**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 the year 2010 – 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. The green manure crops *viz.,* sunhemp, daincha and cowpea were sown in between two rows of cassava @ 50 kg/ha and the green manure crops were incorporated at 50% flowering (45-50 days after sowing). The biofertilizers *viz.,* *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) were applied by mixing with well decomposed FYM. 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 @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) influenced the tuber yield and total dry matter content than the RDF of FYM (10 t ha-1) + 100:50:150 kg NPK ha-1) (farmers practice). The performance on the growth and tuber yield of cassava was poor (14.53 t ha-1) in the control (without the application of FYM and NPK). However, 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 condition, tolerance to drought, pest and diseases. Cassava is an important tuberous crop cultivated both in irrigated and rainfed conditions. In Tamil Nadu during 2014-15, cassava is cultivated in an area of 83,526 hectares with the production of 24,99,280 tonnes. Cassava is mainly cultivated in Salem, Namakkal, Cuddalore, Villupuram, Dharmapuri and Kanyakumari districts of Tamil Nadu. In Tamil Nadu, the major area under cassava cultivation in done in Dharmapuri district (25%) followed by Namakkal district (18%) and Salem district (16%). In Salem district, more than 400 sago industries are involved in the preparation starch, sago grains, vermicelli and chips.

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 tuberous 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 is 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 enzymatic activity due to alteration in the soil structure that favours the microbial growth and beneficial effects of added minerals from organic manure into the soil (Goyal *et al.,* 1993). The soil organic manures facilitates and helps in maximum 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 favours the improvement in water holding capacity, 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 the duration of crop and application of nutrients for maximum tuber yield, the investigation was carried out 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 cassava setts of var. CO (TP) 4 were planted in ridges and furrows method at a spacing of 90 x 75 cm. The green manure crops *viz.,* sunhemp, daincha and cowpea were sown in between two rows cassava @ 50 kg/ha 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) (T1), RDF of FYM (10 t ha-1) + RDF (100:50:150 kg NPK
ha-1) (T2), Green manuring (sun hemp) @ 50kg/ha + RD of NPK (T3), Green manuring (daincha) @50kg/ha + RD of NPK (T4), Green manuring (cowpea) @50kg/ha + RD of NPK (T5), Green manuring (sunhemp) @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha )+ *Phosphobacteria* (5kg/ha) (T6), Green manuring (daincha) @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha )+ *Phosphobacteria* (5kg/ha) (T7), Green manuring (cowpea) @50kg/ha + RD of K+ 50 % RD of NP + *Azosprillium* (5kg/ha )+ *Phosphobacteria* (5kg/ha) (T8). During the time of harvest, observations on plant height, stem girth, number of tubers
plant-1, estimated tuber yield (t ha-1) and starch content (%) were recorded. Physiological parameters *viz.,* harvest index and total dry matter production was also recorded. The harvest index was the ratio of economic yield to biological yield at harvesting time expressed in percentage. The dry weight of leaf, stem and tubers were added and recorded as total dry matter production and expressed in g plant-1.

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 data on various parameters studied during the course of investigation were statistically analyzed and applying the technique of analysis of variance suggested by
Panse and Sukhatme (1985).

**Results and discussion**

**Growth parameters**

The experimental data on the growth parameters revealed that the tallest plants
(307.50 cm) and the shortest plants (193.10 cm) was recorded during 2013 by the incorporation of green manure as daincha @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha ) + *Phosphobacteria* (5kg/ha) and control (without FYM and NPK) respectively (Table 1). The same trend was observed with the pooled mean data from 2011 to 2015 also. The shortest plants
(205.65 cm) were observed in the Control (without FYM and NPK). 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. The pooled mean data on stem girth revealed that maximum stem girth (12.88 cm) was recorded by the incorporation of green manure as daincha @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha )+ *Phosphobacteria* (5kg/ha) and the minimum stem girth (7.53 cm) was recorded in the control (without FYM and NPK) (Table 1).

**Yield parameters**

The incorporation ofgreen manures and biofertilizers significantly influenced the tuber yield and number of tubers in cassava. The four years of pooled mean data revealed that the maximum number of tubers per plant (10.25) was recorded by the incorporation of green manure as daincha @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha). The minimum number of tubers per plant (6.20) was observed in the control (without FYM and NPK) (Table 1). Similarly, the highest mean tuber yield (34.79 t ha-1) and the lowest tuber yield (14.53 t ha-1) was recorded by the incorporation of green manure as daincha @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) and control (without FYM and NPK) respectively (Table 1) respectively.

**Quality parameters**

 The pooled mean data on the starch content of tubers does not exhibit any significant difference among the treatments. However, the maximum mean starch content of tubers (24.63%) was recorded by the incorporation of green manure as daincha @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha). The minimum starch content of tubers (18.80%) was observed in the control (without FYM and NPK) (Table 1). The application of RDF of FYM (10 t ha-1) + 100:50:150 kg NPK ha-1) recorded starch content of 24.03%.

**Physiological parameters**

The pooled mean data revealed that there was no significant difference among the treatments on harvest index of tapioca. Among the treatments, the maximum harvest index of 0.56 was recorded by the incorporation of green manure as daincha @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) (table 2). The same treatment has also recorded the maximum total dry matter content of 3.68 kg plant-1 when compared with other treatments. The control (without FYM and NPK) recoded the harvest index of 0.33 and total dry matter content of 2.24 kg plant-1 (Table 2).

The reason for better performance by the incorporation of green manures is that green manures might have influenced by the way of improved soil structure, increased porosity, increased water holding capacity and added nitrogen, phosphorous and potassium nutrients to soil, thereby sustainable release to the crop plants. This is in confirmation with the findings of Suja *et al.* 2013. In addition to the above, application of organic manures would have favoured the improvement in water holding capacity, porosity of soil (Hershey *et al.,* 2013). The result is an indicative fact that incorporation of green manure and biofertlizers is not only improved the tuber yield but also improves the fertility status of the soil.

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | **Stem girth (cm)** | **Number of tubers per plant** | **Tuber yield (t ha-1)** | **Starch content (%)** |
| T1 | Control (without FYM and NPK) | 205.65 | 7.53 | 6.20 | 14.53 | 18.18 |
| T2 | RDF of FYM (10 t ha-1) + 100:50:150 kg NPK ha-1) | 234.15 | 10.30 | 6.45 | 24.84 | 24.03 |
| T3 | Green manuring (sunhemp) @50kg/ha + RD of NPK | 251.08 | 10.80 | 7.98 | 27.40 | 21.60 |
| T4 | Green manuring (daincha) @50kg/ha + RD of NPK | 257.73 | 10.43 | 8.38 | 29.19 | 24.15 |
| T5 | Green manuring (cowpea) @50kg/ha + RD of NPK | 235.90 | 10.83 | 7.10 | 23.06 | 23.03 |
| T6 | Green manuring (sunhemp) @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) | 244.15 | 10.35 | 7.88 | 30.24 | 23.05 |
| T7 | Green manuring (daincha) @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) | 280.30 | 12.88 | 10.25 | 34.79 | 24.63 |
| T8 | Green manuring (cowpea) @50kg/ha + RD of K+ 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) | 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 |

**Table 2. Effect of low input technology on pooled mean of harvest index and
 of cassava var. CO (TP) 4**

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Harvest index** | **Total dry matter production (kg plant-1)** |
| T1 | Control (without FYM and NPK) | 0.33 | 2.24 |
| T2 | RDF of FYM (10 t ha-1) + 100:50:150 kg NPK ha-1) | 0.37 | 2.29 |
| T3 | Green manuring (sunhemp) @50kg/ha + RD of NPK | 0.51 | 3.01 |
| T4 | Green manuring (daincha) @50kg/ha + RD of NPK | 0.44 | 3.05 |
| T5 | Green manuring (cowpea) @50kg/ha + RD of NPK | 0.50 | 2.69 |
| T6 | Green manuring (sunhemp) @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) | 0.51 | 2.86 |
| T7 | Green manuring (daincha) @50kg/ha + RD of K + 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) | 0.56 | 3.68 |
| T8 | Green manuring (cowpea) @50kg/ha + RD of K+ 50 % RD of NP + *Azosprillium* (5kg/ha) + *Phosphobacteria* (5kg/ha) | 0.51 | 2.68 |
| CD (0.05) | 0.92 | 0.56 |
| SEd | 0.46 | 0.28 |