

# Effect of Ginger-Paddy Cropping Sequence on Availability of Macro and Micro Nutrient Status of Acid Soil in Hill Zone

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**Abstract** – Two field experiments were carried out at Zonal Agriculture Research Station, Mudigere, Karnataka with the aim to study the effect of ginger-paddy cropping sequence on availability of macro and micro nutrient status of acid soil. In a RCBD design nine treatments comprised of one level of N, two levels of phosphorus and four levels of potassium were tried on ginger followed by paddy in the same plots. The results revealed that, the residual plots with increase in levels of P and K, there was an increase in the availability of total and available macro and micronutrients of acid soil. However, significant depletion of available N, S, exchangeable Mg and total nutrients like N, K, Ca, Mg, S, Fe, Mn, Zn and Cu content of acid soil was recorded due to ginger-paddy cropping sequence. On the contrary, the available P and total-P content found to be accumulated more, and relatively higher exchangeable Ca, available Fe, Mn and Zn content was recorded in acid soil even after harvest paddy. Available forms nutrients depleted more than the total forms of nutrients in soil.

**Keywords** – Residual Nutrients, Ginger-Paddy, Acid Soil, Macro and Micronutrients.

## I. INTRODUCTION

Nutrient availability in cultivated soils depends on type of soil, type and nature of nutrient feeding habit of the previous crop, nutrient management practices adopted and other physical, chemical and environmental factors. Any crop cannot utilize applied nutrients fully in one crop season even with best management practices due to various soil and climatic factors. The unutilized nutrients is deposited or fixed in the soil that we termed as “residual nutrients”. The residual nutrients acts as reservoir of nutrients in soil that can be exploited for subsequent crop production with least nutrient management practices. The nutrient uptake pattern varies with type of crop, age and duration of the crops. Ginger being rhizomatous and heavy feeder of nutrients may exploit the soil available nutrients in one season and thus causes drastic decline in the nutrient status of soils and intern may affect the growth and yield of subsequent crops. The nutrient dynamics related to assessment and quantification of available and total nutrients under residual treatments in acid soil with a sequence of ginger-paddy cropping system is not studied systematically and documented much. There is an urgent need to understand chemistry of soil, fate and availability of nutrients after continuous growing of two crops in the same field. Hence, an investigation was planned to study

how the residual nutrients of previous crop (ginger) affect the performance of paddy and also its effects on changes in the availability of nutrients (available and total) in acid soil after harvest of ginger-paddy. Further, an understanding of nutrient dynamics in soil will help to take up an appropriate nutrient management practices for replenishing and maintaining soil fertility status in an intensive cropping system.

## II. MATERIALS AND METHODS

Two field experiments were conducted at Zonal Agriculture Research Station, Mudigere, Karnataka which comes under hill zone-9 of Karnataka during the kharif season of 2006-07 to study the effect of ginger-paddy cropping sequence on availability of macro and micro nutrient status of acid soil in hill zone. Ginger (variety: Rio-de-Janeiro) was grown first followed by paddy in order to study its residual effects on paddy growth and nutrient status of acid soil. The soil was acidic pH (5.94) with sandy clay loam texture. The soil is characterized by medium in available N, low in available P and medium in available K content. The experiment consisted of 9 treatments comprising one level of N ( $100 \text{ kg N ha}^{-1}$ ), two levels of P ( $50$  and  $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ ) and four levels of K ( $50, 75, 100$  and  $125 \text{ kg K}_2\text{O ha}^{-1}$ ) which were replicated three times in RCBD. The FYM @  $25 \text{ t ha}^{-1}$  was applied to soil commonly to all the treatments. Urea, Rock phosphate and Muriate of potash were used as a source of NPK respectively for both the crops. After harvest of ginger, paddy (*Oriza sativa* L.), variety IET-13901 (Thunga), were raised in the same experimental design during the kharif season to study the residual effect. The crop was raised as per the package of practice ( $75:75:90 \text{ kg NPK ha}^{-1}$ ). After harvest of paddy, composite soil samples were collected from each plot using screw auger and subjected for analysis of total and available nutrient status in the processed samples. Available N, P, K and total N, P, K (HF acid digested soil) by Jackson (3) and available and total micronutrients by Page et al.,(4) were used and estimated as per standard methods of analysis.

## III. RESULTS AND DISCUSSION

*Available and total primary nutrients status of acid soil*

The data (Table 1) clearly revealed that, as the levels of P and K increased the availability of total and available nutrients also increased except in control. Significant depletion in the available and total N and K content of soil was recorded after paddy cultivation compared to its initial status recorded after ginger. This was attributed to mineralization, transformations and subsequent crop uptake and other leaching losses during the crop growth period. On the contrary, there was a buildup of available P and total-P content of acid soil even after paddy was noticed. This might be attributed to more transformation and further hydrolysis of ferric and aluminium phosphate under submerged conditions. Ponnampereuma (5) studied the P transformations under submerged conditions and observed an increase in available-P and attributed this to hydrolysis of ferric and aluminium phosphate. The results are in conformity with the findings of Aiyer and Nair (1), Allison(2), Ramachandra(6), Ravi and Siddaramappa, (7), Yeledhalli et al., (7) and Veeranna et al.(9) who reported that residual P content increased with increase in the level of fertilizer applied. However, the lowest accumulation of available N (220 kg/ha), P (27.60 kg/ha) and K (122.54 kg/ha) in soil after harvest of paddy was recorded especially in the treatment T<sub>6</sub>-with N<sub>100</sub>P<sub>75</sub>K<sub>50</sub> kg/ha compared to control and initial status. This might be due to more availability of nutrients and their subsequent crop uptake.

#### *Available and total secondary nutrients status of acid soil*

With regard to secondary nutrients status in soil after ginger-paddy sequence, except exchangeable Ca, significant reduction in the exchangeable Mg, available S, total Ca, Mg and S content of soil was recorded after harvest of paddy compared to its initial status in soil after the harvest of ginger (Table 2). But, the exchangeable Ca content of soil found to be relatively higher due to liming of acid soil (Yeledhalli et al., 10). Further, it was noticed that at a given level of N and P, increase in the rate of K application significant increase in the availability of exchangeable Ca, Mg, available S and total Ca, Mg and S in acid soil compared to control. However, the treatments, T<sub>2</sub> (N<sub>100</sub>P<sub>50</sub>K<sub>50</sub>) and T<sub>6</sub> (N<sub>100</sub>P<sub>75</sub>K<sub>50</sub>) recorded significantly lower amount of exchangeable Ca, Mg and available S compared to all other treatments except control. This may be due to higher uptake of Ca and Mg and S by paddy and also leaching losses due to heavy rainfall. The accumulation of secondary nutrients in soil after harvest of two crops (Ginger-paddy) found to be lowest and recorded to the tune of 3.50 cmol/kg of exchangeable Ca, 0.71 cmol/kg of exchangeable Mg and 13.60 mg/kg of available S in the residual treatments except control.

#### *Available and total micronutrients status of acid soil*

Results of the Table 3 demonstrated that, except Cu, the available Fe, Mn and Zn content of acid soil significantly increased after harvest of paddy over its initial status recorded after ginger (Srikanth et al, 8). This might be due to better transformations and conversions in to available form under submerged conditions. Further, it was observed that the available micronutrient status varied inversely with their uptake by the crop. The treatment, T<sub>6</sub>

(N<sub>100</sub>P<sub>75</sub>K<sub>50</sub>) recorded significantly lower amounts of DTPA available Fe, Mn, Zn and Cu followed by T<sub>2</sub> (N<sub>100</sub>P<sub>50</sub>K<sub>50</sub>) in soil compared to all other treatments. It may be attributed to the higher crop removal and their transformation and redistribution into sparingly soluble or unavailable forms. The total Fe, Mn, Zn and Cu content in soil was found to be relatively low compared to their status in soil after the harvest of ginger-paddy probably because of crop removal and transformations from residual accumulation and their movement to sub soil layer. The micro nutrient status of acid soil after harvest of ginger-paddy was recorded to be 20.03, 9.59, 0.92 and 1.28 mg/kg of available Fe, Mn, Zn and Cu respectively except control.

## IV. CONCLUSION

It is evident from the experimental results that significant depletion of nutrients especially available N, S, exchangeable Mg and total N, K, Ca, Mg, S, Fe, Mn, Zn and Cu content of acid was noticed after ginger followed by paddy cultivation. But, the available-P and total-P content of acid soil found to be accumulated more and relatively higher exchangeable Ca and available micronutrients like Fe, Mn and Zn in acid soil was also recorded even after harvest of ginger and paddy. With these findings, continuous cropping ginger-paddy in the same land may decline the available macro and micro nutrients and fertility status of soil in general especially in the heavy rain fall area of hill zone.

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Table 1: Effect of residual nutrients on available and total primary nutrients status of acid soil after ginger- paddy cultivation.

Residual Treatments	Avail. N	Avail. P <sub>2</sub> O <sub>5</sub>	Avail. K <sub>2</sub> O	Total-N	Total-P	Total- K
	<-----( $\text{kg ha}^{-1}$ )----->			<-----( $\text{mg kg}^{-1}$ )----->		
<b>Initial Status (after ginger)</b>	<b>329.58</b>	<b>20.75</b>	<b>329.58</b>	<b>1890</b>	<b>762</b>	<b>2473</b>
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> )	233.00	17.89	118.67	1608	765	2439
T <sub>2</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>50</sub> )	225.00	29.40	124.20	1639	805	2415
T <sub>3</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>75</sub> )	234.00	35.70	128.23	1650	808	2431
T <sub>4</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>100</sub> )	256.00	44.50	129.57	1663	812	2445
T <sub>5</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>125</sub> )	292.00	47.90	131.10	1653	820	2454
T <sub>6</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>50</sub> )	220.00	27.60	122.54	1650	818	2410
T <sub>7</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>75</sub> )	225.00	31.30	132.07	1658	823	2426
T <sub>8</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>100</sub> )	251.00	40.80	135.57	1664	829	2438
T <sub>9</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>125</sub> )	282.00	46.60	137.82	1656	831	2450
S.Em $\pm$	1.46	0.02	0.25	1.51	0.57	0.38
CD at 5%	4.38	0.06	0.75	4.53	1.71	1.14

Table 2: Effect of residual nutrients on available and total secondary nutrient status of acid soil after ginger-paddy cultivation.

Residual Treatments	Exch. Ca	Exch. Mg	Avail. S	Total- Ca	Total-Mg	Total-S
	<--- $\text{cmol(p+)} \text{ kg}^{-1}$ --->		( $\text{mg kg}^{-1}$ )	<---( $\text{mg kg}^{-1}$ )--->		( $\text{mg kg}^{-1}$ )
<b>Initial Status (after ginger)</b>	<b>3.50</b>	<b>1.45</b>	<b>16.26</b>	<b>5640</b>	<b>1296</b>	<b>337</b>
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> )	3.07	0.37	12.00	5560	1248	319.68
T <sub>2</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>50</sub> )	3.50	0.83	13.66	5414	1201	306.08
T <sub>3</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>75</sub> )	3.77	0.86	14.92	5540	1218	311.05
T <sub>4</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>100</sub> )	4.27	0.94	16.62	5514	1246	310.18
T <sub>5</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>125</sub> )	4.76	0.93	18.65	5490	1229	307.55
T <sub>6</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>50</sub> )	4.12	0.71	14.73	5450	1188	301.34
T <sub>7</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>75</sub> )	4.65	0.73	15.65	5516	1222	308.21
T <sub>8</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>100</sub> )	4.83	0.94	16.52	5522	1234	309.04
T <sub>9</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>125</sub> )	4.89	0.96	18.64	5568	1224	309.29
S.Em $\pm$	0.051	0.006	0.10	0.36	0.204	0.009
CD at 5%	0.152	0.017	0.31	1.08	0.612	0.027

Table 3: Effect of residual nutrients on available and total micronutrient status of acid soil after ginger - paddy cultivation.

Residual Treatments	Available micronutrients (mg kg <sup>-1</sup> )				Total micronutrients (mg kg <sup>-1</sup> )			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
<b>Initial Status (after ginger)</b>	<b>19.50</b>	<b>10.10</b>	<b>1.06</b>	<b>1.78</b>	<b>41600</b>	<b>538</b>	<b>180.00</b>	<b>39.00</b>
T <sub>1</sub> (N <sub>0</sub> P <sub>0</sub> K <sub>0</sub> )	18.60	9.32	0.83	1.18	41400.00	540.30	176.40	36.20
T <sub>2</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>50</sub> )	20.17	11.02	0.92	1.35	41300.00	532.00	173.50	34.10
T <sub>3</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>75</sub> )	23.40	12.67	1.37	1.40	41505.00	533.30	174.80	35.60
T <sub>4</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>100</sub> )	23.57	13.20	1.42	1.55	41566.00	534.00	175.50	36.20
T <sub>5</sub> (N <sub>100</sub> P <sub>50</sub> K <sub>125</sub> )	22.02	9.92	1.27	1.50	41650.00	533.90	176.80	35.40
T <sub>6</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>50</sub> )	20.03	9.59	0.99	1.28	41225.00	530.10	171.20	32.80
T <sub>7</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>75</sub> )	23.48	11.51	1.25	1.38	41424.00	532.90	174.60	33.40
T <sub>8</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>100</sub> )	22.45	12.02	1.19	1.52	41685.00	533.60	175.40	35.10
T <sub>9</sub> (N <sub>100</sub> P <sub>75</sub> K <sub>125</sub> )	20.23	9.85	1.22	1.48	41775.00	535.50	176.20	36.80
S.Em ±	0.016	0.019	0.078	0.007	6.78	0.06	0.055	0.019
CD at 5%	0.048	0.057	0.232	0.021	20.34	0.18	0.165	0.058