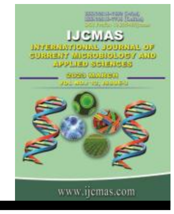
Int.J.Curr.Microbiol.App.Sci (2023) *12*(03): 225-234

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 12 Number 3 (2023)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2023.1203.027

Effect of Integrated Nutrient Management on Production of Summer Mungbean (*Vigna radiata* (L.) Wilczek)

Shital Kumar[1], Ashish Shivran[2], Ramanjit Kaur[1]*, Jhabar Mal Sutliya[2], Sunil kumar[1], Isha Ahlawat[2], Akshay Glotra[1] and Deepak Meena[1]

[1]Department of Agronomy, ICAR- Indian Agricultural Research Iinstitute, New Delhi- 110012, India
[2]Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana-125004, India

**Corresponding author*

Keywords

Mungbean, INM, Rhizobium, PSB and Vermicompost, atmospheric nitrogen

Article Info

Received: 12 February 2023
Accepted: 06 March 2023
Available Online: 10 March 2023

A B S T R A C T

Summer mungbean is a short duration, third most important pulse crop grown after chickpea and pigeonpea in India. Being pulses is considered as orphan crop because of growing in marginal land with less care. Mungbean is able to fix atmospheric nitrogen to fulfil its nitrogen requirement to somewhat but that is not enough to achieve potential yield. So, experiment was conducted to evaluate the effect of integrated nutrient management (INM) on growth, yield and quality of summer mungbean at CCSHAU, Hisar during summer 2020. The experiment was laid out in Randomised block design replicated thrice contained twelve treatments. The result revealed that maximum growth parameter, yield attributes, seed yield (11.03q ha^{-1}), biological yield(36.41q ha^{-1}), NPK uptake in seed& straw (37.28, 7.57 and 14.44 & 45.15, 4.61 and 25.62 kg ha^{-1}, respectively) and N content in soil after harvest (126.38 kg ha^{-1}) were recorded in treatment 75% RDF + 25% RDN through vermicompost + Rhizobium + PSB. Application of 100% RDN through vermicompost + Rhizobium + PSB recorded highest P and K content in soil after harvest (10.74 and 251.88 kg ha^{-1}). INM methods not only raised production, but also enhanced the nutrient uptake due to increase in root surface area their penetrability, and enhanced the nutritional content in summer mungbean.

Introduction

In national food grain basket pulses play significant role. Globally, India is a major producer and consumer of pulses. Pulses are the major source of protein which helps to feed the 40% poor and vegetarian people of the country (Avinash and Patil, 2018). Being there unique character of fixing atmospheric nitrogen make them more special and versatile, called “mini fertilizer" factory and also known as "marvel of nature" due to their deep tap root system that reduces soil erosion and make them tolerant to drought stress (Shrikant, 2010). Mungbean (*Vigna radiate* (L.) Wilczek) commonly known as green gram or golden gram, ranks third after chickpea (*Cicer arietinum* L.) and pigeonpea (*Cajanus cajan* (L.) Huth) based on both area and production among all pulses grown in India. Among pulse crop, mungbean is an excellent source of high quality protein which is easily digestible ranged from 20.97–31.32% (Anwar *et al.,* 2007), which contains good quality of lysine (4600 mg/g N) and tryptophan (60mg/ g N) in their grains (Puniya *et al.,* 2018).

It is also a good source of carbohydrate (51%), moisture (10%), minerals (4%) *viz*., calcium, zinc and folate (124, 3, and 549 mg 100^{-1} g grains respectively), and vitamins (4%) such as vitamin A (94 mg 100^{-1} g) as well as vitamin C (8 mg 100^{-1} g), riboflavin and thiamine in mungbean sprout (Choudhary, 2010). It is mainly grown in rainy/ *kharif* season, but can also be an ideal crop under spring and summer seasons because of its low water requirement and capacity to withstand under high temperature.

Being pulses is considered as orphan crop because of growing in marginal land with less care. Mungbean is able to fix atmospheric nitrogen to fulfil its nitrogen requirement to somewhat but that is not enough to achieve potential yield. To achieve its full yield potential we need to supply the all the essential nutrient in optimum amount. Because, the continuous use of high analysis fertilizer in major cropping system like rice-wheat, maize-wheat and rice-mustard reduce the factor productivity and decline the inherent fertility of soil leads to number of macro and micro-nutrient deficiency.

Using organic source of nutrients (manure and compost) which act as a soil conditioner help in improving the soil physical, chemical and biological health, but due to slow release of these nutrients unable to fulfil their nutrient demand in single season of crop (Akhtar *et al.,* 2011). To overcome such deficiencies and maintain the soil fertility we need to find some alternate option to supply the nutrients and maintain the soil health. For this we integrated different sources of nutrient like organic, inorganic and bio fertilizer to enhance the availability and helps the crop to uptake more nutrients. Bio-fertilizers are the substances containing variety of microbes having the capacity to enhance plant nutrient uptake by colonizing the rhizosphere and make the nutrients easily accessible to plant root hairs. Bio-fertilizer like *Rhizobium* initially require huge amount of energy to multiply their number which helps in fixing the atmospheric nitrogen. For example, for fixing one molecule of atmospheric nitrogen *Rhizobium* require16 moles of adenosine triphosphate (Singh and Singh, 2018 and Hubbell and Kidder, 2009). Other Bio-fertilizer like Phosphorus solubilizing bacteria (PSB) helps to enhance the availability or solubility of fixed form of phosphorus in soil.

INM system technique employs a well-balanced mix of inorganic fertiliser and organic manure to improve soil fertility and crop yield (Kumar *et al.,* 2013). 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 bio-fertilizers 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). Therefore, to reduce the losses and indiscriminate use of inorganic fertilizers, substitution with available organic sources of nutrients and bio-fertilizers is inevitable. In order to develop sustainable farming system with reduced use of synthetic fertilizer, more attention needs to be given for the use of organic manure that could have beneficial effects on crop production as well as on soil health.

Materials and Methods

A field experiment was conducted "To study the effect of integrated nutrient management on growth, yield and quality of summer mungbean" at Experimental area, Agronomy farm, CCSHAU, Hisar, Haryana (India) during summer 2020.

Geographically, Hisar is located at 29^0 09' 14.28" North latitute, 75^{0}43' 02.84" East longitude and at an altitude of 234 metres above mean sea level. The place falls in western agro-climatic zone IV (Trans Gangetic Plain region).The prevailing climate in Hisar is known as a local steppe climate typically semi-arid and monthly-wise weather parameters during the crop season recorded at college meteorological observatory have been presented in Fig 1.

The soil of the experimental field was loamy sand in texture, alkaline in reaction, poor in organic matter (2.7 x 10^{-5} %), low in available nitrogen (116.25 kg ha^{-1}) and phosphorus (9.29 kg ha^{-1}) and medium in potassium content (242.42 kg ha^{-1}). The soil samples were tested for pH, organic carbon content, electrical conductivity, available N, P and K as per methods given by Richards (1968); Walkley and Black (1934); Subbiah and Asija (1956); Olsen (1954) and Metson *et al.*, (1956), respectively. Simple RBD with three replications was used in the trial and each replication contains twelve treatments *viz.*, Control (T_1), 50% RDF (T_2), 75% RDF (T_3), RDF 20 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1} (T_4), 50% RDF + *Rhizobium* + PSB (T_5), 50% RDF + 50% RDN through Vermicompost (T_6), 50% RDF + 50% RDN Vermicompost + *Rhizobium* + PSB (T_7), 75% RDF + *Rhizobium* + PSB (T_8), 75% RDF + 25% RDN through Vermicompost (T_9), 75% RDF + 25% RDN through Vermicompost + *Rhizobium* + PSB (T_{10}), 100%RDF + *Rhizobium* + PSB (T_{11}) and 100% RDN through Vermicompost *Rhizobium* + PSB (T_{12}). Recommended dose of fertilizers were N and P applied @ 20 kg ha^{-1} and 40 kg ha^{-1} respectively. The full dose of N and P were given through urea (46% N) and DAP (46% P and 18% N) respectively. The seeds were inoculated with *Rhizobium* and PSB. The vermicompost contained 1.85% N, 0.85% P, and 1.06% K. Application of well decomposed vermicompost in experimental plot was according to treatment at the time of sowing, with the help of thoroughly mixing of vermcompost in soil. The crop was sown in 2nd fortnight of March using variety MH 421. The requisite plot wise fertilizers were prepared and applied before sowing. Each treatment was accommodated in 6.0 x 3.0 m^2 plots with row to row distance 30 cm and plant to plant 10 cm. Data on plant height, number of branches plant^{-1}, LAI (leaf area index), dry matter accumulation plant^{-1}, pod length, number of pods plant^{-1}, number of seeds pod^{-1}, 1000 grain weight and grain yield plant^{-1} and yield parameters such as biological yield, grain yield and harvest index were recorded as per the standard procedures. The plant and soil samples were collected at harvest, oven dried at 65°C, processed and analysed for total N, P and K following standard procedures. Nitrogen was estimated in plant samples by modified Kjeldhal's method as described by (Jackson, 1973). The phosphorus content was determined as per procedure outlined by Gupta (2007). Potassium in the acid digest of plant samples was determined using flame photometer. The data were pooled and statistically analysed by adopting appropriate method of standard analysis of variance (Gomez and Gomez, 1984).

Results and Discussion

Growth parameter

The influence of INM on summer mungbean growth parameters such as plant height, leaf area index, number of branches plant^{-1}, and dry matter accumulation plant^{-1} were found to be significant. Data from studies reveals that treatment 75% RDF + 25% RDN through Vermicompost + *Rhizobium* + PSB (T_{10}) significantly increased the growth parameters at 30, 45 DAS and at harvest compared to control and other treatments (Table 1), and was statistically comparable to treatments 100% RDN through Vermicompost *Rhizobium* + PSB (T_{12}) and 100% RDF + *Rhizobium* + PSB (T_{11}). The combined application of organic, inorganic and bio-fertilizer boosted the availability of major nutrients to plant, enhanced cell multiplication and early root growth. That led to higher absorption of nutrients from deeper layers of soil and ultimately resulting in increased plant growth (Sankar *et al.,* 2005). The ability of plants to grow taller could be due to readily available nitrogen, which is a key component of protoplasm and aids in photosynthesis as well as speeds up metabolism, cell division, and cell elongation (Tisdale *et al.,* 1995). The high availability of nitrogen helps in production of auxin that increases number of branches per plant (Sharma and Dayal, 2005). The better emergence, stronger root system and faster plant growth could be factors in increased LAI.

According to Watson (1952), LAI and CGR are crucial growth indicators for evaluating the effectiveness of crop production. Increase in total dry matter towards maturity may be due to growth pattern, higher rate of CO_2 fixation and RuBP carboxylase activity during crop growth (Lawlor, 1995). (Seyed Sharidi and Raei, 2011) Reported that higher LAI increases the absorption of solar energy that led to more biomass production. Similar result also found by (Singh *et al.,* 2017)

Yield attributes and yield

The significant increase in the yield attributing characteristics such as pod length (8.25 cm.), number of pods plant^{-1} (19.33), number of seeds pod^{-1}(8.81) and seed yield plant^{-1}(12.39 g) and yield parameters such as biological yield (36.41 q ha^{-1}) and seed yield (11.03 q ha^{-1}) was observed with the treatment T_{10} as compared to control (5.68 cm, 13.85, 6.78, 9.22g and 26.06 and 7.06 q ha^{-1}) and other treatments (Table 2) and was found at par with treatments $T_{12}$and T_{11}. Combine application of organic manure, inorganic fertilizer and bio-fertilizer provide favourable moisture regime and aeration (vermicompost has positive effect on soil porosity) for better root growth and respiration and higher soil biological activity as compared to only inorganic fertilizers (Singh, 2021). This increased the availability of essential nutrients to plant, improve the photosynthesis and plant growth attributes, crop growth rate and ultimately increased yield attributes through improved supply of the primary macronutrients (NPK). Total dry matter accumulation is an important parameter in boosting the source sink relationship and yield potential (Dordas, 2009). More availability of nutrients leads to more growth, more photosynthesis, more biological yield and finally more partition to grain (Khandelwal *et al.,* 2013).

Nutrient uptake

The data pertaining in Table 3 conveyed that the maximum NPK uptake in seed & straw was obtained with application T_{10} (37.28, 7.57 and 14.44& 45.15, 4.61 and 25.62 kg ha^{-1}, respectively), which was statistically at par with treatment of T_{12} (36.66, 7.48 and 14.21 & 44.23, 4.48 and 25.02 kg ha^{-1}, respectively) followed by other treatments. Minimum NPK uptake in seed and straw was found under the control treatment (22.62, 4.65 and 8.95 & 32.15, 3.28 and 17.46 kg ha^{-1}, respectively).

At cellular level dry matter accumulation and nutrient contents are directly influence by the uptake of N, P_2O_5 and K_2O. The absorption of major nutrients *viz*., N, P_2O_5 and K_2O is the function of crop yield and its content. The increased NPK content of seed and stover with INM may be ascribed to greater availability of NPK in soil and also for efficient absorption by the roots (Shivran and Ahlawat, 2000). Biofertilizers inoculation with PGPR (plant growth promoting rhizobacteria) in plants significantly increased the N and P content along with enhanced the uptake of essential nutrient by solubilizing the unavailable form and made available in the root zone. These findings were in close conformity with the Puente *et al.,* (2004) and Kumar *et al.,* (2015).

Soil Nutrient status

The significant increase in the N content in soil after harvest was observed treatment T_{10}as compared to control and other treatments (Table 3), which was found statistically at par with T_{12}, T_{11}, T_7, T_9, T_8, T_4 and T_6 and minimum N content in soil after harvest was recorded under the control. This could be due to application NPK and vermicompost along with biofertilizer (*Rhizobium* and PSB) favours optimum activity in biological nitrogen fixation that improves N status in soil.

Table.1 Effect of integrated nutrient management on growth parameters of summer mungbean

Treatments	Plant height (cm)				Leaf area index (LAI)				Number of branches per plant				Dry matter accumulation (g/ plant)			
	15 DAS*	30 DAS	45 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
T1	8.60	15.22	33.99	45.95	0.198	0.553	2.011	1.492	0.95	1.40	2.92	4.31	5.20	13.88	32.09	90.29
T2	8.85	15.40	35.10	46.73	0.205	0.578	2.248	1.962	1.07	1.62	3.32	4.84	5.30	14.21	34.30	93.98
T3	9.09	15.81	35.94	48.62	0.200	0.593	2.472	2.148	1.09	1.83	3.59	5.26	5.53	15.44	35.31	96.52
T4	8.43	17.24	37.80	50.55	0.196	0.629	2.817	2.339	1.13	1.99	3.96	5.84	5.81	16.67	36.50	101.17
T5	8.06	15.59	35.13	47.62	0.169	0.582	2.340	2.074	1.08	1.75	3.43	5.11	5.42	14.82	34.37	94.81
T6	9.31	16.53	36.99	49.57	0.196	0.619	2.662	2.263	1.10	1.91	3.77	5.50	5.71	15.96	36.12	97.84
T7	9.99	18.80	39.11	53.56	0.206	0.699	3.244	2.671	1.16	2.24	4.35	6.45	5.98	18.22	38.34	104.35
T8	9.00	17.63	38.14	51.98	0.199	0.645	2.990	2.409	1.14	2.10	4.09	6.11	5.87	17.12	37.24	101.81
T9	9.40	18.13	38.43	52.06	0.204	0.682	3.120	2.538	1.15	2.17	4.28	6.30	5.91	17.37	38.05	103.42
T10	11.63	20.04	40.25	55.76	0.213	0.759	3.947	3.194	1.20	2.51	4.90	7.04	6.21	19.72	40.41	109.48
T11	10.37	19.24	38.93	53.69	0.210	0.720	3.484	2.842	1.17	2.37	4.60	6.80	6.04	18.67	38.54	104.59
T12	10.98	19.90	39.76	54.36	0.211	0.743	3.721	2.963	1.18	2.43	4.78	6.93	6.14	18.91	40.02	106.70
SE(m)±	0.85	0.57	1.36	2.08	0.008	0.024	0.121	0.096	0.05	0.09	0.19	0.36	0.23	0.63	1.51	4.76
CD(5%)	NS*	1.67	3.98	6.09	NS**	0.070	0.356	0.283	NS**	0.26	0.56	1.06	NS	1.85	4.44	13.96

*DAS; Day after sowing, **NS; Non significant

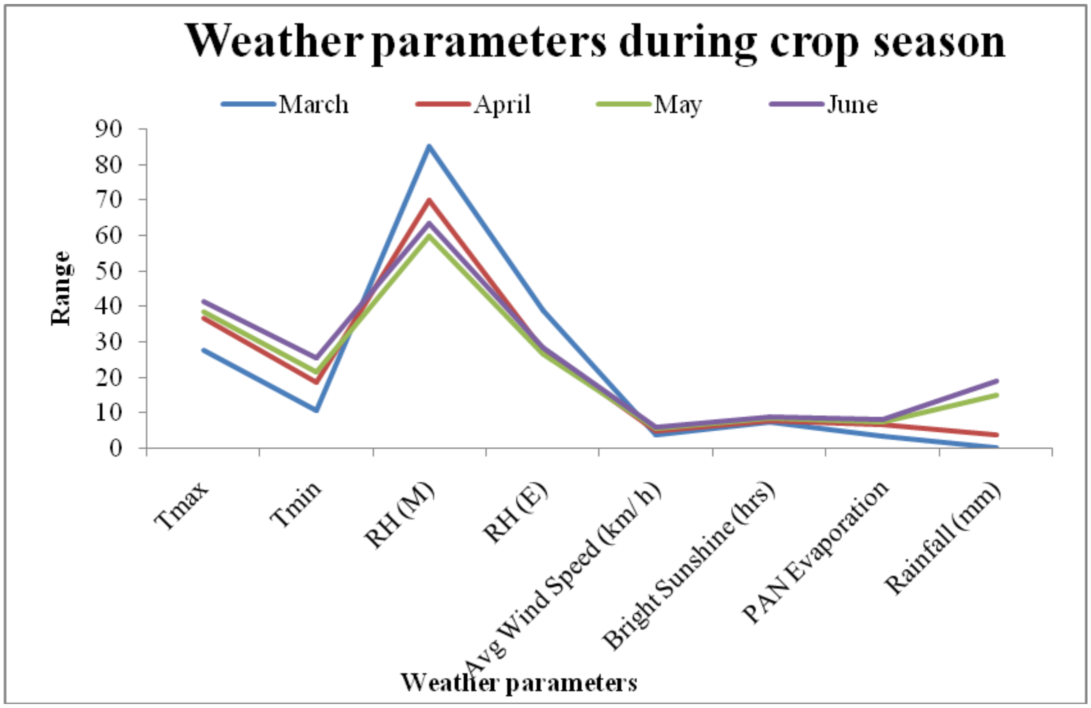
Table.2 Effect of integrated nutrient management on yield attributes and yields of summer mungbean

Treatments	Pod length (cm)	Number of pods $plant^{-1}$	Number of seed pod^{-1}	Seed yield $plant^{-1}$ (g)	1000 seed weight (g)	Biological yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index (%)
T1	5.68	13.85	6.78	9.22	35.83	2606	706	27.1
T2	6.06	14.63	6.98	9.76	36.46	2804	799	28.15
T3	6.44	15.90	7.25	10.32	37.11	2964	852	28.73
T4	7.13	16.82	7.78	10.94	37.84	3198	923	29.00
T5	6.27	15.06	7.20	10.09	36.92	2859	810	28.57
T6	6.82	15.94	7.53	10.84	37.41	3103	883	28.81
T7	7.77	18.23	8.10	11.88	39.56	3381	1008	29.69
T8	7.28	17.40	7.94	11.38	38.63	3255	955	29.62
T9	7.57	17.52	8.03	11.66	38.8	3348	990	29.63
T10	8.25	19.33	8.81	12.39	41.35	3641	1103	30.49
T11	7.85	18.45	8.28	11.99	40.07	3427	1031	30.05
T12	8.1	18.94	8.62	12.07	40.78	3582	1088	30.24
SE(m)±	0.44	0.310	0.45	0.67	1.88	169	60	1.87
CD(5%)	1.29	0.909	1.32	1.97	NS	496	175	NS

Table.3 Effect of integrated nutrient management on nutrient uptake and soil nutrient status of summer mungbean

Treatments	NPK uptake (kg ha^{-1}) in seed			NPK uptake (kg ha^{-1}) in straw			NPK soil status after harvest (kg/ ha)		
	N	P	K	N	P	K	N	P	K
T_1- Control	22.62	4.65	8.95	32.15	3.28	17.46	115.13	8.21	204.01
T_2- 50% RDF	26.16	5.35	10.18	33.98	3.47	18.61	117.91	8.82	208.76
T_3- 75% RDF	28.06	5.71	10.91	36.02	3.7	20	119.38	8.90	213.91
T_4- RDF (20 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1})	30.66	6.09	11.88	39.35	4.01	20.76	121.25	9.04	217.83
T_5- 50% RDF + *Rhizobium* + PSB	26.5	5.6	10.36	34.82	3.57	19.49	118.90	9.14	221.31
T_6- 50% RDF + 50% RDN through Vermicompost	29.27	5.8	11.33	38.04	3.92	20.38	120.02	9.85	240.58
T_7- 50% RDF + 50% RDN Vermicompost + *Rhizobium* + PSB	33.67	6.82	13.09	41.59	4.22	22.99	124.09	10.03	245.61
T_8- 75% RDF + *Rhizobium* + PSB	31.85	6.4	12.33	39.98	4.06	21.44	121.75	9.18	227.88
T_9- 75% RDF + 25% RDN through Vermicompost	33.04	6.66	12.84	41.34	4.18	22.36	123.19	9.20	230.14
T_{10}- 75% RDF + 25% RDN through Vermicompost +*Rhizobium* + PSB	37.28	7.57	14.44	45.15	4.61	25.62	126.38	9.45	238.89
T_{11}- RDF + *Rhizobium* + PSB	34.62	6.94	13.41	42.23	4.27	23.33	124.37	9.22	234.58
T_{12}- RDN through Vermicompost + *Rhizobium* + PSB	36.66	7.48	14.21	44.23	4.48	25.02	125.63	10.74	251.88
SE(m) ±	1.87	0.4	0.75	2.61	0.27	1.21	2.21	0.20	3.98
CD(5%)	5.48	1.17	2.2	7.64	0.79	3.55	6.49	0.59	11.67

Fig.1 Monthly-wise weather parameters during the crop season of summer mungbean



The significant increase in the P and K content in soil after harvest was observed with the use T_{12} compared to control and other treatments (Table 3), which was found statistically at par with $T_7$and minimum P and K content in soil after harvest was recorded under the control.

This could be due to Vermicompost takes longer time to release nutrients as compare to NPK fertilizer and summer mungbean is short duration, that's result P and K released from Vermicompost remains in soil.

According to the above mentioned findings, using the combination of inorganic, organic and bio-fertilisers was more productive than using inorganic fertilisers with bio-fertilisers or organic manure (Vermicompost) with bio-fertilisers. We may be able to lower inorganic fertiliser doses by mixing different source of nutrients.

The results show that in the case of MH 421, 75% RDF + 25% RDN through Vermicompost +*Rhizobium* + PSB produced statistically the same yield as RDN through Vermicompost + *Rhizobium* + PSB and 100% RDF + *Rhizobium* + PSB. So, if we use 75% RDF + 25% RDN through Vermicompost +*Rhizobium* + PSB, we will be able to cut consumption of inorganic fertilizer by 25%.

References

Akhtar, M., Naeem, A., Akhter, J., Bokhari, S. A. and Ishaque, W. (2011) Improvement in nutrient uptake and yield of wheat by combined use of urea and compost. *Soil Environment*, 30(1), 45-49.

Anwar, F., Latif, S., Przybylski, R., Sultana, B., and Ashraf, M. (2007) Chemical composition and antioxidant activity of seeds of different cultivars of mungbean. *Journal of food science*, 72(7), S503-S510. https://doi.org/10.1111/j.1750-3841.2007.00462.x

Avinash, C. S. and Patil, B. L. (2018). Trends in area, production and productivity of major pulses in Karnataka and India: An economic analysis. *Journal of Pharmacognosy and*

Phytochemistry, 7(4), 2097-2102.

Choudhary, H. R. (2010). Integrated Nutrient Management in Mungbean (*Vigna radiata* (L.) Wilczek) (Doctoral dissertation, Swami Keshwanand Rajasthan Agricultural University).

Dordas, C. (2009). Dry matter, nitrogen and phosphorus accumulation, partitioning and remobilization as affected by N and P fertilization and source–sink relations. *European Journal of agronomy*, 30(2), 129-139. https://doi.org/10.1016/j.eja.2008.09.001

Gomez K A and Gomez A A. (1984) *Statistical Procedures for Agricultural Research*. An International Rice Research Institute Book, A Wiley Interscience, John Wiley and Sons Inc., New York, USA.

Gupta A K. (2007) The complete technology book on biofertilizers and organic farming. *National Institute of Industrial Research Press*, India.

Hubbell, D. H. and Kidder, G. (2009) Biological Nitrogen Fixation. *University of Florida IFAS Extension Publication SL*16: pp. 1-4.

Jackson, M. L. (1973) Soil chemical analysis prentice hall of India. Pvt. Ltd. New Delhi, 498.

Khandelwal, R., Choudhary, S. K., Ghoshlya, J., and Singh, P. (2013) Short communication effect of fertilizer and bio-fertilizers on growth, yield and economics of cowpea. *Annals of Plant and Soil Research*, 15(2), 177-178.

Kumar, P., Shukla, Y. R., and Kumar, R. (2013) Effect of integrated nutrient management practices on seed yield and contributing characters in radish (*Raphanus sativus* L.) cv. Chinese Pink. *Advance Research Journal of Crop Improvement*, 4(1), 74-78.

Kumar, S., Dhar, S., Kumar, A., and Kumar, D. (2015) Yield and nutrient uptake of maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping system as influenced by integrated potassium management. *Indian Journal of Agronomy*, 60(4), 511-515.

Lawlor, D. W. (1995) Photosynthesis, productivity and environment. *Journal of experimental botany*, 46, 1449-1461. https://doi.org/10.1093/jxb/46.special_issue.1449

Metson, A. J., Arbuckle, R. H., and Saunders, M. L. (1956) The potassium-supplying power of New Zealand soils as determined by a modified normal-nitric-acid method. In Transactions of the 6th *International Congress of Soil Science B* (pp. 619-627).

Olsen, S. R. (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate (No. 939). US Department of Agriculture.

Puente, M. E., Bashan, Y., Li, C. Y., and Lebsky, V. K. (2004) Microbial populations and activities in the rhizoplane of rock-weathering desert plants. I. Root colonization and weathering of igneous rocks. *Plant Biology*, 6(05) 629-642. https://doi.org/10.1055/s-2004-821100

Puniya, R., Palsaniya, S., Chand, L., Sharma, A., Thakur, N. P., and Bazaya, B. R. (2017) Influence of sowing dates and varieties on the yield, heat use efficiency, energy utilization and economics of summer mungbean. Legume Research: *An International Journal*, 41(5). https://doi.org/10.18805/LR-3789.

Rautaray, S. K., Ghosh, B. C. and Mitra, B. N. (2003) Efficacy of organic materials on growth and yield of rice as influenced by time of application under integrated nutrient management. *Oryza*, 40(1&2): 18-21.

Richards L. A. (1968) Diagnosis and Improvement of Saline and Alkali Soils. USDA Handbook no. 60. Oxford and IBH Publishing, New Delhi.

Sankar, V., Veeraragavathatham, D. and Kannan, M. (2005) Postharvest Storage life of Onion influenced by Organic farming practices. In: NRCG Report, National Symposium on current trends in Onion, Garlic, Chillies and Seed Spices- production, marketing and utilization, November, 25-27, Rajguru Nagar, Pune. pp. 104-105.

SeyedSharidi R, Raei Y. (2011) Evaluation of yield and the some of physiological indices of barley (*Hordeum vulgare* L.) genotypes in relation to different plant population levels. *Australian Journal of Basic and Applied Sciences* 5(9), 578-584.

Sharma, V. K., and Dayal, B. (2005) Effect of organic and inorganic source of nitrogen on growth, yield and nutrients uptake under cowpea-unseed cropping system. *Legume Research-An International Journal*, 28(2), 79-86.

Shivran, D. R., and Ahlawat, I. P. S. (2000) Effect of cropping systems and fertilizers on pigeonpea (*Cajanus cajan*) and wheat (*Triticum aestivum*) in pigeonpea-wheat sequence. *Indian Journal of Agronomy*, 45(4) 669-675.

Shrikant, M. V. (2010) Studies on integrated nutrient management on seed yield, quality and storability in green gram (*Vigna radiata* (L.) Wilczek) Ph. D (Doctoral dissertation, Thesis, University of agricultural science. Dharwad, Karnataka).

Singh, M., Deokaran, M. J., and Bhatt, B. P. (2017) Effect of integrated nutrient management on production potential and quality of summer mungbean (*Vigna radiata* L.). *Journal KrishiVigyan*, 5, 39-45. https://doi.org/10.5958/2349-4433.2017.00009.5

Singh, V. K. (2021) Effects of vermicomposting on the soil fertility and growth attributes of crop plants in the farming system. *International Journal of Advanced Research in Engineering and Applied Sciences*, 10(5), 21-29

Singh, Z., and Singh, G. (2018) Role of *Rhizobium* in chickpea (*Cicer arietinum*) production-A review. *Agricultural Reviews*, 39(1). https://doi.org/10.18805/ag.R-1699

Subbiah, B., and Asija, G. L. (1956) Alkaline permanganate method of available nitrogen determination. *Current science*, 25, 259.

Tisdale, S. P., Nelson, W. L., Beaton, J. D. and Havlin, J. L. (1995) *Soil Fertility and Fertilizers*, 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 62-65.

Walkley, A., and Black, I. A. (1934) An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil science*, 37(1), 29-38. http://dx.doi.org/10.1097/00010694-193401000-00003

Watson, D. J. (1952) The physiological basis of variation in yield. *In Advances in agronomy* (Vol. 4, pp. 101-145). Academic Press. https://doi.org/10.1016/S0065-2113(08)60307-7

How to cite this article:

Shital Kumar, Ashish Shivran, Ramanjit Kaur, Jhabar Mal Sutliya, Sunil kumar, Isha Ahlawat, Akshay Glotra and Deepak Meena. 2023. Effect of Integrated Nutrient Management on Production of Summer Mungbean (*Vigna radiata* (L.) Wilczek). *Int.J.Curr.Microbiol.App.Sci.* 12(03): 225-234.
doi: https://doi.org/10.20546/ijcmas.2023.1203.027