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Standardization of Low Input Technology for Cassava

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Abstract

A field experiment was conducted at Tapioca and Castor Research Station, Yethapur during 2011 – 2015 with an objective to identify the suitable green manure crop in combination with biofertilizers to improve growth, tuber yield and starch content of cassava. The cassava setts of var. CO (Tp) 4 were planted in ridges and furrows method at a spacing of 90 x 75 cm (90 cm between ridges and 75 cm between furrows). The green manure crops *viz.,* sunhemp, daincha and cowpea were sown in between two rows of cassava @ 50 kg ha^{-1} seed rate and the green manure crops were incorporated at 50% flowering (45-50 days after sowing). The biofertilizers *viz., Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) were applied by mixing with well decomposed FYM during the last ploughing. The experiment comprised of eight treatments involving green manures and biofertilizers in Randomized Block Design. The results of the experiment revealed that the incorporation of green manure as daincha @ 50 kg ha^{-1} + Recommended dose of K + 50% Recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) resulted in maximum tuber yield (34.79 t ha^{-1}) and total dry matter content (3.68 kg $plant^{-1}$) than the RDF (FYM 10 t ha^{-1}) + 100:50:150 kg NPK ha^{-1}) (farmers practice). The growth and tuber yield was significantly higher over the Control (without FYM and NPK). The incorporation of different green manures did not influence the quality of tubers (starch content).

Key words: Low input technology, green manures, biofertilizers, yield

Introduction

Cassava or tapioca (*Manihot esculenta* Crantz.) belongs to the family Euphorbiaceae which is grown widely in tropical countries. This crop is well known for its adaptability to poor soil conditions, tolerance to drought, pest and diseases. Cassava is an important tuber crop cultivated both in irrigated and rainfed conditions. In Tamil Nadu during 2014-15, cassava was cultivated in an area of 83,526 hectares with the production of 24,99,280 tonnes in Salem, Namakkal, Cuddalore, Villupuram, Dharmapuri and Kanyakumari districts. In Salem district, more than 400 sago industries are involved in the preparation of starch, sago grains, vermicelli and chips from cassava.

Cassava is mainly grown in rainfed conditions as mono-crop year after year in the same field. Tuber initiation starts two months after planting. Being a tuber crop, the tuber yield mainly depends on the nutritional status of soil and judicious application of fertilizers. Incorporation of green manure crops *viz.*, daincha, sunhemp and cow pea can produce huge biomass and can supply ample quantity of nutrients required by cassava. With these back ground, the experiment was planned to identify the effective and economic green manures as a substitute to reduce the fertilizer application and maximization of tuber yield. Incorporation of organic manures in soil increases soil microbial activity due to alteration in the soil structure that favours the microbial growth and beneficial effects of added minerals from organic manures

in the soil (Goyal et al., 1993). The soil organic manures facilitates and helps in enhancing leaf area or size of canopy and enhances the tuber yield (Suja, 2013). Substantial improvements to crop productivity usually include the application of exogenous application of nutrients in organic and inorganic form (Howeler, 2011). Application of organic manures improves the water holding capacity and porosity of soil (Suja et al., 2013). Fertilizer costs continue to rise worldwide and their inappropriate application is frequently associated with nutrient runoff into water systems or seepage into groundwater (Hershey et al., 2013). Considering its long duration and application of nutrients for maximum tuber yield, the investigation was conducted in cassava.

Materials and Methods

The field experiment was conducted consecutively for four years from 2011 to 2015 at Tapioca and Castor Research Station, Yethapur, Salem (11º 35' N latitude, 78 º 29' E longitude) at an altitude of 282 meters above MSL. This station is located in the agro climatic region of North Western Zone of Tamil Nadu. The planting was taken up during second week of December and the harvest of tuber was done during the last week of September. The cassava setts of var. CO (Tp) 4 were planted in ridges and furrows method at a spacing of 90 x 75 cm (90 cm between ridges and 75 cm between furrows). The green manure crops *viz.*, sunhemp, daincha and cowpea were sown in between two rows cassava @ 50 kg ha^{-1} after planting of setts of cassava and the green manure crops were incorporated at 50% flowering (45-50 days after sowing). The biofertilizers were applied by mixing with well decomposed FYM.

The treatments were imposed and replicated thrice in Randomized Block Design *viz.*, Control (without FYM and NPK) (T_1), RDF of FYM (10 t ha^{-1}) + RDF (100:50:150 kg NPK ha^{-1}) (T_2), Green manuring (sun hemp) @ 50 kg ha^{-1} + Recommended dosage of NPK (T_3), Green manuring (daincha) @ 50 kg ha^{-1} + Recommended dose of NPK (T_4), Green manuring (cowpea) @ 50 kg ha^{-1} + Recommended dose of NPK (T_5), Green manuring (sunhemp) @ 50 kg ha^{-1} + recommended dose of K + 50% Recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) (T_6), Green manuring (daincha) @ 50 kg ha^{-1} + Recommended dose of K + 50% Recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) (T_7), Green manuring (cowpea) @ 50 kg ha^{-1} + Recommended dose of K+ 50% Recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) (T_8). During the time of harvest, observations on plant height, stem girth, number of tubers per plant, tuber yield and starch content were recorded. Physiological parameters *viz.*, harvest index and total dry matter production were also recorded. The dry weight of leaf, stem and tubers were added and recorded as total dry matter production.

Standard cultivation practices recommended for cassava as per crop production techniques of Horticultural crops (2013) published by TNAU were adopted uniformly for all experimental plots. The plants were maintained with furrow irrigation method and the irrigations were given at weekly intervals from planting to three months after planting and subsequently at fifteen to twenty days interval until harvest. The data on various parameters recorded during the course of investigation were statistically analyzed according to Panse and Sukhatme (1985).

Results and Discussion

Growth parameters

The growth parameters revealed that the tallest plants (307.50 cm) were recorded during 2011-2015 by the incorporation of green manure as daincha @50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}). (Table 1). The application of RDF of FYM (10 t ha^{-1}) + 100:50:150 kg NPK ha^{-1} (without any incorporation of green manures) recorded the plant height of 234.15 cm. Maximum stem girth (12.88 cm) was recorded in plants by the incorporation of green manure as daincha @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}). (Table 1).

Yield parameters

The incorporation of green manures and biofertilizers significantly influenced the tuber yield and number of tubers per plant. The four years of pooled mean data analysis revealed that the maximum number of tubers per plant (10.25) was recorded in plants by the incorporation of green manure as daincha @ 50 kg ha^{-1}

Table 1. Effect of low input technology on pooled mean of growth, yield and starch content of cassava var. CO (Tp) 4 (pooled mean of 4 years)

	Treatments	Plant height (cm)	Stem girth (cm)	Number of tubers per plant	Tuber yield (t ha^{-1})	Starch content (%)
T_1	Control (without FYM and NPK)	205.65	7.53	6.20	14.53	18.18
T_2	RDF of FYM (10 t ha^{-1}) + 100:50:150 kg NPK ha^{-1})	234.15	10.30	6.45	24.84	24.03
T_3	Green manuring (sunhemp) @50 kg ha^{-1} + recommended dose of NPK	251.08	10.80	7.98	27.40	21.60
T_4	Green manuring (daincha) @ 50 kg ha^{-1} + recommended dose of NPK	257.73	10.43	8.38	29.19	24.15
T_5	Green manuring (cowpea) @ 50 kg ha^{-1} + recommended dose of NPK	235.90	10.83	7.10	23.06	23.03
T_6	Green manuring (sunhemp) @50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1})	244.15	10.35	7.88	30.24	23.05
T_7	Green manuring (daincha) @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1})	280.30	12.88	10.25	34.79	24.63
T_8	Green manuring (cowpea) @ 50 kg ha^{-1} + recommended dose of K+ 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1})	243.43	10.08	6.78	26.37	21.33
	CD (0.05)	53.72	1.63	1.16	3.06	3.17
	SEd	26.85	0.81	0.58	1.53	1.59

+ recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}). The minimum number of tubers per plant (6.20) was observed in the control (without FYM and NPK) (Table 1). Similarly, the maximum mean tuber yield (34.79 t ha^{-1}) was recorded in plants by the incorporation of green manure as daincha @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) which is significantly higher than the control (without FYM and NPK) (Table 1).

Quality parameters

The starch content of tubers do not exhibit significant difference among the treatments. However, the maximum mean starch content of tubers (24.63%) was recorded in plants by the incorporation of green manure as daincha @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}). (Table 1).

Physiological parameters

There was no significant difference among the treatments on harvest index. Among the treatments, the maximum harvest index of 0.56 was recorded in plants by the incorporation of green manure as daincha @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) (table 2). The same treatment has also resulted in the maximum total dry matter of 3.68 kg plant^{-1}. Incorporation of green manures improved soil structure, increased porosity, water holding capacity and nutrients status *viz.*, nitrogen, phosphorous and potassium nutrients to soil, thereby sustainable release of nutrients to the crop plants. This is in confirmation with the

Table 2. Effect of low input technology on pooled mean of harvest index and total dry matter production of cassava var. CO (Tp) 4 (pooled mean of 4 years)

	Treatments	Harvest index	Total dry matter production (kg plant^{-1})
T_1	Control (without FYM and NPK)	0.33	2.24
T_2	RDF of FYM (10 t ha^{-1}) + 100:50:150 kg NPK ha^{-1})	0.37	2.29
T_3	Green manuring (sunhemp) @50 kg ha^{-1} + recommended dose of NPK	0.51	3.01
T_4	Green manuring (daincha) @ 50 kg ha^{-1} + recommended dose of NPK	0.44	3.05
T_5	Green manuring (cowpea) @50 kg ha^{-1} + recommended dose of NPK	0.50	2.69
T_6	Green manuring (sunhemp) @50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1})	0.51	2.86
T_7	Green manuring (daincha) @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1})	0.56	3.68
T_8	Green manuring (cowpea) @50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1})	0.51	2.68
	CD (0.05)	0.92	0.56
	SEd	0.46	0.28

findings of Suja et al. (2013). In addition this, application of organic manures would have improved water holding capacity and porosity of soil (Hershey *et al*., 2013). The incorporation of green manure as daincha @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) which is saving the cost of 50% of the recommended dose of NP fertilizers besides, improving the fertility of soil. The result is an indicative fact that incorporation of green manure and biofertlizers improves the fertility status of the soil and cassava yield.

Conclusion

The results of the experiment on the low input technology for cassava revealed that the growth and tuber yield was significantly higher over the control (without FYM and NPK). The incorporation of green manure daincha @ 50 kg ha^{-1} + recommended dose of K + 50% recommended dose of NP + *Azosprillium* (5 kg ha^{-1}) + *Phosphobacteria* (5 kg ha^{-1}) resulted in maximum tuber yield (34.79 t ha^{-1}) and total dry matter content (3.68 kg plant^{-1}) than the RDF (FYM 10 t ha^{-1}) + 100:50:150 kg NPK ha^{-1}) (farmers practice) besides, improving the fertility of soil.

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