



P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemijournal.com

IJCS 2021; 9(2): 270-273

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Received: 04-01-2020

Accepted: 27-02-2020

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International Journal of Chemical Studies

Effect of phosphorus enriched organic manures on p-uptake and p-availability to onion crop in Vertisol

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DOI: <https://doi.org/10.22271/chemi.2021.v9.i2d.11822>

Abstract

The experiment was conducted in Kalaburagi district, which belongs to North Eastern Dry Zone (Zone-2) of Karnataka state. The experiment was laid out in split-plot design with three main plot treatments viz., control (0 Kg P₂O₅ ha⁻¹), 50 per cent of recommended dose of P (30 Kg P₂O₅ ha⁻¹) and 100 per cent of recommended dose of P (75 Kg P₂O₅ ha⁻¹) and seven sub-plot treatments viz., no organic manure, farmyard manure @ 12 t per ha⁻¹, vermicompost @ 6 t per ha⁻¹, poultry manure @ 6 t per ha⁻¹, P enriched farmyard manure @ 6 t per ha⁻¹, P enriched vermicompost @ 3 t per ha⁻¹ and P-enriched poultry manure @ 3 t per ha⁻¹. Application of P-enriched organic manures at different levels of P-fertilizers had significantly increased the P-uptake of onion crop. Among different P-enriched organic manures, poultry manure gave highest uptake and available status of phosphorus.

Keywords: P-enriched organic manures, poultry manure, P-availability uptake

Introduction

In vertisol, the phosphorus availability to crops is seldom exceeds 15-20 per cent due to its high fixation in the soil. Hence to reduce the phosphorus fixation in soil, to enhance the efficiency of the applied phosphatic fertilizer and to keep the phosphorus more timely available to crops the organic matter plays a significant greater role. It has been proved that addition of P-enriched farmyard manure reduced the fixation and enhanced the availability of both native and applied phosphorus to crops. Therefore, there is a need to develop viable technology to increase the efficiency of inorganic P-fertilizer through P-enriched organic manures. Kaswan *et al.* (2017) [9] reported that application of FYM at the rate of 40 t ha⁻¹ significantly increased phosphorus uptake under organic treatments as compared to control. It was due to the use of various sources of organic manures applied to onion might have improved the phosphorus availability in soil and thus benefited the crop.

Materials and Methods

The total content of nutrients (N, P₂O₅ and K₂O) in all the selected farmyard manure (FYM), vermicompost (VC), poultry manure (PM) were determined and the calculated quantity of each organic manure was taken separately and mixed well with single superphosphate. Single superphosphate mixed organic manure was filled separately in polyethylene bag and required quantity of water was added to each bag to maintain moist condition (50% of maximum water retention capacity of the manure). These bags were kept for a period of one month by adding water as per the requirement to maintain uniform moisture level in the entire incubated time. After the incubation period of 30 days all these manures were dried and applied to soil. Onion was grown as a test crop. Pre-calculated quantities of N and K₂O and S were given to all the plots at during transplanting of onion. Organic manures and P-enriched organic manures were applied in a band placement before transplanting of onion seedlings. Three levels of P₂O₅ that is 0, 50 and 100 per cent were given to main plots in the form of single superphosphate to onion crop. The required quantity of fertilizers were supplied in the form of urea, single superphosphate and muriate of potash. Half the recommended dose of nitrogen, full doses of different levels phosphatic and potassic fertilizer, were given to onion crop as a basal dose. The remaining half of the nitrogen was top dressed at 45 days after transplanting.

The soil was deep black (100-150 cm) with clay texture having moderately alkaline in reaction (pH) (8.1), low in salt content (EC) (0.19 dS m⁻¹), low organic carbon content (0.39%), available N content was low (227 kg ha⁻¹), available P₂O₅ content was medium (32 kg ha⁻¹), available K₂O content was high (418 kg ha⁻¹). With respect to micronutrients, DTPA extractable zinc content (0.67 ppm), iron content (7.13 ppm), Copper content (1.73 ppm) and Manganese content (15.74 ppm) were above the critical limit and nutrient composition of organic manures are presented in table 1.

Table 1: Nutrient composition of organic manures (on oven dry basis)

| Properties | FYM | VC | PM |
|-----------------------------------------------|------|------|------|
| pH (1:2.5) | 6.70 | 7.20 | 7.13 |
| E.C (dS m ⁻¹) at 25 °C | 0.10 | 1.20 | 0.13 |
| Total nutrient composition | | | |
| Nitrogen (N) % | 0.90 | 0.70 | 3.10 |
| Phosphorus (P ₂ O ₅) % | 0.60 | 0.50 | 1.20 |
| Potash (K ₂ O) % | 0.80 | 0.75 | 1.40 |

P- uptake

Phosphorous content in onion crop was determined by Vanadomolybdate phosphoric acid yellow colour method and absorbance of the solution was recorded at 430 nm using spectrophotometer (Jackson, 1973) [7] and expressed on percentage, and finally uptake of nutrient was calculated and expressed in kg ha⁻¹.

Results and Discussion

Uptake of phosphorus (kg ha⁻¹) in leaf samples of onion crop at harvest: The data (Table 2) on the uptake of phosphorus in leaf samples of onion crop at harvest as influenced by residual organic manures, P-enriched organic manures at different levels of P-fertilizer and their interactions were found to be significant. Phosphorus enriched organic manures differed significantly on the uptake of phosphorus as compared to organic manures. Among the P-enriched organic manure treatments, P-enriched PM recorded maximum uptake of phosphorus (10.07 kg ha⁻¹) followed by FYM (9.16 kg ha⁻¹)

and VC (8.60 kg ha⁻¹). In organic manures, PM, FYM and VC recorded 9.03, 8.08 and 7.33 kg ha⁻¹ uptake of phosphorus, respectively and no organic manure treatment (6.75 kg ha⁻¹). Incorporation of P-enriched organic manures and organic manures influenced the uptake of phosphorus by onion crop. The uptake of phosphorus in P-enriched organic manures added plots was more compared to organic manures which may be ascribed to the increase in the availability of phosphorus in the soil due to addition of P-enriched organic manures than compared to organic manures. This may be due to the difference in the chemical composition of organic manures which led to more availability of nutrients. These observations are in accordance with the reports of Basavaraj and Manjunathaiah (2003) [3].

In different levels of P-fertilizer treatments uptake of phosphorus was found to be significantly increased over no P-fertilizer treatment. The amount of uptake of phosphorus was highest (9.88 kg ha⁻¹) at 100 per cent RDF-P followed by 50 per cent RDF-P (8.76 kg ha⁻¹) and no P-fertilizer treatment (6.65 kg ha⁻¹). The interaction between P-enriched organic manures at different levels of P-fertilizer showed significant effect on the uptake of phosphorus. Significantly highest uptake of phosphorus (11.02 kg ha⁻¹) was observed in the combination of 50 per cent recommended dose of P-fertilizer (30 kg P₂O₅) and P-enriched poultry manure @ 3 t ha⁻¹ (M₂S₆). Application of levels of P-fertilizer significantly increased the uptake of phosphorus by onion crop. This may be due to the increase in the availability of phosphorus with the levels of P-fertilizer in the soil which leads to more uptake of phosphorus by onion crop. Similar observations were reported by Kumar (2015) [10] and Arunkumari *et al.* (2018) [2].

The combined addition of P-enriched organic manures and organic manures at different levels of P-fertilizer had a significant effect on the uptake of phosphorus by onion crop. Application of P-enriched PM along with the addition of 100 per cent RDF-P was found to be superior in the uptake phosphorus. Similar observations were reported by Mathukia *et al.* (2014) [11] revealed that application of FYM and VC to groundnut, while that of RDF and FYM to garlic significantly increased uptake of N, P, K and S.

Table 2: Effect of organic manures and P-enriched organic manures at different levels of P- fertilizer on uptake of phosphorus (kg ha⁻¹) in leaf and bulb samples of onion crop at harvest

| | Uptake of phosphorus in leaf (kg ha ⁻¹) | | | | Uptake of phosphorus in bulb (kg ha ⁻¹) | | | |
|----------------|-----------------------------------------------------|----------------|----------------|-------|-----------------------------------------------------|----------------|----------------|-------|
| | M ₀ | M ₁ | M ₂ | Mean | M ₀ | M ₁ | M ₂ | Mean |
| S ₀ | 4.83 | 6.20 | 9.22 | 6.75 | 8.30 | 8.55 | 12.19 | 9.68 |
| S ₁ | 6.39 | 8.20 | 9.67 | 8.08 | 9.95 | 11.18 | 12.75 | 11.29 |
| S ₂ | 5.29 | 7.37 | 9.33 | 7.33 | 6.89 | 10.85 | 12.87 | 10.20 |
| S ₃ | 7.38 | 9.32 | 10.38 | 9.03 | 9.53 | 10.98 | 12.84 | 11.12 |
| S ₄ | 7.57 | 10.08 | 9.84 | 9.16 | 9.33 | 13.52 | 12.81 | 11.88 |
| S ₅ | 6.34 | 9.74 | 9.72 | 8.60 | 8.29 | 12.90 | 12.79 | 11.33 |
| S ₆ | 8.73 | 10.45 | 11.02 | 10.07 | 10.76 | 13.57 | 13.85 | 12.73 |
| Mean | 6.65 | 8.76 | 9.88 | 8.43 | 9.01 | 11.65 | 12.87 | 11.18 |
| | S.E.m± | | C D (P=0.05) | | S.E.m± | | C D (P=0.05) | |
| Main plot | 0.05 | | 0.21 | | 0.15 | | 0.57 | |
| Sub plot | 0.09 | | 0.25 | | 0.30 | | 0.86 | |
| Interaction | 0.15 | | 0.31 | | 0.52 | | 1.06 | |

Main plot: P-fertilizer application (M)

M₀: No P- fertilizer (RDF-NK)

M₁: 50% recommended dose of P-fertilizer (30 Kg P₂O₅ ha⁻¹)

M₂: 100% recommended dose of P-fertilizer (75 Kg P₂O₅ ha⁻¹)

Sub plot: Organic manures application (S)

S₀: Control (No organic manure)

S₁: Farmyard manure @ 12 t ha⁻¹

S₂: Vermicompost @ 6 t ha⁻¹

S₃: Poultry manure @ 6 t ha⁻¹

S₄: P- Enriched Farmyard manure @ 6 t ha⁻¹

S₅: P- Enriched Vermicompost @ 3 t ha⁻¹

S₆: P- Enriched Poultry manure @ 3 t ha⁻¹

RDF: 125:75:125:50; N: P₂O₅: K₂O: S; Kg ha⁻¹

Uptake of phosphorus (kg ha⁻¹) in bulb samples of onion at harvest

The data (Table 2) indicated that the uptake of phosphorus by onion as influenced by organic manures, P-enriched organic manures at different levels of P-fertilizer and their interactions were found to be significant. Among organic manures, FYM observed maximum uptake of phosphorus 11.29 kg ha⁻¹ followed by PM 11.12 kg ha⁻¹ and lowest in VC 10.20 kg ha⁻¹ and no organic manure treatment (9.68 kg ha⁻¹). Among the P-enriched organic manure treatments, P-enriched PM recorded maximum uptake of phosphorus 12.73 kg ha⁻¹ followed by FYM 11.88 kg ha⁻¹ and VC 11.33 kg ha⁻¹. Similar findings were reported by Basavaraj and Manjunathaiah (2003) [3] in maize reported that phosphorus uptake was observed due to

the application of P-enriched organic manures as compared with organic manures alone. Among P-enriched organic manures PM gave highest uptake of P (12.73 kg ha⁻¹).

The application of different levels of P-fertilizer had significantly increased the uptake of phosphorus over no P-fertilizer treatment. The amount of uptake of phosphorus was highest (12.87 kg ha⁻¹) in 100 per cent RDF-P followed by 50 per cent RDF-P (11.65 kg ha⁻¹) and no P-fertilizer treatment (9.01 kg ha⁻¹). The interaction of P-enriched organic manures, organic manures at different levels of P-fertilizer had significant effect on the uptake of phosphorus. The highest amount of uptake of phosphorus (13.85 kg ha⁻¹) was recorded due to application of P-enriched PM in combination with 100 per cent RDF-P.

Table 3: Effect of organic manures and P-enriched organic manures at different levels of P-fertilizer on available nitrogen and phosphorus status (kg ha⁻¹) in soil after harvest of crop

| | Available phosphorus (kg ha ⁻¹) | | | |
|----------------|---------------------------------------------|----------------|----------------|-------|
| | M ₀ | M ₁ | M ₂ | Mean |
| S ₀ | 26.90 | 36.07 | 39.95 | 34.31 |
| S ₁ | 28.89 | 39.85 | 47.92 | 38.89 |
| S ₂ | 27.40 | 37.16 | 45.83 | 36.80 |
| S ₃ | 29.59 | 40.85 | 49.22 | 39.89 |
| S ₄ | 29.29 | 40.45 | 48.82 | 39.52 |
| S ₅ | 27.90 | 38.86 | 45.83 | 37.53 |
| S ₆ | 29.89 | 41.35 | 50.42 | 40.55 |
| Mean | 28.55 | 39.23 | 46.86 | 38.21 |
| | S.E.m± | | C D (P=0.05) | |
| Main plot | 0.09 | | 0.35 | |
| Sub plot | 0.01 | | 0.04 | |
| Interaction | 0.02 | | 0.05 | |

Main plot: P-fertilizer application (M)

M₀: No P-fertilizer (RDF-NK)

M₁: 50% recommended dose of P-fertilizer (30 Kg P₂O₅ ha⁻¹)

M₂: 100% recommended dose of P-fertilizer (75 Kg P₂O₅ ha⁻¹)

Sub plot: Organic manures application (S)

S₀: Control (No organic manure)

S₁: Farmyard manure @ 12 t ha⁻¹

S₂: Vermicompost @ 6 t ha⁻¹

S₃: Poultry manure @ 6 t ha⁻¹

S₄: P-Enriched Farmyard manure @ 6 t ha⁻¹

S₅: P-Enriched Vermicompost @ 3 t ha⁻¹

S₆: P-Enriched Poultry manure @ 3 t ha⁻¹

RDF: 125:75:125:50; N: P₂O₅: K₂O: S; Kg ha⁻¹

Available P₂O₅ content (kg ha⁻¹) of soil after the harvest of onion crop

The application of organic manures enriched with P obviously brought an improvement in available P content of soil as compared to organic manures. Among the P-enriched organic manure treatments, PM recorded maximum available P 40.55 kg P₂O₅ ha⁻¹, followed by FYM 39.52 kg P₂O₅ ha⁻¹ and VC 37.53 kg P₂O₅ ha⁻¹. In organic manures, PM, FYM and VC recorded 39.89, 38.89, and 36.80 manures available kg P₂O₅ ha⁻¹, respectively over no organic manure treatment (34.31 kg P₂O₅ ha⁻¹). The available phosphorus in P-enriched organic manures applied plots was more compared to organic manures which may be due to the formation of metallo-organic complexes with organic ligands which decreased their susceptibility to absorption, fixation or precipitation reactions in soil. Thus, forming soluble complexes with native as well as applied P. The difference in the available status within the organic manures treatments may be due to the difference in the content of P in the manures. Similar views were expressed by Junior *et al.* (2016) [8], Archana (2016) [1].

Application of levels of P-fertilizer increased the available P significantly over no P-fertilizer treatment. The amount of available P was highest (46.86 kg P₂O₅ ha⁻¹) 100 per cent RDF-P followed by 50 per cent RDF-P (39.23 kg P₂O₅ ha⁻¹) over no P-fertilizer treatment (28.55 kg P₂O₅ ha⁻¹). Application of levels of P-fertilizer significantly increased the

amount available P₂O₅ in soil. The increase in the availability of P₂O₅ over no P-fertilizer treatment at 50 and 100 per cent RDF-P was to the tune of 39.23 and 46.86 per cent, respectively. It is an established fact that application of increasing level of fertilizer would result in an increase in the available nutrient status of soil. Similar observations were made by Geleta *et al.* (2017) [6].

The combination between P-enriched organic manures, organic manures at different levels of P-fertilizer showed significant effect on available P. Significantly highest available P (50.42 kg P₂O₅ ha⁻¹) was observed in the combination of M₂S₆. Application of P enriched PM along with the addition of 100 per cent RDF-P was found to be superior to all other treatments in enhancing the available P contents of soil. Similar observations were reported by Farahad *et al.* (2009) [5], Chattoo *et al.* (2010) [4]. They reported that the available nutrient status of the soil increased significantly due to combined application of various organic manures and fertilizers.

References

1. Archana K, Prabhakar Reddy T, Anjaiah T, Padmaja B. Effect of dose and time of application of Phosphorous on yield and economics of rice grown on P accumulated soil. International Journal of Science and Environmental Technology 2016;5(5):3309-3319.

2. Arunakumari H, Luther MM, Chandrasekhar K, Babu PR, Rani YA. Effect of phosphorus management on growth and yield of rice. *International Journal Communication Science* 2018;6(5):2980-2985.
3. Basavaraj, Manjunathaiah HM. Effect of phosphorus enriched organic Manures on yield and uptake of phosphorus in maize in vertisol, *Karnataka Journal of Agricultural Sciences* 2003;16(2):300-303.
4. Chattoo MA, Najjar GR, Mir SA, Faheema S. Effect of organic manure and inorganic fertilizer on growth, yield, nutrient uptake and economics of onion. *Yellow Globe. Journal of Eco-friendly Agriculture* 2010;5(1):12-14.
5. Farahad W, Saleem MF, Cheema MA, Hammad HM. Effect of poultry manure levels on the productivity of spring maize (*Zea mays* L.). *Journal of Animal and Plant Science* 2009;19(3):122-125.
6. Geleta DS, Nigussie DR, Kebede W, Getachew T, Sharma JJ. Influence of Combined Application of Inorganic N and P Fertilizers and Chicken Manure on Quality and Shelf-Life of Garlic (*Allium sativum* L.) Bulbs, *Journal of post harvest technology* 2017;4(4):56-67.
7. Jackson ML. *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd., New Delhi 1973, 498.
8. Junior JN, Ribeiro RMP, Chaves AP, Sousa VDFL, Grangeiro LC, de Negreiros MZ *et al.* Effect of phosphorus fertilization on yield and quality of onion bulbs. *African Journal of Agricultural Research* 2016;11(45):4594-4599.
9. Kaswan PK, Yadav PK, Kumar HRK, Jakhar, Kumawat A, Kumar H. Effect of different varieties and FYM levels on yield and quality of onion (*Allium cepa* L.) in Arid Western Rajasthan, India. *International Journal of Current Microbiology and Applied Science* 2017;6(6):497-503.
10. Kumar M. Studies of integrated nutrient management on growth, yield and quality traits of onion (*Allium cepa* L.) (Doctoral dissertation, JNKVV) 2015.
11. Mathukia RK, Sheikh MA, Sagarka BK, Panara DM. Evaluation of natural foe summer ground nut, paper present in National found role of organic farming in climate resilient and sustainable agriculture held at Navsari Agriculture University, Navsari. Abstract book 2014, 190-191.