



Potential of Integrated Nutrient Managements (INM) on Nutrient Uptake (N, P and K) by Chickpea

Kalyani Meravi ^a, Kamal Kishor Patel ^a, Ajay Kumar Shah ^{b*},
Shekhar Singh Baghel ^a, Vikash ^a, Priya Jaiswal ^b
and Devid kumar Sahu ^a

^a Department of Soil Science and Agricultural Chemistry, CoA, JNKVV, Jabalpur, Madhya Pradesh, Pin -482004, India.

^b Department of Forestry, CoA, JNKVV, Jabalpur, Madhya Pradesh, Pin- 482004, India.

Authors' contributions

This work was carried out in collaboration among all authors. The author KM was done the trial under M.Sc. research work in JNKVV, Jabalpur. Authors KKP and AKS helped in research work and analyzed the row data. Author SSB helped in research guidance and other authors helped in the data collection. All authors read and approved the final manuscript.

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ABSTRACT

This work estimated the potential uses of NPK by chickpea under using of different combination of bio-fertilizer. The field experiment was conducted at Research Field, Department of Soil Science, JNKVV, Jabalpur (M.P.). The field is located in the south-eastern part of Madhya Pradesh at 23°13' North latitude, 79° 57' East longitudes at an altitude of 393 meter above the mean sea level. The experimental field was well-drained with levelled topography. The experiment was carried out on chickpea (JG-14). The experiment was consists of three main-plot treatments of NPK and six sub-plot treatments of vermicompost and biofertilizers which were replicated three times in a split plot design (SPD) with treatments error was $P>0.05$ value during analysis. The results revealed that the INM influence directly on NPK (nitrogen, phosphorus and potassium) uptake. The treatment 100%

*Corresponding author: E-mail: shahajay.1209@hotmail.com, shahajay.1209@gmail.com;

NPK (65.08 and 26.39 kg ha⁻¹) with combination vermicompost and Rhizobium+ PSB+KSB+ Trichoderma (biofertilizers) (61.77 and 27.45 kg ha⁻¹) highest nitrogen uptake. Phosphorus uptake estimated maximum in treatment of 50% NPK (7.24 and 4.03 kg ha⁻¹) with combination vermicompost and biofertilizers (10.03 and 4.92 kg ha⁻¹) moreover potassium uptake found highest in 100% NPK (5.10 and 27.11 kg ha⁻¹) with vermicompost and biofertilizers (4.92 and 27.80 kg ha⁻¹) in grain and stover respectively.

Keywords: *Rhizobium; Trichoderma; Pseudomonas; vermicompost; biofertilizers etc.*

ABBREVIATIONS

PSB : Phosphate Solubilizing Bacteria

KSB : Potassium Solubilizing Bacteria

1. INTRODUCTION

Food security, food quality, soil health sustainability and climate resilience are the key areas of the integrated crop management concept (ICM). Integrated nutrient management (INM) in conventional agriculture is recognized as one of the strategies to address the above priorities under the ICM. At the same time, we rely sufficiently on organic sources to meet the nutritional needs of our crops, in addition to using chemical fertilizers to feed the vast world population in general and India in particular. Integrated nutrient management refers to maintaining soil fertility and plant nutrient supply at optimal levels to maintain desired productivity by optimizing the benefits of all possible sources of organic, inorganic and biological components in an integrated manner. Integrated Nutrient Management (INM) uses of chemical fertilizers along with organic fertilizers, crop residues, and cover crops, legumes in cultivation systems, the use of bio-fertilizers and other locally available nutrient sources to provide nutrients to plants at optimal levels to maintain crop productivity in an integrated manner [1].

2. MATERIALS AND METHODS

The field experiment was carried out at Research field of Department of Soil Science, JNKVV, Jabalpur during Rabi season 2021-22. The experiment consists of three main-plot treatments of NPK and six sub-plot treatments of vermicompost and biofertilizers which were replicated three times in a split plot design (SPD). "The NPK fertilizers were supplied through urea, single super phosphate, muriate of potash were applied at recommended dose of 20:60:20 kg/h. The experimental data were tabulated and analyzed statistically by the method of analysis of variance" as described by Gomez and Gomez [2].

2.1 Nutrient Content Estimation

The percentage nutrient content has been measured in different ways that is nitrogen content in chickpea pods and stover were estimated based on dry weight using the micro-Kjeldahl method according to the method described by AOAC [3], using the vanadomolybdate yellow color method published by Bhargava and Raghupathi (1984) and using a flame photometer following the method of Bhargava and Raghupathi (1984).

2.2 Nutrient Uptake

The nitrogen, phosphorous, and potassium content of chickpea pods and stover were measured on a dry weight basis using standard procedures as described before. The uptake of nutrients by chickpea pods and stover was computed in terms of Kg ha⁻¹ by multiplying the respective content of nutrient and yield ha⁻¹ using the following formula:

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \text{Nutrient content (\% yield (kg ha}^{-1}\text{)) / 100}$$

3. RESULTS AND DISCUSSION

3.1 Nitrogen Uptake by Chickpea at Harvest

The data on contents of N uptake in the grain and stover of chickpea are presented in Table 1. "The N uptake in the grain of chickpea in Kg ha⁻¹ at harvest ranged from 53.68 to 69.80 Kg ha⁻¹ with an average of 60.17 Kg ha⁻¹. NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas exhibited significantly maximum response with 69.80 Kg ha⁻¹ which was 14% more over that of control (60.17 Kg ha⁻¹). This was followed by the response of NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma with 68.86 Kg ha⁻¹ on the other hand, the response of the treatments NPK100+ VC+ Rhizobium +PSB+KSB were found statistically at par" [4].

Table 1. Mean comparisons nitrogen uptake under different treatments of fertilizer by grain and stover of check pea crop

Main treatments / Sub treatments	Grain				Straw			
	0% NPK	50% NPK	100% NPK	Mean	0% NPK	50% NPK	100% NPK	Mean
<i>Vermicompost+ Rhizobium + PSB</i>	54.83	60.89	65.44	60.38	24	25.07	25	24.69
<i>Vermicompost + Rhizobium + KSB</i>	55.42	58.92	58.92	57.75	25.33	25.93	26.36	25.88
<i>vermicompost + Rhizobium +PSB+KSB</i>	55.15	58.33	66.05	59.84	25.28	27	27.41	26.56
<i>Vermicompost + Rhizobium +PSB +KSB +Trichoderma</i>	62.67	56.98	68.86	61.77	26.29	26.67	27.57	27.45
<i>Vermicompost + Rhizobium + Trichoderma + Pseudomonas</i>	59.05	56.46	69.80	61.4	28.5	26.13	28.5	26.67
<i>control</i>	53.68	60.17	61.4	58.41	25	24.17	26.67	25.28
Mean	56.8	58.62	65.08		25.73	25.83	26.39	
	NPK(A)	VC+BF(B)	AxB		NPK(A)	VC+BF(B)	AxB	
SEm±	0.88	1.51	2.61		0.52	0.84	1.45	
CD(0.05)	3.45	4.36	7.66		2.04	2.42	4.19	

Table 2. Mean comparisons phosphorus uptake under different treatments of fertilizer by grain and stover of check pea crop

Main treatments / Sub treatments	Grain				Straw			
	0% NPK	50% NPK	100% NPK	Mean	0% NPK	50% NPK	100% NPK	Mean
<i>Vermicompost+ Rhizobium + PSB</i>	7.03	9.7	9.41	8.71	4.31	4.24	5.42	4.66
<i>Vermicompost + Rhizobium + KSB</i>	8.69	8.15	9.56	8.8	4.43	4.05	4.71	4.39
<i>vermicompost + Rhizobium +PSB+KSB</i>	7.2	7.15	10.97	8.44	4.49	4.76	5.22	4.82
<i>Vermicompost + Rhizobium +PSB +KSB +Trichoderma</i>	7.72	9.47	11.17	10.03	3.27	4.84	5.43	4.92
<i>Vermicompost + Rhizobium + Trichoderma + Pseudomonas</i>	7.98	10.14	11.95	6.94	3.88	4.99	5.89	3.92
<i>control</i>	6.75	7.24	6.94	6.98	3.8	4.03	3.92	3.92
Mean	7.56	8.64	10		4.03	4.49	5.1	
	NPK(A)	VC+BF(B)	AxB		NPK(A)	VC+BF(B)	AxB	
SEm±	1.07	0.69	1.2		0.27	0.19	0.34	
CD(0.05)	4.21	2	3.46		1.04	0.56	0.97	

Table 3. Mean comparisons potassium uptake under different treatments of fertilizer by grain and stover of check pea crop

Main treatments / Sub treatments	Grain				Straw			
	0% NPK	50% NPK	100% NPK	Mean	0% NPK	50% NPK	100% NPK	Mean
<i>Vermicompost+ Rhizobium + PSB</i>	4.31	4.24	5.42	4.66	23.14	25.62	27.61	25.46
<i>Vermicompost + Rhizobium + KSB</i>	4.43	4.05	4.71	4.39	27.06	22.12	23.76	24.31
<i>vermicompost + Rhizobium +PSB+KSB</i>	4.49	4.76	5.22	4.82	20.91	20.93	29.13	23.66
<i>Vermicompost + Rhizobium +PSB +KSB +Trichoderma</i>	3.27	4.84	5.43	4.92	27.12	22.76	29.38	27.8
<i>Vermicompost + Rhizobium + Trichoderma + Pseudomonas</i>	3.88	4.99	5.89	3.92	28.97	23.95	30.46	22.28
control	3.8	4.03	3.92	3.92	20.11	21.87	22.28	21.42
Mean	4.03	4.49	5.1	0	24.55	22.88	27.11	0
	NPK(A)	VC+BF(B)	AxB		NPK(A)	VC+BF(B)	AxB	
SEm±	0.27	0.19	0.34		0.85	1.01	1.75	
CD(0.05)	1.04	0.56	0.97		3.33	2.92	5.06	

“The N uptake in the stover of chickpea in Kgha^{-1} at harvest ranged from 24.00 to 28.50 kg/ha with an average of 25.98 kg/ha. *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 28.50 kg/ha which was 14% more over that of control (24.00 Kgha^{-1}). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 27.57 qha^{-1} [4] On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par. This is due to bio-fertilizer helps the availability of nutrients in available form of nitrogen. Bio-fertilizers are microbial inoculants of bacteria, algae, fungi alone or in combination and they augment the availability of nutrients to the plants. Bio-fertilizers are the preparations containing microorganisms beneficial to agricultural production in terms of nutrient supply especially N and P finding denoted Choudhary et al. [1].

3.2 Phosphorus Uptake by Chickpea at Harvest

The data on contents of P uptake in the grain and stover of chickpea are presented in Table 2. The P uptake in the grain of chickpea in kg/ha at harvest ranged from 6.75 to 11.95 Kgha^{-1} with an average of 8.74 Kgha^{-1} . *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 11.95 Kgha^{-1} which was 44% more over that of control (6.75 kg/ha). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 11.17 Kgha^{-1} . On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par.

The P uptake in the stover of chickpea in at harvest ranged from 3.80 to 5.89 Kgha^{-1} with an average of 3.92 Kgha^{-1} . *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 5.89 kg/ha which was 34% more over that of control (3.92 Kgha^{-1}). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 5.43 Kgha^{-1} . On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par. The nutrient status of plant tissue being the genetic character was affected less by the environment but, higher growth require higher uptake Reager et al. [5] and Shah et al. [6] found that mustard

used phosphorus uptake more correlated with the INM combination.

3.3 Potassium Uptake by Chickpea at Harvest

The data on contents of K uptake in the grain and stover of chickpea are presented in Table 3. The K uptake in the grain of chickpea in kg/ha at harvest ranged from 3.80 to 5.89 kg/ha with an average of 4.54 Kgha^{-1} . *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 5.89 kg/ha which was 48% more over that of control (3.80 Kgha^{-1}). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 5.43 kg/ha. On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par.

The K uptake in the stover of chickpea in at harvest ranged from 20.11 to 30.46 Kgha^{-1} with an average of 24.84 Kgha^{-1} . *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 30.46 kg/ha which was 21% more over that of control (20.11 Kgha^{-1}). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 29.38 Kgha^{-1} . On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par. This may be due to better synthesis of chlorophyll in leaves since bio-fertilizer contain appreciable quantities of other nutrients, which might have helped in more absorption of nutrients content in form of NPK. These result have also been reported by Singh et al. [7], Harikesh, et al., [8], Patel et al. [9], and Khan et al. [10].

4. CONCLUSION

Integrated nutrient management refers to maintaining soil fertility and plant nutrient supply at optimal levels to maintain desired productivity by optimizing the benefits of all possible sources of organic, inorganic and biological components in an integrated manner. The INM was shows efficient use of nutrient uptake that is nitrogen, phosphorus and potassium through grain and stover of chickpea. The highest nitrogen uptake reflected in the treatment of INM 100% NPK with *vermicompost + Rhizobium + Trichoderma + Pseudomonas*) nutrients by grain and stover. Phosphorus as well as potassium nutrients

uptake estimated highest in the treatments of INM combination (100%NPK + *vermicompost* + *Rhizobium* + *Trichoderma* + *Pseudomonas*).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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