Balanced Fertilisation for Cassava

By S. Kamaraj, R. Jagadeeswaran, V. Murugappan, and T. Nagendra Rao

While cassava is an important crop for the northwestern agro-climatic zone of Tamil Nadu, most farmers under-fertilise this crop. This study indicates that significant yield improvements are possible given an adequate and balanced application of macronutrients, secondary nutrients, and micronutrients.

Cassava has gained importance as a cheap source of carbohydrate in India, used mostly for human consumption. Apart from its role as a staple food, during the past few decades there has been growing recognition of the value of cassava tubers as a low cost energy source for livestock and as a raw material for industrial and fuel alcohol. More than 800 starch and sago industries operate in and around Salem and Namakkal districts of Tamil Nadu. The added value realised from industrial cassava makes this crop one of the most profitable choices for farmers.

While cassava grows in poor soils, the crop responds well to the application of fertilisers. The majority of cassava farmers do not follow balanced fertilisation practices and there is an opportunity to increase yields and crop economics through balanced fertiliser use. No systematic effort has been carried out to formulate a balanced fertiliser schedule for cassava in the north-western agro-climatic zone of Tamil Nadu. Generally N, P, and K are the most common nutrients taken into consideration in any fertilisation schedule, but information on response to other nutrients is missing altogether.

In order to generate a balanced fertiliser schedule for optimum yields of cassava, two field experiments were conducted in farm fields near the villages of Puthiragoundanpalayam and Paravakkadu in Tamil Nadu. The soils of these experimental sites were sandy clay loam (Thulukkanur Series) and sandy loam (Salem Series), respectively. Both soils are classified as Typic Ustropepts. Both experiments were simultaneously conducted in the same season and year in order to get confirmatory results.

Comparison of farmer practice (left) against an improved treatment on the right.

Table 1. Initial soil analysis of cassava experiments

Parameter	Puthiragoundanpalayam	Paravakkadu
Coarse sand, %	43	51
Fine sand, %	13	13
Silt, %	8	13
Clay, %	36	23
Texture	Sandy clay loam	Sandy loam
pH	7.9	8.1
EC, dS/m	0.13	0.19
CEC, cmol/kg	19.8	16.5
Organic C, %	0.53	0.75
$KMnO_4$-N, kg/ha	176	204
Olsen P, kg/ha	7.8	9.0
NH_4OAc-K, kg/ha	230	170
Exchangeable-Ca, cmol/kg	7.4	9.4
Exchangeable-Mg, cmol/kg	3.0	5.1
$CaCl_2$-S, kg/ha	27	42
DTPA-Zn, mg/kg	0.4	0.5
Hot water soluble-B, mg/kg	2.0	2.2

Soil samples (0 to 15 cm) were taken from experimental plots prior to planting and were analyzed for pH, EC, and CEC (Jackson, 1973), $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-P (Olsen et al., 1954), and NH_4OAc-K (Stanford and English, 1949). The soil at Puthiragoundanpalayam was non-saline with a pH of 7.9 and CEC of 19.8 cmol/kg (**Table 1**). At Paravakkadu, the soil was non-saline with a pH of 8.1 and CEC of 16.5 cmol/kg. Available soil N and P were low and K availability was medium at both locations.

The fertiliser rates for N, P, and K consisted of 60, 90, or 120 kg N/ha; 30, 60, 90, or 120 kg P_2O_5/ha; and 80, 160, 240, or 320 kg K_2O/ha. Calcium, S, Zn, and B were also included based on soil testing and a targeted yield-based requirement. Crops received half the N and K as a basal dressing and half as a top-dressing 90 days after planting. The entire quantities of P, Zn, and B were applied during the basal application. Calcium was supplied through a gypsum application 90 days after planting. Sulphur was supplied incidentally through gypsum or zinc sulfate. Elemental S, calcium oxide, and zinc oxide were used as was required in the respective treatments.

Table 2 presents yield response data of the test crop cultivar CO-2 to incremental rates of N, P, and K, given non-limiting supplies of all other applied nutrients. Cassava responded significantly to N, P, and K application at Puthiragoundanpalayam, while the Paravakkadu site had significant responses to P and K. Yield under the complete "optimum" treatment was 52.4 t/ha at Puthiragoundanpalayam and 48 t/ha at Paravakkadu.

Abbreviations and notes for this article: N = nitrogen, P = phosphorus, K = potassium, Ca = calcium, S = sulphur, Zn = zinc, B = boron, EC = electrical conductivity, CEC = cation exchange capacity.

Table 2. Cassava tuber yield response to major nutrients.

Treatments	Puthiragoundanpalayam Yield, t/ha	Puthiragoundanpalayam Yield increase, %	Paravakkadu Yield, t/ha	Paravakkadu Yield increase, %
N^{a}_{60}	42.0	–	45.2	–
N_{90}	52.4	25	48.1	6
N_{120}	46.7	11	45.8	1
C.D. (5%)	5.7		NS[d]	
P^{b}_{30}	40.0	–	38.9	–
P_{60}	40.9	2	45.5	17
P_{90}	52.4	31	48.1	24
P_{120}	44.7	12	45.8	18
C.D. (5%)	4.5		4.2	
K^{c}_{80}	37.9	–	34.9	–
K_{160}	43.0	14	42.9	23
K_{240}	52.4	38	48.1	38
K_{320}	48.2	27	46.8	34
C.D. (5%)	4.5		3.3	

[a]Common doses: 90 kg P_2O_5, 240 kg K_2O, 47 kg Ca, 40 kg S, 6 kg Zn, and 1 kg B/ha
[b]Common doses: 90 kg N, 240 kg K_2O, 47 kg Ca, 40 kg S, 6 kg Zn, and 1 kg B/ha
[c]Common doses: 90 kg N, 90 kg P_2O_5, 47 kg Ca, 40 kg S, 6 kg Zn, and 1 kg B/ha
[d]NS: not significant
C.D. denotes critical difference

Variation in response to optimum fertilisation at the two locations is likely a result of soil textural differences. Optimum fertilisation was also compared against treatments omitting Ca, S, Zn, and B in order to isolate the individual response to secondary and micronutrients (**Table 3**). At Puthiragoundanpalayam, yield decreased by 15, 6, and 20% with omission of Ca, S, and Zn, respectively. Similarly, yield declined by 12, 9, and 7% without Ca, S, and Zn application at Paravakkadum. The omission of B had no significant influence on cassava tuber yield at either site.

Table 3. Influence of fertiliser treatments on cassava tuber yield.

Treatments	Tuber yield, t/ha Puthiragoundampalayam	Tuber yield, t/ha Paravakadu
$N_2 P_3 K_3$ SM[†]	52.4	48.1
$N_2 P_3 K_3$ SM (-Ca)	44.7	42.5
$N_2 P_3 K_3$ SM (-S)	49.5	43.8
$N_2 P_3 K_3$ SM (-Zn)	41.8	44.6
$N_2 P_3 K_3$ SM (-B)	54.4	49.4
SEd	1.57	1.29
C.D. (5%)	3.20	3.55

C.D. denotes critical difference
[†]M denotes micronutrients

The two soils in this study were low in available N and P and therefore cassava responded significantly to their addition. As a tuber crop, cassava removes large amounts of soil K, hence there was marked increase in the yield due to K addition. Given these responses, uptake of N, P and K were significantly reduced in plots not receiving Ca, S, or Zn (**Table 4**).

Table 4. Effect of fertiliser treatments on total N, P, and K uptake in cassava.

Treatments	Puthiragoundampalayam N	Puthiragoundampalayam P	Puthiragoundampalayam K	Paravakadu N	Paravakadu P	Paravakadu K
	Total plant uptake, kg/ha					
$N_2 P_3 K_3$ SM[†]	241	34.0	224	211	41.3	259
$N_2 P_3 K_3$ SM (-Ca)	206	31.3	187	181	36.2	219
$N_2 P_3 K_3$ SM (-S)	199	31.5	204	175	36.4	224
$N_2 P_3 K_3$ SM (-Zn)	197	30.2	170	189	36.8	224
$N_2 P_3 K_3$ SM (-B)	255	38.7	225	210	40.4	257
SEd	10.3	0.81	15.9	6.48	1.10	8.17
C.D. (5%)	21.1	1.66	32.4	13.2	2.24	16.7

C.D. denotes critical difference
[†]M denotes micronutrients
N_2 = 90 kg/ha, P_3 = 90 kg P_2O_5/ha, K_3 = 240 kg K_2O/ha

Summary

This experiment has facilitated a standardised balanced fertiliser schedule for cassava grown in the northwestern agro-climatic zone of Tamil Nadu. Cassava responded well to the increased level of fertilisers up to 150% of the currently recommended rate along with balanced additions of Ca, S, and Zn. The present investigations clearly indicate a need for an upward revision of the existing blanket recommendation of 60 kg N, 60 kg P_2O_5, and 160 kg K_2O/ha. In its place, a generalised requirement of 90-90-240 kg N-P_2O_5-K_2O/ha plus 47 kg Ca/ha, 40 kg S/ha, and 6 kg Zn/ha is suggested for high yielding cassava within the region. BC-INDIA

Dr. Kamaraj was a research scholar, Dr. Jagadeeswaran is Assistant Professor and Dr. Murugappan was Director, Soil and Crop Management Studies, Tamil Nadu Agricultural University. Dr. Rao was formerly Deputy Director, IPNI-India Programme-South Zone.

References

Jackson, M.L. 1973. Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi.

Olsen, S.R., C.V. Cole, F.S. Watanabe, and L. Dean. 1954. USDA Circ., 939. U.S. Govt. Printing Office, Washington DC.

Stanford, S. and L. English. 1949. Agron. J., 41:446-48.

Subbiah, B.V. and G.L. Asija. 1956. Curr. Sci., 25:259-260.