Potential of Integrated Nutrient Managements(INM) on Nutrient uptake (N, P and K) by chickpea

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 $23^0$13' North latitude, 79^0 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 biofetilizers 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% NPK (65.08 and 26.39 $kgha^{-1}$) with combination vermicompost and *Rhizobium*+ *PSB*+*KSB*+ *Trichoderma* (biofetilizers)(61.77 and 27.45 $kgha^{-1}$) highest nitrogen uptake. Phosphorus uptake estimated maximum in treatment of 50% NPK (7.24 and 4.03 $kgha^{-1}$) with combination vermicompost and biofetilizers(10.03 and 4.92 $kgha^{-1}$) moreover potassium uptake found highest in 100% NPK (5.10 and 27.11 $kgha^{-1}$) with vermicompost and biofetilizers (4.92 and 27.80 $kgha^{-1}$) in grain and stover respectively.

Keyword:Rhizobium, Trichoderma, Pseudomonas, Vermicompost, Biofetilizers etc.

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(Choudhary*et al.* 2018)

2. METHODS AND MATERIALS

The field experiment was carried out at Research field of Department of Soil Science, JNKVV, Jabalpur during Rabi season 2021-22 The experiment was consists of three main-plot treatments of NPK and six sub-plot treatments of vermicompost and biofetilizers 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 (1984)

2.1 Nutrient Content estimation

PSB- Phosphate solubilizing bacteria
KSB- Potassium solubilizing bacteria

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 (1995), using the vanado-molybdate 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$Kgha^{-1}$ by multiplying the respective content of nutrient and yield ha^{-1} using the following formula

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

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 $Kgha^{-1}$ at harvest ranged from 53.68 to 69.80 $Kgha^{-1}$ with an average of 60.17 $Kgha^{-1}$. *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 69.80$Kgha^{-1}$which was 14% more over that of control (60.17$Kgha^{-1}$). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 68.86$Kgha^{-1}$on the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par" [10].

Table 1.Mean camparisonsnitrogen uptakeunder different treatments of fertilizer bygrain 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**
Vermicompost+Rhizobium +PSB	54.83	60.89	65.44	60.38	24	25.07	25	24.69
Vermicompost+Rhizobium +KSB	55.42	58.92	58.92	57.75	25.33	25.93	26.36	25.88
vermicompost+Rhizobium+ PSB+KSB	55.15	58.33	66.05	59.84	25.28	27	27.41	26.56
Vermicompost+Rhizobium +PSB+KSB+Trichoderma	62.67	56.98	68.86	61.77	26.29	26.67	27.57	27.45
Vermicompost+ Rhizobium+ Trichoderma+Pseudomonas	59.05	56.46	69.80	61.4	28.5	26.13	28.5	26.67
control	53.68	60.17	61.4	58.41	25	24.17	26.67	25.28

PSB- Phosphate solubilizing bacteria
KSB- Potassium solubilizing bacteria

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	

"The N uptake in the stover of chickpea in Kgha^{-1} at harvest ranged from 24.00 to 28.50kg/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 27.57qha^{-1}". [10] 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 microorganismsbeneficial to agricultural production in terms of nutrient supply especially N and P finding denoted Choudhary *et al*(2018).

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 11.95Kgha^{-1}with an average of 8.74 Kgha^{-1}. *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantlymaximum 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.

Table 2.Mean camparisonsphosphorus uptake under different treatments of fertilizer bygrain 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
Vermicompost+Rhizobium +PSB	7.03	9.7	9.41	8.71	4.31	4.24	5.42	4.66
Vermicompost+Rhizobium +KSB	8.69	8.15	9.56	8.8	4.43	4.05	4.71	4.39
vermicompost+Rhizobium +PSB+KSB	7.2	7.15	10.97	8.44	4.49	4.76	5.22	4.82
Vermicompost+Rhizobium +PSB+KSB+Trichoderma	7.72	9.47	11.17	10.03	3.27	4.84	5.43	4.92
Vermicompost+ Rhizobium+ Trichoderma+Pseudomonas	7.98	10.14	11.95	6.94	3.88	4.99	5.89	3.92
control	6.75	7.24	6.94	6.98	3.8	4.03	3.92	3.92

PSB- Phosphate solubilizing bacteria
KSB- Potassium solubilizing bacteria

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	

The P uptake in the stover of chickpea in at harvest ranged from 3.80 to 5.89Kgha^{-1}with an average of 3.92 Kgha^{-1}. *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantlymaximum response with 5.89 kg/hawhich was 34% more over that of control (3.92Kgha^{-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.* (2006) and Shah *et al.* (2022) 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 5.89kg/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 (3.80Kgha^{-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.

Table 3.Mean camparisonspotassium uptake under different treatments of fertilizer bygrain 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
Vermicompost+Rhizobium+PSB	4.31	4.24	5.42	4.66	23.14	25.62	27.61	25.46
Vermicompost+Rhizobium+KSB	4.43	4.05	4.71	4.39	27.06	22.12	23.76	24.31
vermicompost+Rhizobium+PSB+ KSB	4.49	4.76	5.22	4.82	20.91	20.93	29.13	23.66
Vermicompost+Rhizobium+PSB+ KSB+Trichoderma	3.27	4.84	5.43	4.92	27.12	22.76	29.38	27.8
Vermicompost+ Rhizobium+ Trichoderma+Pseudomonas	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	

PSB- Phosphate solubilizing bacteria
KSB- Potassium solubilizing bacteria

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/hawhich 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*. (2017), Harikesh, *et al.,* (2018), Patel *et al*. (2020), and Khan*et al*. (2021).

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 INM100%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

There are no conflict for our research work on the site / institutions or agency.

AUTHORS' CONTRIBUTIONS

The correspondent author (KalayaniMeravi) was done the trial under M.Sc. research work in JNKVV, Jabalpur. The second and third author (Kamal Kishor Patel and Ajay Kumar Shah) was helping in research work and analysis of row data. The last author (Shekhar Singh Baghel) was helping in the research guidance and other authors helped in the data collection.

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