated nutrient management practices on the growth and establishment of chickpea.

Data pertaining plant height of moong bean there was a significant influence on growth parameters as seen in table 1 and 2 was observed from 15 DAS to at harvest showing some significant impact on the effect of integrated nutrient management on growth parameters at 15, 30, 45 DAS and at harvest of moong bean (*Vigna radiata* L.). The maximum plant height at 15, 30, 45 DAS and at harvest (13.00, 27.14, 48.17 and 58.78 cm) was recorded with application of 100%RDF+(2.5t/ha) VC+ Rh +PSB. Where as the minimum plant height at 15, 30, 45 DAS and at harvest (8.20, 16.43, 28.47 and 33.26 cm) was recorded with control. There was significant difference between different treatment combinations. The present findings are in close agreement with the results reported by Jakhar *et al.* (2020) ^[5], who observed significantly higher plant height in chickpea with integrated application of RDF, vermicompost, and PSB. Similar findings were also reported by Jat *et al.* (2025) ^[6], where integrated nutrient management practices involving RDF, vermicompost, and biofertilizers significantly improved plant height and other growth parameters of chickpea. The results are further corroborated by Meena and Ram (2014) ^[7], who reported that combined application of RDF along with Rhizobium, PSB, and organic manures significantly enhanced plant height due to improved soil fertility and nutrient availability. Similar beneficial effects of integrated nutrient management on growth attributes of chickpea were also reported by Prakash *et al.* (2021) ^[8] and Raghuwanshi *et al.* (2025). The maximum no. of trifoliate leaves per plant at 15, 30, 45 DAS and at harvest (8.04, 15.57, 24.23 and 22.50) was recorded with application of 100%RDF+(2.5t/ha) VC+ Rh +PSB. Where as the minimum no. of trifoliate leaves per plant 15, 30, 45 DAS and at harvest (3.34, 8.44, 13.04 and 10.53) was recorded with control. There was no significant difference between different treatment combinations. The maximum No. of branches/ plant at 15, 30, 45 DAS and at harvest (1.63, 3.22, 5.38 and 6.49) was recorded with application of 100%RDF+(2.5t/ha) VC+ Rh +PSB. Where as the minimum No. of branches/ plant at 15, 30, 45 DAS and at harvest (1.05, 2.06, 3.05 and 4.74) was recorded with control. There was no significant difference between different treatment combinations. The maximum dry matter accumulation/plant at 15, 30, 45 DAS and at harvest (4.70, 10.91, 15.71 and 19.56) was recorded with application of 100%RDF+(2.5t/ha) VC+ Rh +PSB. Where as the minimum dry matter accumulation/plant at 15, 30, 45 DAS and at harvest (2.65, 6.34, 9.91 and 12.34) was recorded with control. There was no

significant difference between different treatment combinations. The results of the current study align closely with the findings presented by Jakhar *et al.* (2020) ^[5], who noted a significant increase in vegetative growth parameters, such as the number of leaves and branches, in chickpea when utilizing a combination of RDF, vermicompost, and biofertilizers. Comparable outcomes were documented by Singh and Yadav (2022) ^[12], who discovered that integrated nutrient management strategies incorporating vermicompost, Rhizobium, and PSB markedly improved the growth characteristics of chickpea, attributed to enhanced nutrient availability and microbial activity. Furthermore, the current findings are corroborated by Meena and Ram (2014) ^[7], who indicated that the joint application of RDF with organic manures and biofertilizers significantly boosted vegetative growth traits in chickpea, resulting from improved soil fertility and nutrient absorption. Raghuwanshi *et al.* (2025) also reported similar positive impacts of integrated nutrient management on leaf development and overall plant growth.

Data pertaining CGR (g m⁻² day⁻¹) of moong bean there was a significant influence on CGR (g m⁻² day⁻¹) as seen in table 2 was observed from 0-15, 15-30, 30-45 DAS and 45 DAS- at harvest showing some significant impact on the effect of integrated nutrient management on CGR (g m⁻² day⁻¹) of moong bean (*Vigna radiata* L.). The maximum CGR (g m⁻² day⁻¹) at 0-15, 15-30, 30-45 DAS and 45 DAS- at harvest (10.44, 13.81, 10.67 and 8.55) was recorded with application of 100%RDF+(2.5t/ha) VC+ Rh +PSB. Where as the minimum CGR (g m⁻² day⁻¹) at 0-15, 15-30, 30-45 DAS and 45 DAS- at harvest (5.90, 8.20, 7.92 and 5.40) was recorded with control. There was no significant difference between different treatment combinations. Data pertaining relative growth rate of moong bean there was a significant influence on relative growth rate as seen in table 1 was observed from 15-30, 30-45 and 45 DAS-at harvest showing some significant impact on the effect of integrated nutrient management on relative growth rate of moong bean (*Vigna radiata* L.). The maximum relative growth rate 15-30, 30-45 and 45 DAS-at harvest (0.0580, 0.0299 and 0.0161) was recorded with application of 100%RDF+(2.5t/ha) VC+ Rh +PSB. Where

as the minimum relative growth rate (0.0503, 0.0236 and 0.0146) was recorded with control. The current findings align closely with the results presented by Jakhar *et al.* (2020) ^[5], who noted a significant increase in RGR and dry matter accumulation in chickpea through the integrated application of RDF, vermicompost, and biofertilizers. Comparable results were also documented by Singh and Yadav (2022) ^[12], who observed that integrated nutrient management utilizing vermicompost, Rhizobium, and PSB significantly improved the growth parameters and physiological efficiency of chickpea plants. These results are further corroborated by Meena and Ram (2014) ^[7], who indicated that the combined application of RDF, organic manures, and biofertilizers enhanced the RGR and biomass production due to improved nutrient availability and enhanced soil fertility status. Additionally, similar positive effects of integrated nutrient management on growth indices and biomass accumulation in chickpea were reported by Raghuwanshi *et al.* (2025). The highest Total number of nodules per plants (44.08) was observed in treatment 100%RDF+(2.5t/ha) VC+ Rh +PSB, Where as the lowest Total number of nodules per plants (25.19) was found in treatment control. There was significant difference between different treatment combinations. However, 50%RDF+(2.5t/ha) VC+ Rh +PSB are found statistically at par to 100% RDF+(2.5t/ha) VC+ Rh +PSB. The current findings align closely with the results presented by Singh and Yadav (2022) ^[12], who noted a significantly greater nodulation in chickpea when utilizing a combined application of RDF, vermicompost, Rhizobium, and PSB. Comparable results were also documented by Jakhar *et al.* (2020) ^[5], who discovered that integrated nutrient management practices improved root nodulation and nitrogen fixation through enhanced microbial activity and nutrient availability. These results are further corroborated by Meena and Ram (2014) ^[7], who indicated that the application of organic manures in conjunction with Rhizobium and PSB significantly boosted both the number and dry weight of nodules in chickpea by enhancing soil fertility and rhizospheric conditions. Similar advantageous effects of integrated nutrient management on nodulation and biological nitrogen fixation in chickpea.

Table 1: Effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.)

No. of Treatments	Treatments	Plant stand/population (at 20 DAS & Harvesting)		Plant height (cm)				No. of trifoliolate leaves per plant				No. of branches/ plant			
		20 DAS	At harvest	15 DAS	30 DAS	45 DAS	At harvest	15 DAS	30 DAS	45 DAS	At harvest	15 DAS	30 DAS	45 DAS	At harvest
T ₁	Control	56.27	50.44	8.20	16.43	28.47	33.26	3.34	8.44	13.04	10.53	1.05	2.06	3.05	4.74
T ₂	50% RDF	61.27	58.06	9.15	20.63	31.94	38.32	4.70	11.08	16.25	14.39	1.14	2.23	4.27	5.05
T ₃	100%RDF	64.41	64.66	10.49	24.05	42.42	48.20	6.29	13.57	19.80	17.43	1.28	2.78	4.98	6.03
T ₄	50%RDF+RH+PSB	62.56	61.41	9.42	22.57	37.11	44.88	5.86	11.77	17.38	15.44	1.19	2.37	4.40	5.26
T ₅	50%RDF+(2.5t/ha) VC	69.86	67.49	10.97	24.96	44.33	54.49	6.41	14.17	21.58	18.25	1.34	2.87	5.13	6.11
T ₆	50%RDF+(2.5t/ha) VC+ Rh +PSB	73.60	70.53	12.69	26.71	46.61	56.54	6.87	15.29	22.69	13.53	1.47	3.16	5.30	6.42
T ₇	100%RDF+ Rh +PSB	67.63	63.41	10.34	23.06	40.81	47.01	6.14	13.13	19.07	17.14	1.24	2.66	4.77	5.85
T ₈	100%RDF+ 2.5t/ha) VC	72.15	68.37	12.41	26.25	45.37	55.49	6.76	14.76	22.26	19.44	1.43	3.06	5.24	6.27
T ₉	100%RDF+(2.5t/ha) VC+ Rh +PSB	75.65	71.72	13.00	27.14	48.17	58.78	8.04	15.57	24.23	22.50	1.63	3.22	5.38	6.49
	SE(d)	0.783	0.550	0.257	0.377	0.468	0.601	0.267	0.130	0.313	0.203	0.034	0.035	0.063	0.043
	C.V.	1.431	1.053	2.927	1.964	1.412	1.517	5.410	1.214	1.960	1.436	3.143	1.567	1.640	0.897

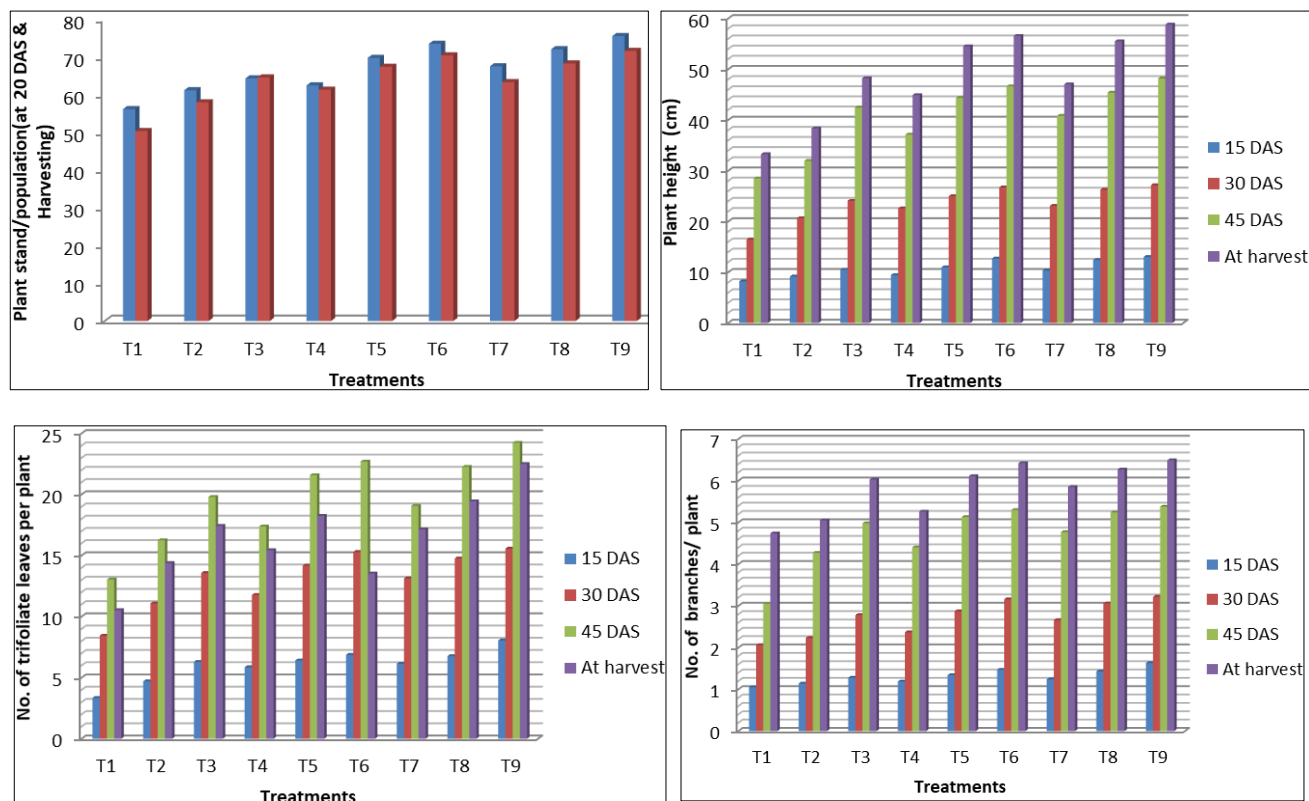
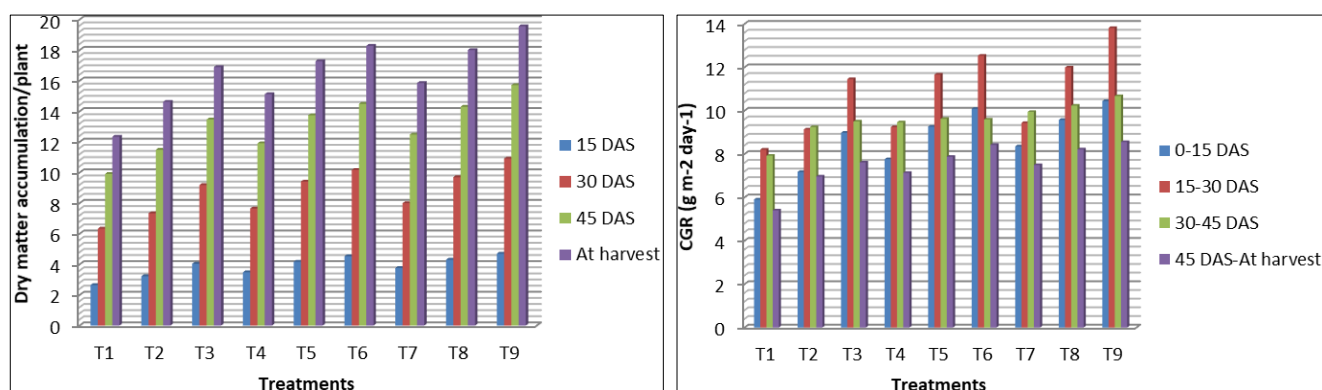


Fig 1: Effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.)

Table 2: Effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.)

No. of Treatments	Treatments	Dry matter accumulation/plant				CGR (g m ⁻² day ⁻¹)				RGR			Total number of nodules per plants
		15 DAS	30 DAS	45 DAS	At harvest	0-15 DAS	15-30 DAS	30-45 DAS	45 DAS-At harvest	15-30 DAS	30-45 DAS	45 DAS-At harvest	
T ₁	Control	2.65	6.34	9.91	12.34	5.90	8.20	7.92	5.40	0.0503	0.0236	0.0146	25.19
T ₂	50% RDF	3.23	7.34	11.49	14.62	7.17	9.13	9.24	6.96	0.0547	0.0243	0.0146	27.01
T ₃	100% RDF	4.04	9.19	13.47	16.89	8.98	11.45	9.50	7.61	0.0547	0.0255	0.0151	34.40
T ₄	50% RDF+Rh+PSB	3.49	7.65	11.91	15.12	7.76	9.24	9.46	7.13	0.0523	0.0295	0.0159	30.45
T ₅	50% RDF+(2.5t/ha) VC	4.17	9.41	13.74	17.28	9.26	11.66	9.62	7.87	0.0543	0.0252	0.0153	36.28
T ₆	50% RDF+(2.5t/ha) VC+ Rh +PSB	4.53	10.17	14.49	18.28	10.08	12.53	9.59	8.42	0.0537	0.0297	0.0155	40.97
T ₇	100% RDF+ Rh +PSB	3.76	8.00	12.48	15.85	8.35	9.43	9.94	7.49	0.0563	0.0296	0.0160	32.00
T ₈	100% RDF+ 2.5t/ha) VC	4.31	9.70	14.30	18.00	9.57	11.99	10.23	8.21	0.0540	0.0259	0.0153	38.53
T ₉	100% RDF+(2.5t/ha) VC+ Rh +PSB	4.70	10.91	15.71	19.56	10.44	13.81	10.67	8.55	0.0580	0.0299	0.0161	44.08
	SE(d)	0.076	0.188	0.290	0.312	0.169	0.318	0.452	0.214	0.001	0.001	0.001	0.746
	C.V.	2.404	2.637	2.725	2.322	2.403	3.602	5.786	3.495	2.452	5.919	4.112	2.664



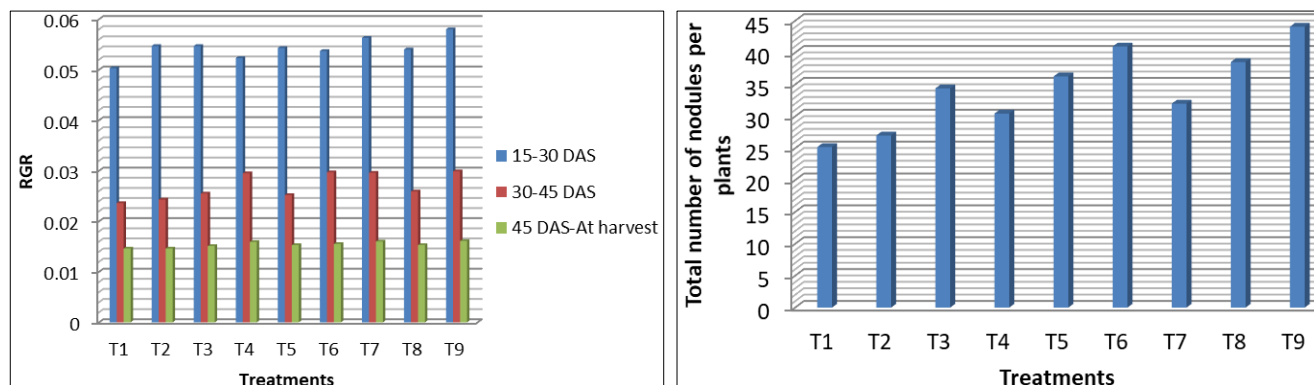


Fig 2: Effect of Integrated nutrient management on growth parameters of moong bean (*Vigna radiata* L.)

Conclusion

It is concluded that for obtaining highest yield in moong bean (*Vigna radiata* L.) during *kharif* season, application of 100% RDF+(2.5t/ha) VC+ Rh +PSB (Treatment 9) recorded higher plant stand/population, plant height (cm), no. of trifoliolate leaves per plant, no. of branches/ plant, dry matter accumulation/plant in gram, crop growth rate, relative growth rate, total number of nodules per plants of moong bean.

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