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Integrated Nutrient Management for Cassava Under Rainfed Conditions of Andhra Pradesh

Cassava is an important industrial crop grown under rainfed conditions in Andhra Pradesh. It is grown in 17,000-22,000 hectares (CMIE, 2007) in the upland tracts of East Godavari district of the state. Cassava is a heavy feeder of nutrients and requires large quantities of N, P and K for realization of high yields (Mitra et al., 1990). Continuous cassava cropping without adequate soil fertility management can result in severe reduction in the growth and yield of succeeding crops in addition to deterioration of soil fertility (Nayar, 1994). Green manuring in combination with biofertilizers is one of the most effective and environmentally sound methods that can offer an opportunity to improve soil physico-chemical properties and reduce the use of chemical fertilizers. The effectiveness of green manure is related to its biomass production and ability to accumulate higher amounts of N within short period of time. Application of green manures and biofertilizers in the farming systems can sustain high yields through improvements in water and nutrient use efficiencies, soil biotic activity and soil organic matter levels. Zhongyong et al. (2006) and Lou et al. (2008) reported that organic manure-biofertilizer-chemical fertilizer combination promotes cassava yields and starch content. Research work on the effect of green manure crops in combination with biofertilizers on the growth and productivity of cassava is limited in Andhra Pradesh. Hence the present study was taken up to evaluate three green manure crops for their biomass production and to find out their effects in combination with biofertilizers on the growth and tuber yield of cassava under rainfed conditions of Andhra Pradesh.

The experiment was carried out at Dr.Y. S. R, Horticultural University, Venkatramannagudem, Andhra Pradesh, India, during 2010-2012. The soil of the experimental site was well drained, red sandy loam, low in organic C (0.28%) and available N (107.2 kg ha^{-1}), medium in available P (13.33 kg ha^{-1}) and high in available K (230.72 kg ha^{-1}) with near neutral pH of 6.61. The test variety was H-165. Eight treatment combinations were tried in randomized block design with three replications.

The treatments were as follows.

T_1 : Control (without nutrient application)

T_2 : Recommended Dose of Fertilizers (RDF) (FYM @10 t ha^{-1} and NPK @ 100:50:100 kg ha^{-1})

T_3 : Sunhemp @ 50 kg ha^{-1} + recommended dose (RD) of NPK

T_4 : Dhaincha @ 50 kg ha^{-1} + RD of NPK

T_5 : Cowpea @ 50 kg ha^{-1} + RD of NPK

T_6 : Sunhemp @ 50 kg ha^{-1} + RD K + 50% RD NP + *Azospirillum* + phosphorus solubilising bacteria (PSB) @ 5 kg ha^{-1} each

T_7 : Dhaincha @ 50 kg ha^{-1} + RD K + 50% RD NP + *Azospirillum* + PSB @ 5 kg ha^{-1} each

T_8 : Cowpea @ 50 kg ha^{-1} + RD K + 50% RD NP + *Azospirillum* + PSB @ 5 kg ha^{-1} each

The entire dose of P_2O_5 was applied as basal in the form of single super phosphate, while N and K were applied as Urea and Muriate of potash respectively in three equal splits as top dressings at 30, 60 and 90 days after planting as per the treatments around the plant at 10 cm distance in a circular ring of 5 cm depth followed by earthing up of the soil. Farmyard manure was applied one week before planting as per the treatments and thoroughly incorporated into the soil, while green manure crops (cowpea, dhaincha and sunhemp) were sown @ 50 kg ha^{-1} at the time of planting of cassava and incorporated at 50% flowering stage. Furthermore, *Azospirillum* and PSB @ 5 kg ha^{-1} each were applied in the plots as per the treatments and thoroughly incorporated into the soil before planting of cassava.

Observations on plant growth, viz., plant height and stem girth, were recorded at harvest from five randomly selected, labeled plants from the net plot in each

treatment in each replication. Observations on yield and yield attributes were also recorded from five randomly selected labeled plants from the net plot in each treatment in each replication at harvest. The number of tubers per plant was counted and the maximum girth of 10 cassava tubers was measured at random and the average was calculated. Yield of fresh tubers harvested from the net plot area was also recorded and expressed in t ha^{-1}. Biomass of the green manure crops was recorded using quadrat having size of 0.5 m^2 placed randomly at three places in each treatment at 50% flowering stage and fresh weight was recorded and expressed in t ha^{-1}

The data on various characters studied during the course of investigation were statistically analyzed as per the procedure outlined by Panse and Sukhatme (1978).

Among the three green manure crops, sunhemp produced the greatest biomass (26.0 t ha^{-1}) followed by dhaincha (23.6 t ha^{-1}) and cowpea (19.8 t ha^{-1}). The highest biomass production by sunhemp might be due to its faster growth rate, early branching, larger and thicker leaves and well developed root system than that of the other two crops. Cowpea produced the least biomass due to its short stature, less number of primary branches and smaller leaves. Similar observations were made by Hiremath and Patel (1996) at Navsari, Gujarat.

The data on growth and yield characters are presented in Table 1. Significant influence of the different integrated nutrient management (INM) treatment combinations on plant height and stem girth was observed at harvest. Among the different INM practices, T_6 (sunhemp @ 50 kg ha^{-1} + RD K + 50% RD NP + *Azospirillum* + PSB @ 5 kg ha^{-1} each) resulted in significantly higher plant height (372.7 cm) followed by T_7 (370 cm). Significantly higher stem girth at harvest was observed in T_7 (10.7 cm), followed by T_6 (9.7 cm).

A significant influence of the different INM treatments on the number of tubers per plant, tuber girth and tuber yield was also observed. Among the treatments, T_6 resulted in the greatest number of tubers per plant (13.0) and tuber girth (21.0 cm) followed by T_7 (11.0 and 19.8 cm respectively).

Plants under T_6 produced significantly higher tuber yield (33.6 t ha^{-1}) (Table 1). Tuber yield in the treatments T_7 (30.1 t ha^{-1}), T_3 (30.0 t ha^{-1}) and T_8 (30.00 t ha^{-1}) were on par with T_6. Suja et al. (2005) also reported similar results in cassava due to integrated use of biofertilizers, FYM and 50% of N and P and full K. The highest tuber yield in T_6 may be attributed to the synergistic interactions between biofertilizers and inorganic fertilizers (Subbiah, 1994).The higher tuber yield in these treatments can be attributed to the effect of biofertilizers that converts N and P in organic form to inorganic form, which is preferred by plants. Moreover, these biofertilizers stimulate plant growth either directly, by producing plant hormones and improving nutrient uptake, or indirectly, by changing the microbial balance in the rhizosphere in favor of the beneficial microorganisms as reported by Amara et al. (1995) and Lazarovits and Nowak (1997). El-Kramany et al. (2000) observed that the significant effect of biofertilizers may be due to the effect of different strains such as N fixers,

Table 1. Effect of INM treatments on growth, yield, quality and economics of cassava

Treatments	Plant height (cm)	Stem girth (cm)	Number of tubers per plant	Tuber girth (cm)	Tuber yield (t ha^{-1})	Starch (% FW basis)	B:C ratio
T_1	250.7	7.3	6.0	17.1	15.6	20.1	0.16
T_2	318.9	9.0	9.0	19.0	24.9	22.3	2.14
T_3	325.7	9.2	11.0	19.7	30.0	25.4	2.18
T_4	315.2	9.0	10.0	18.5	27.3	23.8	2.24
T_5	305.7	8.8	9.0	18.2	26.1	22.4	1.73
T_6	372.7	9.7	13.0	21.0	33.6	26.2	2.37
T_7	370.0	10.7	11.0	19.8	30.1	26.5	1.78
T_8	356.0	9.4	10.0	18.6	30.0	26.0	1.39
CD (0.05)	62.36	1.65	2.0	2.68	4.42	2.31	

nutrient mobilizing microorganisms etc., which hasten the release and the availability nutrients.

Thus among the different INM treatments, T_6 (sunhemp @ 50 kg ha^{-1} + RD K + 50% RD NP + *Azospirillum* + PSB @ 5 kg ha^{-1} each) resulted in significantly greater plant height, stem girth, number of tubers per plant, tuber yield and starch content.

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References

Amara, M. A., Nasr, S. A. and. Rabie, K. A. 1995. Phytohormonal interactions between *Pseudomonas fluorescens*, *Rhizobium leguminosarum* and *Triticum aestivum*. *Ann Agric. Sci.*, **40**(1): 81-97.

CMIE. 2007. Agriculture, Centre for Monitoring Indian Economy, Mumbai, Maharashtra. 291 p.

El-Kramany, M. F., Ahmed, M. K., Bahr, A. A. and Kabesh, M. O. 2000. Utilization of biofertilizers in field crop production. *Egypt J. Appl. Sci.*, **15**: 137-142.

Hiremath, S. M. and Patel, Z. G., 1996. Biomass production, N accumulation and nodulation of green manure species during winter season. *J. Maharastra Agric. Univ.*, **21**:57-59.

Lazarovits, G. and Nowak, J. 1997. Rhizobacteria for improvement of plant growth and establishment. *Hort Sci.*, **32**(2): 188-192.

Lou, X. l., Zhong, X., Xia, H., Ying, P. A., Cheng, L., Fang, S. Z. and Lin, C. H., 2008. Effects of bio-organic fertilizer on the growth of cassava and the physical, chemical and biological character of soil. *Acta Agriculturae Boreali-Occidentalis Sinica*, **01**: 65-71.

Mitra, S. K., Sadhu, M. K. and Bose, T. K. 1990. *Nutrition of Vegetable Crops*. Naya Prakash, 206, Bidhan Sarani, Calcutta, India.

Nayar, T. V. R. 1994. Agro-techniques and nutritional requirements for cassava. In: *Advances in Horticulture*, **Vol. 8**, Chadha K. L. and Nayar, G. G. (Eds.). Malhotra Publishing House, New Delhi, India, pp. 234-249.

Panse, V. G. and Sukhatme, P. V. 1978. *Statistical Methods for Agricultural Workers*. Indian Councial of Agricultural Research, New Delhi.

Subbaiah, K. 1994. Effect of N, P and biofertilizers on yield and nutrient uptake in chilli and Bellary onion. *Madras Agric. J.*, **81**(5): 277-279.

Suja, G., Nayar, T. V. R. and Potty, V. P. 2005. Response of cassava (*Manihot esculenta* Crantz) to biofertilizers. *J. Root Crops*, **31**:100-105.

Zhongyong, C., Xinglu, L., Jiang, S., Hexia, X., Minqing, C., Yuanlan, H. and Yinghua, Y. P. 2006. The effects of bio-organic fertilizer on plant growth and root tuber yield of cassava. *Chainais Agricultural Sci. Bull.*, **22** (11): 202-206.

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