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POTENTIAL EFFECT OF INTEGRATED NUTRIENT MANAGEMENTS ON SOIL MICROBIAL POPULATION IN RHIZOSPHERIC VERTISOL

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ABSTRACT

This study compares the potential of integrated nutrient managements on soil microbial activity using different composting methods. The research was carried out at Research Institute, Department of Soil Science, JNKVV, Jabalpur (M.P.).The study area has a flat topography and is well located. Research was conducted on chickpea JG-14). The study consisted of three primary treatments with fertilizer (NPK) and six treatments with vermicompost and biofertilizers which were multiplied by three in the plot design (SPD) and the treatment error was a value of $P > 0.05$ at analysis. The results showed that INM directly affects the Rhizobium spp Population in rhizospheric soil *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with 6.49 log cfu ($5.89x10^6$ cfu/g) which was 42% more over that of control (3.37 log cfu ($1.68x10^4$ cfu/g). *Trichoderma* population was estimated in similar treatments exhibited highest response with 5.88 log cfu ($7.59 x10^5$ cfu/g) which was 73% more over that of control. *Pseudomonas spp* presented highest response with 5.83 log cfu ($6.81 x10^4$ cfu/g) under T_5combination of NPK with enriched vermicompost as like as the dehydrogenase activity was monitored by T_5 with 8.53 µg TPF $h^{-1}g^{-1}$.

Keywords: *Rhizobium* sp, *Pseudomonas* sp., *Trichoderma*, Dehydrogenase activity and soil fertility

Introduction

Vertisols in the tropics occur in a range of climates and are used in a range of production systems (Pal *et al.*, 2012). The vertisols and associated soils occupy about 116 Mha in India (Bhattacharyya *et al.*, 2010). It is generally known as black cotton soil indifferent part of country. In this soil nutrient availability for plant is less due to accumulation of nutrient that is indicative of deficiency of N, P, K, S, Zn, B and Mo that could be amended by fertilizer application. the average fertilizer application per hectare of about 145 kg in India during 2019-20 was much below than that in the SAARC countries of about 174 kg ha^{-1}(Shukla *et al.*, 2022). The aim of the farmer is to use the fertilizer in such a way as to achieve the most profitable operation. Good fertilization also reduces excessive and unintended fertilization, which not only harms the farmer but also pollutes nearby water bodies. Fertilizers can help bring about changes in agriculture. Operators can reduce unit costs and increase production costs by increasing fertilizer prices for capital and production costs (Stewart, 2024). Fertilizer application in ecosystems managed for agricultural production is a major contributor to soil acidification (Bolan *et al*., 2005). Preservation of rhizospheric soil during INM (Integrated Nutrient Management) renovation. INM has a major long-term effect on crops that follow after it, in addition to providing vermicompost with readily available nitrogen for the growth of soil microorganisms and the improvement of soil physical qualities. In order to achieve environmentally friendly practices, INM will combine the advantageous aspects of both sources to

create a blend that can be used to maintain soil fertility, maximize yield, maximize profitability, and ultimately reduce environmental pollution. This blend will also help to accumulate a balance between fertilizer inputs and crop nutrient requirements and reduce the widespread use of chemical fertilizers. The impact of INM on soil activity at varying fertility levels is identified in this study.

Material and Methods

The experiment was carried out on chickpea (JG-14). Present 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 bio-fertilizers which were replicated three times analyzed statistically through split plot design (SPD)by the method of analysis of variance as described by Gomez and Gomez (1984). They are explaining in the below:

A. Main plot treatments:(NPK - 03)

M1 0% NPK
M2 50% NPK
M3 100% NPK

B. Sub plot treatments: (organics - 06)

T1 *vermi compost + Rhizobium+ PSB*
T2 *vermi compost + Rhizobium + KSB*
T3 *vermi compost + Rhizobium + PSB + KSB*
T4 *vermi compost + Rhizobium + PSB + KSB + Trichoderma*
T5 *vermi compost + Rhizobium + Trichoderma + Pseudomonas*
T6 *control*

Methodology for population of microbial counts in rhizospheric soil

Samples of rhizospheric soil at harvest of the crop were used as fresh as possible without grinding, sieving or any modifications. The collected samples could be stored in low density polythene bags in the refrigerator at 4°C. The intervals of collecting rhizospheric soil samples were before sowing and at harvest of the crop chickpea. To evaluate the effect of different treatments on microbial population in soil, the study was done adopting serial dilution method. Soil samples collected periodically for microbial study were processed for serial dilution by suspending 10 g of soil sample in 90 ml sterilized water in flasks and were shaken thoroughly which resulted 10^{-1} dilution. Subsequent serial dilutions were made to up 10^{-9} dilution for plating purpose. The populations of different species of microorganisms under study in the soil samples at different dilutions were counted using different growth media.

Population of *Rhizobium* sp. in rhizospheric soil

Inoculation of Petri plates containing the sterilized YAMA medium was done by taking 1 ml of each 10^{-6} to 10^{-9} dilutions of the soil sample as required for *Rhizobial* population counts in soil. Plating was performed in triplicate for each dilution adopting pour plate method. The Composition of Yeast Extract Mannitol Agar (YAMA) medium for growth *Rhizobium* sp. were used following ingredient Mannitol (10 g), K_2HPO_4 (0.5 g), $MgSO_4$. $7H_2O$ (0.2 g), NaCl (0.1 g), $CaCO_3$ (1g), Yeast Ext (1g), Agar (20 g) in the Distilled water (1000 ml).An aliquot of 1 ml from 10^{-6} to 10^{-9} soil dilutions was taken as inoculum in a sterilized Petri plate under aseptic condition of laminar air flow chamber. Then the sterilized molten YAMA medium was poured and gently swirled clockwise and anticlockwise to mix the inoculum and the medium. After solidification of the inoculated medium, the plates were incubated upside down at 28 ±2ºC for 3-7 days. The colonies with specific growth characteristics (round and convex elevated mucilaginous) of rhizobium were counted after 3 – 7 days.

Population of *Pseudomonas* sp.

An aliquot of 1 ml from 10^{-7} to 10^{-9} dilutions of a soil sample was used as inoculum in Petri dishes. To the Petri dish 12-15 ml of the sterilized King's B medium was poured and immediately swirled horizontally to get the uniform distribution of the inoculated medium. Each dilution was similarly inoculated in triplicate. The plates were incubated upside down at 28±2°C for 3-7 days (24-72 hr). The colonies with specific growth characteristics (smooth, entire circular, convex, opaque, glistening, yellowish green pigmentation) of *Pseudomonas* species and were identified up to 3 – 7 days and counted. The composition of King's B medium (King et al. 1954) for growth of Pseudomonas sp. the following ingredient are used in 1 L of Distilled water *i.e.* Peptone (20 g), Glycerol (15 ml), $MgSO_4.7H_2O$ (1.5 g), K_2HPO_4 (1.5 g) and Agar (20 g).

Dehydrogenase enzyme

Dehydrogenase activity was determined by the dehydrogenase activity can be assayed and expressed as the rate of formation of tri-phenyl formazan (TPF) from 2,3,5-Tri phenyl tetrazolium chloride (TTC). Higher the biological activity faster will be the formation of tri-phenyl formazan (TPF).

Result and Discussion

Population of *Rhizobium* sp

The data about population of *Rhizobium* sp. in the surface soil (0 to 15 cm depth) before sowing and at harvest chickpea are presented in Table 1. The population of *Rhizobium* sp in the surface soil (0 to 15 cm depth) before sowing in ranged from 3.37 log cfu ($1.68x10^4$ cfu/g) to 6.49 log cfu ($5.89x10^6$cfu/g) with an average of 4.98 log cfu ($4.55x10^4$ cfu/g). *NPK100 + VC+ Rhizobium + PSB + KSB + Trichoderma + pseudomonas* exhibited significantly maximum response with 6.49 log cfu ($5.89x10^6$ cfu/g) which was 42% more over that of control (3.37 log cfu ($1.68x10^4$ cfu/g). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 6.42 log cfu ($5.77x10^6$ cfu/g). On the other hand, the response of the treatments *NPK100+VC+Rhizobium +PSB+KSB* were found statistically at par. The population of *Rhizobium*spp. in the surface soil (0 to 15 cm depth) at harvestin ranged from 3.48 log cfu ($1.35x10^4$ cfu/g) to 6.48 log cfu (6.48 $x10^5$cfu/g) with an average of 4.92 log cfu ($4.55x10^4$ cfu/g). *NPK100+ VC+ Rhizobium + PSB + KSB + Trichoderma + pseudomonas* exhibited significantly maximum response with6.48 log cfu (6.48 $x10^5$ cfu/g) which was 29% more over that of control (4.92 log cfu ($4.55x10^4$ cfu/g).This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 6.15 log cfu ($3.89x10^5$cfu/g). On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par. As like findings was found by following researchers *i.e.* Divyavani *et al.,* 2020, Kumawat *et al.,* 2009 and Dhyani 2011

Population of *Trichoderma*

The data about population of *Trichoderma* in the surface soil (0 to 15 cm depth) before sowing and at harvest chickpea are presented in Table 2.The population of *Trichoderma*in the surface soil before sowing in ranged from 1.47 log cfu ($1.02x10^5$ cfu/g) to 5.88 log cfu (7.59 $x10^5$cfu/g) with an average of 3.24 log cfu ($2.95x10^5$cfu/g). *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited maximum response with5.88 log cfu (7.59 $x10^5$ cfu/g) which was 73% more over that of control 1.47 log cfu ($1.02x10^5$ cfu/g). This was followed by the response of *NPK100 + VC + Rhizobium + PSB + KSB + Trichoderma* with 5.69 log cfu ($4.90x10^6$cfu/g). On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par.

The population of *Trichoderma* in the surface soil (0 to 15 cm depth) at harvest in ranged from 4.07 log cfu ($1.38x10^4$ cfu/g) to 6.19 log cfu (8.91 $x10^4$cfu/g) with an average of 4.51 log cfu ($3.24x10^5$cfu/g). *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with6.19 log cfu (8.91 $x10^4$ cfu/g) which was 29% more over that of control (4.07 log cfu ($1.38x10^4$ cfu/g). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 5.83 log cfu ($7.24x10^5$cfu/g). On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par. Higher soil fertility, nutrient uptake, and the growth of rhizosphere fungal and bacterial communities were all facilitated by trichoderma and biochar, and these factors increased tomato yields, antioxidants, and mineral content these studies was denoted by Sani *et al.,* 2020 and similar result find out through researchers *i.e.* Cai *et al.,* 2015 and Adesemoye *et al.,* 2009.

Population of *Pseudomonas* sp

The data about population of *Pseudomonas* sp in the surface soil (0 to 15 cm depth) before sowing and at harvest chickpea are presented in Table 3.

The population of *Pseudomonas spp* before sowing soil in ranged from 3.12 log cfu ($2.25x10^4$ cfu/g) to 5.83 log cfu (6.81 $x10^4$cfu/g) with an average of 4.22 log cfu ($4.66x10^5$cfu/g). *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* exhibited significantly maximum response with5.83 log cfu (6.81 $x10^4$ cfu/g)which was 33% more over that of control 3.12 log cfu ($2.25x10^4$ cfu/g). This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 5.73 log cfu ($6.35x10^3$cfu/g). On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par.

The population of *Pseudomonas spp*in the surface soil (0 to 15 cm depth) at harvest in ranged from 3.29 log cfu ($1.95x10^4$ cfu/g) to 7.27 log cfu ($6.85x10^4$cfu/g) with an average of 5.68 log cfu ($4.82x10^5$cfu/g). *NPK100 + VC + Rhizobium + PSB + KSB + Trichoderma + pseudomonas* exhibited significantly maximum response with7.27 log cfu (6.85 $x10^4$ cfu/g) which was 31% more over that of control 3.29 log cfu ($1.95x10^4$ cfu/g). This was followed by the response of *NPK100 + VC+ Rhizobium + PSB + KSB + Trichoderma* with 7.21 log cfu ($6.63x10^5$cfu/g). On the other hand, the response of the treatments *NPK100+ VC+ Rhizobium +PSB+KSB* were found statistically at par. In order to sustain a mutualistic relationship with

the linked plant, Pseudomonas species create antagonistic mechanisms like ISR and chemicals like cell wall breakdown enzymes and antibiotics. This association has an impact on the populations of soil these finding found by Sah 2021, Ahemad *et al.,* 2010 and Gupta *et al.,* 2011.

Dehydrogenase activity in soil of chickpea at harvest

The data about dehydrogenase activity in soil at harvest are presented in Table 4. The status of the Dehydrogenase activity in soil influence by the microbial treatments, which were ranged from 5.05 to 7.76 µg TPF h^{-1} g^{-1} soil with average of 6.45 µg TPF h^{-1} g^{-1} soil. In view to all the treatments, significantly lowest dehydrogenase activity was monitored by *NPK 100+ VC+ Rhizobium + PSB + KSB+ Trichoderma+ pseudomonas* with 5.05 µg TPF h^{-1} g^{-1} soil which was 21% lower than that of control 7.76 µg TPF h^{-1} g^{-1}. This was followed by the response of *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma* with 8.46 µg TPF h^{-1} g^{-1}.On the other hand, the response of the treatments *NPK 100 + VC + Rhizobium + PSB + KSB* were found statistically at par. Midya *et al.,* 2021 found that all INM treatments significantly enhanced soil dehydrogenase activities in soil, as compared to absolute control and application of 100% recommended dose of chemical fertilizer similarly other finding observed by Dinesh *et al.,* 2011 and biofertilizer, since soil biomass carbon in organically amended soil strongly correlates with dehydrogenase activity, which is dependent on the metabolic activity of soil biota revealed in result of Garcia-Gill *et al.,* 2000.

Conclusion

From the present investigation the following conclusions could be drawn: The population of *Rhizobium* sp. in the surface soil (0 to 15 cm depth) before sowing and at harvest in *NPK100 + VC + Rhizobium +PSB+KSB+Trichoderma+ Pseudomonas* exhibited maximum response with 6.49 log cfu ($5.89x10^6$ cfu/g) and 6.48 log cfu ($6.48 x10^5$ cfu/g) respectively. The population of *Trichoderma* in the surface soil (0 to 15 cm depth) before sowing and at harvest in *NPK100 + VC + Rhizobium + PSB + KSB + Trichoderma + Pseudomonas* exhibited highest response with 5.88 log cfu ($7.59 x10^5$ cfu/g) and 6.19 log cfu ($8.91 x10^4$ cfu/g) respectively. The population of *Pseudomonas spp* in the surface soil (0 to 15 cm depth) before sowing and at harvest in *NPK100+ VC+ Rhizobium +PSB+ KSB+ Trichoderma+ pseudomonas* presented highest response with 5.83 log cfu ($6.81 x10^4$ cfu/g). In view to all the treatments, highest dehydrogenase activity was monitored by *NPK100 + VC + Rhizobium + PSB + KSB + Trichoderma + pseudomonas* with 8.53 µg TPF h^{-1} g^{-1}.

Table 1 : Effect of Integrated Nutrient Management on population of *Rhizobium sp* in rhizospheric soil of chickpea

S. No.	Treatment	Population of *Rhizobium* sp.	
		Before sowing	At harvesting
1	NPK0+VC+Rh+PSB	5.75 ($4.03x10^5$)	5.39 ($2.45x10^5$)
2	NPK0+VC+Rh+KSB	4.61 ($4.07x10^4$)	4.49 ($3.09x10^4$)
3	NPK0+VC+Rh+PSB+KSB	4.28 ($1.91x10^4$)	4.07 ($1.17x10^4$)
4	NPK0+VC+Rh+PSB+KSB+Trich	4.45 ($2.28x10^6$)	6.24 ($1.74x10^6$)
5	NPK0+VC+Rh+PSB+KSB+Trich+Pseud	6.29 ($1.95x10^6$)	6.06 ($1.15x10^5$)
6	NPK0+Control	4.67 ($1.68x10^4$)	4.47 ($1.35x10^4$)
7	NPK50+VC+Rh+PSB	6.34 ($3.47x10^6$)	5.34 ($2.19x10^6$)
8	NPK50+VC+Rh+KSB	3.55 ($3.55x10^3$)	3.27 ($1.86x10^3$)
9	NPK50+VC+Rh+PSB+KSB	3.37 ($2.34x10^3$)	3.16 ($1.45x10^3$)
10	NPK50+VC+Rh+PSB+KSB+Trich	5.06 ($1.15x10^5$)	5.59 ($2.82x10^6$)
11	NPK50+VC+Rh+PSB+KSB+Trich+Pseud	5.64 ($4.37x10^5$)	4.51 ($3.24x10^4$)
12	NPK50+Control	4.57 ($3.72x10^4$)	4.13 ($2.95x10^4$)
13	NPK100+VC+Rh+PSB	4.19 ($4.55x10^4$)	6.31 ($2.04x10^6$)
14	NPK100+VC+Rh+KSB	6.39 ($4.45x10^6$)	3.34 ($1.51x10^6$)
15	NPK100+VC+Rh+PSB+KSB	6.41 ($5.62x10^6$)	4.59 ($2.19x10^3$)
16	NPK100+VC+Rh+PSB+KSB+Trich	6.42 ($5.77x10^6$)	6.15 ($3.89x10^5$)
17	NPK100+VC+Rh+PSB+KSB+Trich+Pseud	**6.49 ($5.89x10^6$)**	**6.48 ($3.91x10^5$)**
18	NPK100+Control	3.42 ($2.63x10^3$)	3.21 ($1.62x10^3$)
Mean		4.98 ($9.55x10^4$)	4.92 ($8.38x10^4$)
SEm±		**0.03**	**0.51**
CD_5%		**0.11**	**1.47**

(Upper values in log cfu and lower values in cfu/g soil)

Table 2 : Effect of Integrated Nutrient Management on population of *Trichoderma*in rhizospheric soil of chickpea

S. No.	Treatment	Population of *Trichoderma*	
		Before sowing	**At harvesting**
1	NPK0+VC+Rh+PSB	2.62 ($4.17x10^4$)	4.46 ($2.88x10^4$)
2	NPK0+VC+Rh+KSB	1.69 ($4.90x10^4$)	4.56 ($3.63x10^4$)
3	NPK0+VC+Rh+PSB+KSB	2.27 ($1.86x10^5$)	4.14 ($3.72x10^5$)
4	NPK0+VC+Rh+PSB+KSB+Trich	2.04 ($1.10x10^5$)	4.86 ($1.55x10^4$)
5	NPK0+VC+Rh+PSB+KSB+Trich+Pseud	1.56 ($3.63x10^5$)	3.38 ($2.40x10^5$)
6	NPK0+Control	1.47 ($1.02x10^5$)	4.07 ($1.38x10^5$)
7	NPK50+VC+Rh+PSB	2.24 ($1.74x10^4$)	3.64 ($4.37x10^5$)
8	NPK50+VC+Rh+KSB	2.38 ($2.40x10^4$)	4.28 ($1.91x10^4$)
9	NPK50+VC+Rh+PSB+KSB	2.57 ($3.72x10^4$)	4.51 ($3.24x10^4$)
10	NPK50+VC+Rh+PSB+KSB+Trich	3.62 ($4.17x10^4$)	4.58 ($3.80x10^4$)
11	NPK50+VC+Rh+PSB+KSB+Trich+Pseud	2.23 ($1.70x10^5$)	5.21 ($1.62x10^5$)
12	NPK50+Control	3.01 ($5.89x10^5$)	4.94 ($8.71x10^4$)
13	NPK100+VC+Rh+PSB	3.51 ($3.24x10^5$)	5.47($2.95x10^5$)
14	NPK100+VC+Rh+KSB	4.37 ($2.34x10^4$)	5.62 ($4.17x10^5$)
15	NPK100+VC+Rh+PSB+KSB	4.81 ($6.46x10^5$)	5.72 ($5.25x10^5$)
16	NPK100+VC+Rh+PSB+KSB+Trich	5.69 ($4.90x10^5$)	5.83 ($7.24x10^4$)
17	NPK100+VC+Rh+PSB+KSB+Trich+Pseud	5.88 ($7.59x10^5$)	6.19 ($8.91x10^4$)
18	NPK100+Control	5.01 ($1.02x10^5$)	4.95 ($2.14x10^4$)
Mean		3.24 ($2.95x10^5$)	4.51 ($3.24x10^4$)
SEm±		**0.03**	**0.33**
CD_5%		**0.10**	**0.96**

(Upper values in log cfu and lower values in cfu/g soil)

Table 3 : Effect of Integrated Nutrient Management on population of *Pseudomonas sp* in rhizospheric soil of chickpea

S. No.	Treatment	Population of *Pseudomonas* sp	
		Before sowing	**At harvesting**
1	NPK0+VC+Rh+PSB	4.42 ($2.61x10^4$)	4.13 ($1.34x10^4$)
2	NPK0+VC+Rh+KSB	4.37 ($2.34x10^6$)	5.02 ($1.04x10^6$)
3	NPK0+VC+Rh+PSB+KSB	4.10 ($1.26x10^4$)	3.45 ($2.8x10^3$)
4	NPK0+VC+Rh+PSB+KSB+Trich	3.78 ($4.03x10^6$)	6.16 ($1.45x10^6$)
5	NPK0+VC+Rh+PSB+KSB+Trich+Pseud	3.40 ($2.53x10^5$)	5.26 ($1.83x10^5$)
6	NPK0+Control	3.12 ($2.25x10^4$)	3.29 ($1.95x10^4$)
7	NPK50+VC+Rh+PSB	3.84 ($4.87x10^6$)	4.66 ($4.57x10^6$)
8	NPK50+VC+Rh+KSB	4.42 ($2.61x10^4$)	5.79 ($6.17x10^3$)
9	NPK50+VC+Rh+PSB+KSB	4.32 ($2.09x10^4$)	5.38 ($2.42x10^2$)
10	NPK50+VC+Rh+PSB+KSB+Trich	3.13 ($1.35x10^6$)	4.76 ($5.75x10^4$)
11	NPK50+VC+Rh+PSB+KSB+Trich+Pseud	3.85 ($7.03x10^3$)	4.13 ($1.34x10^4$)
12	NPK50+Control	4.27 ($1.88x10^6$)	5.02 ($1.04x10^6$)
13	NPK100+VC+Rh+PSB	5.37 ($2.34x10^5$)	4.20 ($1.57x10^4$)
14	NPK100+VC+Rh+KSB	4.61 ($4.11x10^6$)	6.05 ($1.13x10^6$)
15	NPK100+VC+Rh+PSB+KSB	5.67 ($5.62x10^6$)	6.80 ($6.31x10^5$)
16	NPK100+VC+Rh+PSB+KSB+Trich	5.73 ($6.35x10^3$)	7.21 ($6.63x10^5$)
17	NPK100+VC+Rh+PSB+KSB+Trich+Pseud	5.83 ($6.81x10^4$)	7.27 ($6.85x10^5$)
18	NPK100+Control	5.03 ($1.07x10^5$)	5.34 ($2.20x10^4$)
Mean		4.22 ($4.66x10^5$)	5.68 ($4.82x10^5$)
SEm±		0.44	0.79
CD_5%		1.28	2.29

(Upper values in log cfu and lower values in cfu/g soil)

Table 4 : Effect of Integrated Nutrient Management on Dehydrogenase activity in soil of chickpea at harvest

S. No.	Treatment	Dehydrogenase activity (TPF µg 24 hr^{-1} g^{-1})
1	NPK0+VC+Rh+PSB	7.14
2	NPK0+VC+Rh+KSB	7.72
3	NPK0+VC+Rh+PSB+KSB	7.23
4	NPK0+VC+Rh+PSB+KSB+Trich	7.25
5	NPK0+VC+Rh+PSB+KSB+Trich+Pseud	7.41
6	NPK0+Control	**7.76**
7	NPK50+VC+Rh+PSB	6.63
8	NPK50+VC+Rh+KSB	6.65
9	NPK50+VC+Rh+PSB+KSB	7.01
10	NPK50+VC+Rh+PSB+KSB+Trich	7.03
11	NPK50+VC+Rh+PSB+KSB+Trich+Pseud	7.38
12	NPK50+Control	**5.59**
13	NPK100+VC+Rh+PSB	5.30
14	NPK100+VC+Rh+KSB	5.07
15	NPK100+VC+Rh+PSB+KSB	5.35
16	NPK100+VC+Rh+PSB+KSB+Trich	5.17
17	NPK100+VC+Rh+PSB+KSB+Trich+Pseud	5.05
18	NPK100+Control	**5.27**
Mean		**6.29**
SEm ±		**0.46**
CD_5%		**1.33**

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