



## Effect of Levels of Organic Manure and Biofertilizer on Nutrient Uptake by Chinese potato and on Soil Nutrient Status

Chinese potato (*Plectranthus rotundifolius*) is a tropical tuber crop grown for its edible tubers which are used as vegetable. Like other tuber crops, Chinese potato also responds well to application of organic manure. Though, organically grown Chinese potato has high export potential, there is no prescribed fertiliser recommendation for organic production. Hence the study was conducted to understand the response of Chinese potato to different levels of organic manure with and without biofertilizer with a view to formulate recommendation for organic nutrition.

In this study, the effect of three levels of organic manure (100%, 75% and 50% of recommended dose (RD) of NPK @ 60:60:100 kg ha<sup>-1</sup> by Kerala Agricultural University (KAU), Thrissur, India (KAU, 2007) with and without biofertilizer, Plant Growth Promoting *Rhizobacteria* (PGPR) mix I on nutrient uptake by two improved varieties of Chinese potato (Sree Dhara and Suphala) and on soil nutrient status of soil was studied. The PGPR mix I biofertilizer, received from the Department of Microbiology, College of Agriculture (KAU), Vellayani, Thiruvananthapuram is a combination of N fixing and P and K solubilizing bacteria. It was applied @ 2% along with basal dose of organic manures. The experiment was laid out in 3 x 2 x 2 asymmetrical factorial RBD with three replications at College of Agriculture (KAU), Vellayani, Thiruvananthapuram during August to December 2011.

Chinese potato varieties Sree Dhara released from ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI), Thiruvananthapuram and Suphala, released from KAU, Thrissur were used for the experiment. Sree Dhara is a high yielding (25 t ha<sup>-1</sup>) variety of Chinese potato with duration of five months. Suphala is a high yielding (15.93 t ha<sup>-1</sup>), photo-insensitive variety which is adapted for year round cultivation with a duration of 120-140 days (KAU, 2007). Half dose of organic manure was applied as

farmyard manure (FYM) and the remaining as coirpith compost. The doses of FYM and coirpith compost were decided on N equivalent basis and additional requirement of K was supplied through wood ash. The organic manures were analysed for nutrient contents and it was observed that FYM contained 0.5% N, 0.32% P<sub>2</sub>O<sub>5</sub> and 0.2% K<sub>2</sub>O, coirpith compost contained 1% N, 0.12% P<sub>2</sub>O<sub>5</sub> and 1% K<sub>2</sub>O and wood ash contained 0.52% N, 1.04% P<sub>2</sub>O<sub>5</sub> and 2.2% K<sub>2</sub>O. The quantities of organic manures applied in the present study are displayed in Table 1. Neem cake at 1 t ha<sup>-1</sup> and FYM at 10 t ha<sup>-1</sup> were applied uniformly to all the plots. Neem cake was applied as a prophylactic measure against nematode.

Soil samples were collected from the experimental field before and after the study period. The composite soil samples were analysed for mechanical composition and physico-chemical properties. The soil of the experimental site was sandy clay loam belonging to the order Oxisol of Vellayani series. The soil was acidic with a pH of 5.8. It was high in organic carbon (1.46%), low in available nitrogen (188.16 kg ha<sup>-1</sup> N), high in available phosphorus (48.16 kg ha<sup>-1</sup> P), and medium in available potassium (125.89 kg ha<sup>-1</sup> K). After the experiment, composite samples were collected from each plot, and analysed for organic carbon (Walkley and Black, 1934), available N (Subbiah and Asija, 1956) and available P

Table 1. Quantities of organic manures applied as per treatments

Treatments	Quantities of organic manures applied per ha
100% RD* as OM**	6 t FYM+ 3 t coirpith compost + 3 t wood ash
75% RD as OM	4.5 t FYM+ 2.25 t coirpith compost + 2.25 t wood ash
50% RD as OM	3 t FYM+ 1.5 t coirpith compost + 1.5 t wood ash

\*Recommended dose of KAU

\*\* Organic Manure

and K (Jackson, 1973).

Nitrogen content in plant samples was estimated by the modified micro kjeldhal method (Jackson, 1973). Phosphorus content in the plant sample was determined by digestion using tri acid mixtures followed by colour development using ascorbic acid and read in a Spectrophotometer (Bray and Kurtz, 1964). Potassium content in the plant sample was determined by flame photometer method (Piper, 1966). Uptake of nitrogen, phosphorus and potassium were calculated by multiplying the respective nutrient contents with total dry weight of plants and expressed in  $\text{kg ha}^{-1}$ . ANOVA was performed to identify the treatmental effects on the tuber yield and nutrient (NPK) uptake.

Although the N uptake was increasing with levels of organic manure, the effect was not significant (Table 2). Both P and K uptake significantly increased with increasing levels of organic manure. The tuber yield also showed significant increase ( $>20 \text{ t ha}^{-1}$ ) at higher levels of organic manure application (Table 2). In sweet potato, Dhanya (2011) reported the highest uptake of nutrients by the application of 100% RD of NPK through organic manures. The increased uptake of nutrients at incremental levels of organic manure might have resulted in higher tuber yield.

PGPR mix 1 improved the uptake of N, P and K which might be due to increased availability of nutrients from the biofertilizer. The tuber yield also showed significant increase due to PGPR mix I application. Hence application of biofertilizer is a valuable component in organic nutrition of Chinese potato. Among varieties, the ICAR-CTCRI variety Sree Dhara registered significantly higher uptake of nutrients than the variety Suphala.

The nutrient status of the soil after the experiment in terms of organic carbon and available P and K contents showed an increasing trend with incremental levels of organic manure (Table 3). Although the effect of levels of organic manure on available N content of the soil was not significant, available N content increased with the increase in the level of organic manure. Srivastava (1985) and More (1994) also reported that addition of organic manures increased the status of organic carbon and available N, P and K status of the soil. Higher levels of organic manure not only recorded higher tuber yield and higher dry matter production but also improved the nutrient status of the soil after a crop of Chinese potato. The result is indicative of the fact that organic nutrition not only improves the yield but also improves the fertility status of the soil. Archana (2001) also reported that there was no depletion of soil nutrients when organic manure was applied to Chinese potato at recommended dose irrespective of the source of organic manure.

Application of biofertilizer PGPR mix 1 significantly improved the available P and K contents (Table 3) indicating the increased availability of P and K even after the increased uptake by the

Table 2. Effect of levels of organic manure, biofertilizer and varieties on nutrient uptake ( $\text{kg ha}^{-1}$ )

Treatment	Tuber yield( $\text{t ha}^{-1}$ )	N uptake( $\text{kg ha}^{-1}$ )	P uptake( $\text{kg ha}^{-1}$ )	K uptake( $\text{kg ha}^{-1}$ )
Levels of organic manure				
100% RD* as organic manure	23.49	68.10	26.45	145.57
75% RD as organic manure	22.42	62.65	22.82	126.21
50% RD as organic manure	19.88	57.34	18.67	106.03
SE	0.33	3.82	0.53	3.57
CD (0.05)	0.979	NS	1.565	10.48
Biofertilizer				
With PGPR mix 1	23.07	70.71	24.42	137.09
Without PGPR mix 1	20.78	54.69	20.87	114.79
SE	0.27	3.12	0.44	2.92
CD (0.05)	0.799	12.93	1.28	8.55
Varieties				
Sree Dhara	22.86	67.81	24.53	131.90
Suphala	20.99	57.58	20.77	119.97
SE	0.27	3.12	0.44	2.92
CD (0.05)	0.799	12.93	1.28	8.55

NS – Not significant

\*Recommended dose of KAU

Table 3. Effect of levels of organic manure, biofertilizer and varieties on post-harvest soil nutrient status in the two varieties studied

Treatment	Organic carbon %	Available N (kg ha <sup>-1</sup> )	Available P(kg ha <sup>-1</sup> )	Available K(kg ha <sup>-1</sup> )
Levels of organic manure				
100% RD* as organic manure	1.57	207.36	61.10	130.31
75% RD as organic manure	1.44	190.93	59.37	116.89
50% RD as organic manure	1.42	203.84	53.61	97.61
SE	0.04	11.11	2.09	2.47
CD (0.05)	0.104	NS	6.14	7.23
Biofertilizer				
With PGPR mix 1	1.49	210.02	61.10	118.21
Without PGPR mix 1	1.46	191.40	54.95	111.66
SE	0.03	9.07	1.71	2.01
CD (0.05)	NS	NS	5.013	5.903
Varieties				
Sree Dhara	1.49	203.05	58.75	115.83
Suphala	1.46	198.37	57.30	114.04
SE	0.03	9.07	1.71	2.01
CD (0.05)	NS	NS	NS	NS

NS – Not significant

\*Recommended dose of KAU

crop (Table 2). No significant difference in post harvest nutrient status of the soil was observed due to organic nutrition of two varieties of Chinese potato. As both the varieties are equally effective in maintaining the soil nutrient status of the soil, any variety can be chosen for getting higher yields or for early maturity without depletion of soil fertility.

The results indicated that application of 100% recommended dose of NPK through organic manures (Six tonnes farmyard manure + Three tonnes coirpith compost + Three tonne wood ash ha<sup>-1</sup>) along with PGPR mix 1 resulted in the highest uptake of nutrients and tuber yield without affecting soil available nutrient status. The variety Sree Dhara registered higher uptake of nutrients and tuber yield than the variety Suphala. However, there was no significant difference in nutrient status of the soil after the experiment due to the varieties. These results proved the effectiveness of organic manuring on NPK uptake and tuber yield

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<sup>1</sup>College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram, Kerala, India

<sup>2</sup>Agricultural officer, Krishi Bhavan, Panoor, Kerala, India

Corresponding author: Atul Jayapal, E-mail: atuljayapal87@gmail.com

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Atul Jayapal<sup>1</sup>

O.K. Swadija<sup>1</sup>

V.S. Anju<sup>2</sup>