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Effect of Organic Manures and Inorganic Fertilizers on Plant Growth and Tuber Yield of Cassava under Allahabad Agro Climatic Conditions (*Manihot esculenta*) cv. Sree Vishakham

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A B S T R A C T

The present investigation was under taken to study the effect of organic manures and inorganic fertilizers on plant growth and tuber yield of cassava (*Manihot esculenta*.) under Allahabad agro climatic conditions cv. Sree vishakham. The experiment was laid out in Randomized block design with 12 treatments and each replicated thrice. The treatments consist different combinations of inorganic fertilizers like Urea, DAP, MOP, and organic manures like FYM, Poultry manure, Vermicompost. Among these 12 treatments, the growth attributes like plant height, total number of leaves per plant, total number of branches per plant are maximum, yield attributes like, average tuber weight, tuber yield are maximum and number of tuber is minimum under the treatment T_9 (25% RDF +75% Poultry manure) followed by the treatment T_6 (50% RDF + 50% poultry manure). Maximum gross returns (Rs.4,33,300 ha^{-1}), net returns (Rs.2,79,724 ha^{-1}) and B: C ratio (2.82:1) was found in treatment T_9 (25% RDF + 75% poultry manure)

Introduction

Cassava is a perennial shrub of the family Euphorbiaceae, cultivated mainly for its starchy roots.it is one of the most important food staples in the tropics, where it is the fourth most important source of energy. It derives its importance from the fact that it produces more calories /unit area from its starchy tuberous root which is valuable source of cheap calories especially in developing countries (Som, 2007). On a worldwide basis it is ranked as the sixth most important source of calories in the human diet (FAO, 1999). The introduction of improved varieties of cassava helped boost yield of this main staple by almost 40 percent (FAO, 1999). Apart from its use as food, it is also an important industrial raw material for the production of starch, alcohol, pharmaceuticals, gums, confectioneries and livestock feed (Nnodu *et al.,* 2006).

Cassava possesses a high potential for yielding large amounts of food per unit area and also it is an efficient producer of calorie (135 calorie/100 g fresh tuber) compared with other cereal crops (Sridevi *et al.,* 2013). In India, cassava ranks first in area (2.35 lakh ha) and production (5.4 million tonnes of fresh tubers)

followed by sweet potato. Its average productivity is 23 tonnes /ha, the highest in the world (Department of Economics and Statistics, Season and Crop Report, 2005). Although cassava is a perennial crop, the storage roots can be harvested from 6-24 months after planting, depending on cultivar and the growing conditions (El-Sharkawy, 1993). In the humid lowland tropics the roots can be harvested after 6-7 months.

In regions with prolonged periods of drought or cold, the farmers harvest after 18-24 months (Cock, 1984). Moreover the roots can be left in the ground without harvesting for a long period of time, making it very useful crop as a security against famine (Cardoso and Souza, 1999). It is generally propagated from either stem cuttings or sexual seed. Propagation through true seed occurs under natural conditions and is widely used in breeding programme.

Plants from true seeds take longer to become established, and they are smaller and less vigorous than plants from cuttings. Application of organic manures and inorganic fertilizers will increase the crop yield. Agbaje *et al.*, (2004) reported that the influence of NPK fertilizer on tuber yield of early and late planted cassava which resulted fertilizer influence on tuber yield was not significant in early planted cassava and in late planted significant reduction in yields. Ojeniyi *et al., (*2012) reported that effects of combined application of reduced levels of NPK fertilizer and poultry manure on soil and plant nutrient composition, growth and yield of cassava was studied, result was Nutrient content in cassava growth, and tuber yield parameters increased in the order of control<NPK<PM<5t/ha PM+300kg/ha NPK<2.5t/ha PM+450kg/ha NPK, it increased tuber yield by 34, 28, 66,133% respectively. Keeping in view all the above factors an experiment has been conducted to access the effect of organic and inorganic fertilizers on plant growth and tuber yield of cassava with the comparative economics of various treatment combinations.

Materials and Methods

The present research work has been carried out to find the effect of organic manures and inorganic fertilizers on plant growth and tuber yield of cassava (*Manihot esculenta*) under Allahabad agro climatic conditions.

The field experiments were conducted in the vegetable research field, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences (SHIATS), Allahabad. During kharif season (2015-16), the stem cuttings of cassava obtained from CTCRI, Thiruvananthapuram. Cassava (*Manihot esculenta*) variety Sree visakham was utilized for study. Stem cuttings of 15cm were used as planting material. The field was prepared as per the recommended agronomic practices.

Field experimental design and details

Crop: cassava
Cultivar: Sree visakham
Plot size: 5.0 m x 1.0 m
Spacing: 1.0 m x 1.0 m
Design: RBD
Replication: three
Duration: 300 days

Fertilizer application

The recommended fertilizer schedule of 75:50:75 kg N, P_2O_5 and K_2O was followed for the cassava crop. The phosphorus was applied as a single basal dose, whereas nitrogen and potassium were applied in two split doses. The fertilizers urea, diammonium phosphate and muriate of potash were used for the above schedule.

Results and Discussion

Growth Parameters

The data revealed that the combination of different organic manures and inorganic fertilizers affected growth attributes like plant height of cassavas shown in (Table 1). Significant difference in the plant height was recorded due to application of different combination of organic manures and inorganic fertilizers. The treatment T_9 (25% RDF+75%Poultry manure) recorded the maximum plant height (185.93cm), followed by T_6 (50%RDF+50% Poultry manure), (181.50 cm) which differed significantly from each other as well from other treatment.

The data revealed that the combination of different organic and inorganic fertilizers affected growth attributes like total number of leaves per plant of cassavas shown in (Table 2). Significant difference in the plant leaves per plant was recorded due to application of different combination of organic manures and inorganic fertilizers. The treatment T_9 (25% RDF+75%Poultry manure) recorded the maximum plant leaves per plant, followed by T_6 (50%RDF+50% Poultry manure which differed significantly from each other as well from other treatment.

The data revealed that the combination of different organic and inorganic fertilizers affected growth attributes like total number of branches per plant of cassavas shown in (Table 3). Significant difference in the plant leaves per plant was recorded due to application of different combination of organic and inorganic fertilizers. The treatment T_9 (25% RDF+75%Poultry manure) recorded the maximum no of branches per plant, followed by T_6 (50%RDF+50% Poultry manure which differed significantly from each other as well from other treatment.

The plant height, total number of leaves per plant, total number of branches per plant in the treatments T_9 and T_6 might be due to the application of organic manures and inorganic fertilizers might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was due to non-availability of it. Similar findings were reported by *Ojeniyi et al.*, (2012) in cassava.

Details of Treatment

TREATMENTS	TREATMENT COMBINATION
T_0	Control-RDF(75:50:75kg/ha NPK)
T_1	Complete organic (33.3%FYM+33.3%vermicompost+33.3% poultry manure)
T_2	75%RDF+25% FYM
T_3	75%RDF+25% poultry manure
T_4	75%RDF+25% vermicompost
T_5	50%RDF+50% FYM
T_6	50%RDF+50% Poultry manure
T_7	50%RDF+50% Vermicompost
T_8	25%RDF+75% FYM
T_9	25%RDF+75% Poultry manure
T_{10}	25%RDF+75% Vermi compost
T_{11}	25%RDF+25%FYM+25%Poultrymanure+25%Vermicompost

Table.1 Effect of organic manures and inorganic fertilizers on plant height of cassava (cm)

Treatments	Plant height(cm)									
	30dap	60dap	90dap	120dap	150dap	180dap	210dap	240dap	270dap	300dap
T_0	20.73	52.76	70.98	90.38	106.71	118.44	130.70	159.41	172.52	174.50
T_1	21.65	56.74	73.03	97.19	108.33	121.61	131.67	165.44	174.71	176.49
T_2	25.61	54.66	76.23	96.33	113.45	123.67	134.60	166.58	178.52	180.42
T_3	22.12	55.29	77.33	95.23	110.45	119.79	135.77	161.62	177.49	179.37
T_4	23.89	57.11	74.32	92.39	111.43	122.77	133.60	162.54	176.59	178.63
T_5	23.13	53.51	71.33	94.29	112.44	121.7	137.65	163.63	175.28	181.35
T_6	25.97	57.15	77.87	97.60	114.30	124.35	138.53	166.65	178.77	181.50
T_7	25.07	56.42	76.11	93.41	106.71	118.44	136.59	164.60	173.64	181.48
T_8	23.77	56.15	75.15	96.18	108.72	122.57	136.64	165.61	175.64	179.56
T_9	29.25	60.85	80.45	100.20	115.37	125.53	141.61	169	180.45	185.93
T_{10}	21.95	56.51	74.25	95.37	107.47	120.33	130.86	163.87	174.79	176.55
T_{11}	21.07	54.38	75.29	97.16	108.47	118.69	132.67	161.52	176.56	178.41
F test	S	S	S	S	S	S	S	S	S	S
CD (5%)	0.39	0.30	0.31	0.11	0.12	0.51	0.16	0.17	0.20	0.24
CV	0.97	0.32	0.24	0.07	0.07	0.25	0.07	0.09	0.07	0.08
SE(+/-)	0.19	0.15	0.05	0.06	0.25	0.25	0.08	0.08	0.10	0.11

Table.2 Effect of organic manures and inorganic fertilizers on total number of leaves of cassava

Treatments	Total number of leaves									
	30dap	60dap	90dap	120dap	150dap	180dap	210dap	240dap	270dap	300dap
T_0	21.60	30.53	61.13	81.13	90.60	110.87	89.80	80.40	70.87	59.20
T_1	22.47	34.40	62.80	85.53	95.13	112.93	91.60	84.53	73.60	62.40
T_2	23.13	35.53	63.60	84.60	93.87	115.87	90.53	81.40	71.80	61.13
T_3	24.47	37.60	64.20	82.87	94.40	115.60	89.87	83.47	70.87	62.40
T_4	26	36.40	65.62	83.13	93.60	113.13	91.87	84.60	72.87	60.13
T_5	26.47	34.53	62.40	84.60	91.87	114.13	90.60	80.60	74.40	61.80
T_6	26.80	37.87	65.73	86.27	95.87	117.80	92.87	84.87	75.60	62.40
T_7	25.60	33.60	63.60	85.60	93.87	116.13	91.40	81.60	74.87	61.53
T_8	24.13	34.67	62.87	86.20	94.60	111.53	90.60	83.60	72.60	60.67
T_9	28.40	39.87	68	89.87	98.20	120.13	94.87	90.13	79.13	64.20
T_{10}	22.87	32.53	63.93	82.53	91.13	113.87	89.87	82.53	75.33	60.20
T_{11}	23.53	32.60	62.60	84.40	92.60	114.40	91.13	81.40	72.40	61.40
F test	S	S	S	S	S	S	S	S	S	S
CD (5%)	0.63	0.44	0.46	0.41	0.40	0.52	0.47	0.43	0.94	0.54
CV	1.50	0.74	0.42	0.28	0.25	0.27	0.30	0.30	0.75	0.52
SE(+/-)	0.30	0.21	0.22	0.20	0.19	0.25	0.23	0.21	0.45	0.26

Table.3 Effect of organic manures and inorganic fertilizers on total number of Branches of cassava

Treatments	Total number of Plant branches									
	30dap	60dap	90dap	120dap	150dap	180dap	210dap	240dap	270dap	300dap
T_0	2.53	2.27	2.60	2.20	2.40	2.20	2.40	2.07	2.33	2.00
T_1	3.80	3.33	3.20	2.60	2.93	2.40	3.00	3.00	2.60	2.40
T_2	3.40	3.33	2.60	2.40	2.60	2.73	2.47	2.80	2.53	2.87
T_3	3.87	3.40	3.20	2.80	2.60	2.60	2.67	3.00	2.53	3.00
T_4	3.53	2.40	3	3.20	3.13	2.40	2.87	3.00	2.40	2.60
T_5	2.60	2.47	3.60	2.20	3.20	2.20	2.80	2.80	2.47	2.53
T_6	4.60	3.42	4.00	3.40	3.58	3.00	3.97	3.20	3.19	3.19
T_7	3.20	2.40	4.00	2.40	2.87	2.27	2.73	2.60	3.13	2.80
T_8	4.27	3.40	2.60	2.80	2.60	2.40	2.40	2.33	3.00	3.13
T_9	5.53	3.60	4.20	3.60	3.60	3.20	4.00	3.40	3.20	3.20
T_{10}	3.53	3.42	3.00	2.20	3.40	2.60	2.60	3.20	2.53	2.40
T_{11}	3.13	2.53	2.67	2.40	3.57	2.40	3.40	3.00	3.00	2.20
F test	S	S	S	S	S	S	S	S	S	S
CD (5%)	0.47	0.43	0.36	0.33	0.37	0.36	0.42	0.34	0.40	0.35
CV	7.54	8.62	6.52	7.19	7.47	8.39	8.48	6.95	8.50	7.72
SE(+/-)	0.23	0.21	0.17	0.16	0.18	0.17	0.20	0.16	0.19	0.17

Table.4 Effect of organic manures and inorganic fertilizers on number of tubers, average tuber weight (kg), and tuber yield (kg) of cassava

Treatment details	No of tubers per plant	Average tuber weight(kg)	Tuber yield per plant(kg)	Tuber yield per plot(kg)	Tuber yield per hectare(t)
T_0	4.07	0.82	2.25	11.23	22.47
T_1	3.20	0.84	2.41	12.03	24.07
T_2	2.87	0.89	3.19	15.97	31.93
T3	2.73	0.95	2.36	11.80	23.60
T_4	4.00	0.93	3.31	16.57	33.13
T_5	2.60	0.88	2.67	13.37	26.73
T_6	2.67	1.30	3.36	16.80	33.60
T_7	2.80	0.93	2.52	12.60	25.20
T_8	3.07	0.86	2.31	11.57	23.13
T_9	2.20	2.01	4.33	21.67	43.33
T_{10}	3.13	1.13	2.33	11.63	23.27
T_{11}	2.27	1.10	2.28	11.40	22.80
F test	S	S	S	S	S
CD (5 %)	0.48	0.19	0.31	1.55	3.09
C.V	9.59	10.92	6.57	6.57	6.57
SE(+/-)	0.23	0.09	015	0.75	1.49

Table.5 Economics of different treatment for cultivation of cassava

Treatments	Total fixed cost Rs	Total variable cost Rs	Total cost of cultivation Rs	Tuber Yield ha^{-1} (kgs)	Sale rate Rs kg^{-1}	Gross return Rs/ha	Net return Rs/ha	Cost Benefit ratio
T_0	150800	5105	155905	22470	10	224700	68795	1:1.44
T_1	150800	7600	158400	24070	10	240700	82300	1:1.52
T_2	150800	4630	155430	31930	10	319300	163870	1:2.05
T_3	150800	4330	155130	23600	10	236000	80870	1:1.52
T_4	150800	4153	154953	33130	10	331300	176347	1:2.13
T_5	150800	3753	154553	26730	10	267300	112747	1:1.72
T_6	150800	3553	154353	33600	10	336000	181647	1:2.17
T_7	150800	3676	154476	25200	10	252000	97524	1:1.63
T_8	150800	2716	153516	23130	10	231300	77784	1:1.50
T_9	150800	2776	153576	43330	10	433300	279724	1:2.82
T_{10}	150800	3176	153976	23270	10	232700	78724	1:1.51
T_{11}	150800	2750	153550	22800	10	228000	74450	1:1.48

Yield parameters

The data revealed that the combination of different organic manures and inorganic fertilizers affected yield parameters of cassava as shown in (Table 4). In the present study, among the various treatment combinations T_9 (25%RDF+75%poultry manure) recorded maximum yield per plant (4.33kg) minimum number of tubers per plant (2.20), maximum average tuber weight (2.01kg), maximum yield per plot (21.67kg) and maximum yield per hectare (43.33t/ha) followed by T_6 (50%RDF+50%poultry manure) and minimum were recorded in Treatment T_0 (Control).

The increase yield per plant, per plot and per hectare might be due to the increased growth attributes which in turn lead to the increased photosynthates and dry matter production. Minimum number of height and yield in T_0 (Control) might be due to non-availability of organic fertilizer during its development. Similar findings were reported by *Ojeniyi et al., (2012), Ayoola et al., (2006)* in cassava.

Economics of cassava

The optimum rates of fertilizer to use depend not only on physical yield response of cassava but also the economic conditions such as prices of fertilizers and the cassava product. Table 5 shows the economics of cassava cultivation experiment.

The treatment T_9 (25% RDF + 75% Poultry manure) gave highest gross return (4, 33,300), highest net return (2, 79,724) and highest cost benefit ratio (1:2.82).

On the basis of present study, it is concluded that the application of 25% RDF+ 75% Poultry manure resulted in maximum plant height (185.93 cm) and tuber yield (4.33kg/plant).

This treatment also gives maximum gross return (Rs.4, 33,300) and maximum net return (Rs.2, 79,724).

The cost benefit ratio (1:2.82) is also high in this treatment combination

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