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Effect of Intercropping and Organic Manures on Weed Control and Performance of Cassava (*Manihot esculenta* Crantz.)

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Abstract: Field experiments were conducted to find out the effect of intercropping and organic manures on weed control and performance of cassava at Veterinary College and Research Institute Farm, Namakkal during 2001 and 2002. The popular hybrid of cassava H 226 was tried as test crop. Three intercropping systems viz., sole cassava, cassava + maize (var. African tall) and cassava + cowpea (var. CO 5) were assigned to main plots. Six organic manurial treatments viz., FYM (25 t ha^{-1}), Poultry manure (10 t ha^{-1}), composted poultry manure (10 t ha^{-1}), FYM (12.5 t ha^{-1}) + poultry manure (5 t ha^{-1}), FYM (12.5 t ha^{-1}) + composted poultry manure (5 t ha^{-1}) along with control (no organic manure) were assigned to sub plots. The results indicated that intercropping in cassava recorded lesser weed DMP compared to sole cassava especially in the early stages of growth. Intercropping also registered higher weed smothering efficiency. The tuber yield of cassava was not reduced significantly due to cowpea intercrop. All the manurial treatments had lesser WDMP due to better growth of cassava especially in the early growth stages. The tuber yield also increased due to application of organic manures and the highest yield obtained by application of composted poultry manure.

Key words: Cassava, intercropping, poultry manure, weed control, yield

INTRODUCTION

Intercropping in cassava is a widely followed practice in the humid and sub-humid tropics. In Latin America and Africa, cassava is most commonly associated with an early maturing grain crop such as maize or legumes. Cassava, a long season, wide spaced crop is slow in its initial growth and development and therefore, intercropping a short duration crop may increase the biological efficiency as a whole. Normally, green covers are planted with cassava for a variety of purposes such as cultural weed control, fertility and moisture conservation and forage production (Leihner, 1980).

Application of organic manures has various advantages such as increasing soil physical properties, water holding capacity, organic carbon content apart from supplying good quality of nutrients. The addition of organic sources could increase the yield through improving soil productivity and higher fertilizer use efficiency (Santhi and Selvakumari, 2000). High and sustained yield could be obtained with judicious and balanced fertilization combined with organic manures (Kang and Balasubramanian, 1990).

Poultry manure is rich organic manure since solid and liquid excreta are excreted together resulting in no urine loss. In fresh poultry excreta uric acid or urate is the most abundant nitrogen compound (40-70% of total N) while urea and ammonium are present in small amounts (Krogdahl and Dahlsgard, 1981). The nutritional value of unprocessed poultry manure deteriorates rapidly. Hence, the immediate processing of poultry manure to prevent its rapid decomposition and save its nutrient properties is, thus essential.

Composting or the biological degradation of poultry manure produces a material with several advantages with respect to handling by reducing volume, mass of dry matter, odours, fly attraction and weed seed viability (Sweeten, 1980). Composting poultry manure under anaerobic conditions helps for greater recovery of final product and negligible loss of nutrients particularly nitrogen (Kirchmann and Witter, 1989).

It is hypothesized that cassava with fodder cowpea or fodder maize ensure good coverage of soil surface and thereby reduce the weed growth thus improving the performance of the intercropping system. Moreover application of organics improves the fertility status of the soil and has the ability to fulfil the nutrient requirement of the intercropped cassava systems. Since the availability of organics in the form of FYM is prohibitive, use of poultry manure in places of availability may be beneficial. In order to test the hypothesis, field experiments were conducted with the objective of finding out the effect of intercropping and organic manures on the weed control and yield of Cassava.

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MATERIALS AND METHODS

Field experiments were conducted to find out the effect of intercropping and organic manures on the weed control and yield of cassava at Veterinary College and Research Institute Farm, Namakkal during 2001 and 2002. The popular hybrid of cassava, H 226 was tried as test crop. Three intercropping systems viz., sole cassava, cassava + maize (var. African tall) and cassava + cowpea (var. CO 5) were assigned to main plots. Six organic manurial treatments viz., FYM (25 t ha^{-1}), Poultry manure (10 t ha^{-1}), composted poultry manure (10 t ha^{-1}), FYM (12.5 t ha^{-1}) + poultry manure (5 t ha^{-1}), FYM (12.5 t ha^{-1}) + composted poultry manure (5 t ha^{-1}) along with control (no organic manure) were assigned to sub plots. The treatments were fitted in split plot design replicated thrice.

Two rows of intercrops were sown in between the rows of main crop as additive intercropping series. Nutrients were applied only to the main crop. Disease free setts of 20 cm length were prepared and planted at a spacing of 90×90 cm. Seeds of fodder maize and cowpea were dibbled in lines at a spacing of 30×20 cm accommodating two rows of intercrops between the rows of cassava. Manures were applied as per treatments and thoroughly incorporated at the time of forming beds and channels.

A fertilizer dose of 60:60:150 NPK kg ha^{-1} was uniformly applied to all the plots. The entire dose of phosphorus, 50% of recommended dose of nitrogen and 50% of K were applied basally at the time of planting and the remaining 50% of the recommended dose of nitrogen and potassium were top dressed in two equal splits at third and fifth month, respectively, as per the treatments. Fertilizers were applied only to the main crop. After initial and life irrigation on third day, subsequent irrigations were given to the experimental field at an interval of ten days. Three hand weeding on 30th, 60th and 90th day after planting and an earthing up at 120 DAP was given commonly for all the plots irrespective of the treatments.

Composting of poultry manure was initiated using poultry manure and chopped sorghum straw. The bits of sorghum straw were mixed with poultry manure at the rate of 1:10 and packed in dug pits and closed with mud plaster. To maintain optimum moisture, water was sprinkled before it is being packed and left under anaerobic conditions for 75 days as suggested by Sims *et al.* (1992) for composting poultry manure and poultry carcasses.

Weed Dry Matter Production (WDMP): Quadrat of 0.25 m^2 was placed in four places at random outside the net plot and the weeds enclosed were cut close to ground level, sun dried and oven dried till a constant weight was achieved and expressed as g m^{-2}.

Weed Smothering Efficiency (WSE) was worked out by adopting the formula suggested by Subramanian *et al.* (1993) for both intercrops-maize and cowpea.

$$\text{WSE (\%)} = \frac{\text{Weed DMP in sole crop} - \text{Weed DMP in intercrop}}{\text{Weed DMP in sole crop}} \times 100$$

The weed dry matter data was subjected to log (X+2) transformation for statistical analysis

RESULTS AND DISCUSSION

Weed Dry Matter Production (WDMP): Intercropping systems and organic manures played a significant role and the weed drymatter production varied significantly due to the treatments.

Intercropping in cassava recorded the least weed DMP at all stages (Table 1 and 2). The effect was more prominent between 30 and 60 DAP. The lesser weed DMP recorded in intercropped cassava might be due to better coverage of soil surface from the beginning with the intercrop association which might have diminished the light, penetrating to the soil, thus reducing the weed growth. This result corroborated the findings of Leihner (1980) who had found that the sole practice of intercropping beans in cassava reduced the total weed dry weight to 47% at 90 DAP. Similar findings were reported by Ossom (1986), Zuofa *et al.* (1992) and Olasantan *et al.* (1994).

Among the organic manures, the least weed DMP was recorded in poultry manure followed by composted poultry manure. Better growth of cassava in the initial stages under these treatments might have suppressed the weeds. When poultry manure was added, aerobic fermentation occurred with the production of heat and loss of CO_2 and ammonia (Simpson, 1986). The heat produced and the immediate higher availability of N might have caused caustic effect on the germinating weeds, which might have reduced the weed biomass. Another plausible reason might be that poultry manure is totally free of weed seeds because of the use of broken grains in poultry rations.

Weed Smothering Efficiency (WSE): Among the intercrops, cowpea registered higher WSE as compared to maize which might be due to the fact that cowpea ensured better coverage of soil surface from the beginning and diminished light penetration to the soil reducing the weed growth and ensuing better WSE (Table 3). Similar result was reported by Leihner (1980) in cassava + legume intercropping.

Table 1: Effect of intercropping and organic manures on the weed dry matter production (g m^{2}) in cassava intercropping systems

	2001			2002		
Treatments	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
I_1 sole cassava	1.51 (30.52)	1.22 (14.59)	0.91 (6.04)	1.52 (31.25)	1.35 (20.29)	1.08 (10.11)
I_2 cassava + maize	1.46 (26.77)	1.12 (11.18)	0.78 (4.09)	1.48 (28.00)	1.14 (11.74)	0.92 (6.41)
I_3 cassava + cowpea	1.41 (23.77)	0.96 (7.14)	0.69 (2.94)	1.42 (24.42)	1.05 (9.32)	0.68 (2.83)
SE_d	0.01	0.01	0.01	0.01	0.01	0.01
CD (p = 0.05)	0.02	0.01	0.01	0.02	0.02	0.02
M_1 control	1.50 (29.99)	1.14 (12.23)	0.80 (4.44)	1.44 (29.35)	1.21 (14.88)	0.94 (7.24)
M_2 FYM (25 t ha^{-1}),	1.46 (27.29)	1.11 (11.19)	0.79 (4.34)	1.43 (28.46)	1.18 (13.82)	0.91 (6.68)
M_3 Poultry manure (10 t ha^{-1})	1.41 (24.56)	1.06 (9.88)	0.79 (4.27)	1.40 (26.23)	1.16 (13.03)	0.87 (5.93)
M_4 composted poultry manure (10 t ha^{-1})	1.42 (24.56)	1.06 (9.83)	0.79 (4.25)	1.40 (26.74)	1.16 (12.93)	0.86 (5.75)
M_5 FYM (12.5 t ha^{-1}) + poultry manure (5 t ha^{-1})	1.48 (28.34)	1.12 (11.56)	0.80 (4.43)	1.42 (27.99)	1.18 (14.03)	0.90 (6.58)
M_6 FYM (12.5 t ha^{-1}) + composted poultry manure (5 t ha^{-1})	1.48 (28.32)	1.11 (11.12)	0.80 (4.40)	1.43 (28.57)	1.18 (14.02)	0.90 (6.50)
SE_d	0.01	0.01	0.01	0.01	0.01	0.01
CD (p = 0.05)	0.02	0.01	0.01	0.01	0.02	0.02

(Figures in parenthesis indicate original value)

Table 2: Effect of intercropping and organic manures on the weed dry matter production (g m^{-2}) at 60 DAP in cassava

	2001				2002			
Treatment	I_1 sole cassava	I_2 cassava + maize	I_3 cassava + cowpea	Mean	I_1 sole cassava	I_2 cassava + maize	I_3 cassava + cowpea	Mean
M_1 control	1.39 (22.41)	1.15 (12.28)	1.08 (9.95)	1.21 (14.88)	1.11 (11.00)	0.98 (7.46)	0.72 (3.26)	0.94 (7.24)
M_2 FYM (25 t ha^{-1})	1.34 (19.84)	1.14 (11.83)	1.07 (9.79)	1.18 (13.82)	1.10 (10.58)	0.92 (6.33)	0.71 (3.14)	0.91 (6.68)
M_3 Poultry manure (PM) (10 t ha^{-1})	1.32 (18.71)	1.12 (11.32)	1.04 (9.06)	1.16 (13.03)	1.05 (9.33)	0.90 (5.88)	0.66 (2.57)	0.87 (5.93)
M_4 Composted poultry manure (CPM) (10 t ha^{-1})	1.32 (18.72)	1.12 (11.18)	1.04 (8.90)	1.16 (12.93)	1.05 (9.24)	0.88 (5.51)	0.66 (2.52)	0.86 (5.75)
M_5 FYM (12.5 t ha^{-1}) + PM (5 t ha^{-1})	1.36 (21.11)	1.14 (11.90)	1.05 (9.09)	1.18 (14.03)	1.09 (10.26)	0.94 (6.71)	0.68 (2.79)	0.90 (6.58)
M_6 FYM (12.5 t ha^{-1}) + CPM (5 t ha^{-1})	1.36 (20.99)	1.14 (11.93)	1.05 (9.14)	1.18 (14.02)	1.09 (10.25)	0.93 (6.55)	0.67 (2.71)	0.90 (6.50)
Mean	1.35 (20.29)	1.14 (11.74)	1.05 (9.32)		1.08 (10.11)	0.92 (6.41)	0.68 (2.83)	

	SE_d	CD (p = 0.05)	SE_d	CD (p = 0.05)
I	0.01	0.02	0.01	0.02
M	0.01	0.02	0.01	0.02
M at I	0.01	0.02	0.01	0.02
I at M	0.01	0.02	0.01	NS

(Figure in parenthesis indicate original value)

Table 3: Effect of intercropping and organic manures on the weed smothering efficiency (%)

	2001			2002		
Treatments	I_2 cassava + maize	I_3 cassava + cowpea	Mean	I_2 cassava + maize	I_3 cassava + cowpea	Mean
M_1 control	11.61	21.50	16.56	9.38	21.01	15.20
M_2 FYM (25 t ha^{-1})	12.34	22.00	17.17	9.81	21.52	15.67
M_3 Poultry manure (10 t ha^{-1})	12.89	22.68	17.78	11.60	22.37	16.99
M_4 composted poultry manure (10 t ha^{-1})	12.56	22.76	17.66	10.88	22.15	16.52
M_5 FYM (12.5 t ha^{-1}) + poultry manure (5 t ha^{-1})	12.00	22.24	17.12	10.43	21.90	16.17
M_6 FYM (12.5 t ha^{-1}) + composted poultry manure (5 t ha^{-1})	12.50	21.76	17.13	10.38	21.76	17.07
Mean	12.31	22.15		10.41	21.79	

(Data not statistically analysed)

All organic manure treatments exhibited higher WSE than no organic manure control. This might be attributable to the better growth of intercrops in these treatments, which could have led to the foliage cover resulting in higher WSE. At both the intercropping systems, poultry manure 10 t ha^{-1}; CPM either alone or with FYM registered higher WSE. Better growth of intercrops as evidenced by higher biomass accumulation in these treatments in the present investigation might be the reason for such higher WSE.

Fresh tuber yield (Table 4): The various treatments imposed had their own influence on the tuber yield with

Table 4: Effect of intercropping and organic manures on the tuber yield (t ha^{-1}) of cassava

	2001				2002			
Treatment	I_1 sole cassava	I_2 cassava + maize	I_3 cassava + cowpea	Mean	I_1 sole cassava	I_2 cassava + maize	I_3 cassava + cowpea	Mean
M_1 control	22.33	21.07	22.09	21.83	22.65	21.40	22.05	22.03
M_2 FYM (25 t ha^{-1})	32.14	31.11	31.66	31.63	33.18	31.78	32.09	32.35
M_3 Poultry manure (10 t ha^{-1})	32.59	31.69	32.19	32.16	33.22	31.85	32.38	32.48
M_4 composted poultry manure (10 t ha^{-1})	35.28	33.97	34.78	34.67	36.12	34.81	35.38	35.44
M_5 FYM (12.5 t ha^{-1}) + poultry manure (5 t ha^{-1})	34.25	32.80	33.83	33.62	34.76	33.58	33.95	34.10
M_6 FYM (12.5 t ha^{-1}) + composted poultry manure (5 t ha^{-1})	34.78	33.23	34.43	34.15	35.59	34.28	34.89	34.92
Mean	31.89	30.64	31.49		32.59	31.28	31.79	

	SE_d	CD (p = 0.05)		SE_d	CD (p = 0.05)
I	0.40	0.88	I	0.40	0.90
M	0.03	0.07	M	0.03	0.07
M at I	0.06	0.11	M at I	0.06	0.11
I at M	0.40	0.89	I at M	0.41	0.90

varying magnitudes. Highest tuber yield was recorded by sole cassava followed by cassava intercropped with cowpea that was comparable with sole cassava. The lowest yield was associated with cassava intercropped with maize. In sole cassava, there was no competition for various resources except intra-species competition. This might have paved way for the increase in growth and yield parameters that would have increased the yield. Many scientists (Prabhakar *et al*., 1983; Mestra, 1990; Karnik *et al*., 1993) reported a similar higher tuber yield by sole cassava.

Even though cassava intercropped with cowpea recorded lesser yield than sole cassava, the yield reduction was not significant. There was a set back in the growth parameters due to cowpea intercropping. However, after the harvest of cowpea, the smothering effect was reduced slowly and an improvement in growth and yield parameters was obtained as evidenced in this present study and this might cumulatively have contributed for the increase in yield of cassava. The work of Villanueva (1983) revealed that intercropping legumes like groundnut, mung bean, cowpea and bush bean, did not significantly reduce the yield of cassava. Savithri and Alexander (1995) reported that there was no significant difference in yield of cassava when intercropped with cowpea and this lend support to this present finding.

The reduction in tuber yield of cassava intercropped with fodder maize might be attributable to the higher competition by maize for resources in the early stages and the resultant effect on the growth and yield parameters up to harvest. Similar yield reduction by intercropping maize in cassava was reported by Ezumah (1990) and Ikeorgu and Odurukwe (1993). Olasantan *et al*. (1997) concluded that the main factor limiting the yield in a cassava-maize intercropping system was the depression of the early cassava growth by vigorous maize component, which reduced the amount of assimilate allocated to cassava roots.

On comparing the data on yield due to the organic manures, it was clearly evident that all the treatments that received organic manures recorded higher tuber yield than no organic manure control suggesting the importance of organic manures. Higher tuber yield due to organic manures could be attributed to favourable changes in soil that might have resulted in loose and friable soil condition and enabled better tuber formation. Moreover, positive influence of these treatments might be due to slow and steady availability of nutrients throughout the crop growth period from organic manures. Mohankumar *et al*. (1976) and Pillai *et al*. (1987) reported the beneficial effect of FYM at 12.5 t ha^{-1} in enhancing the yield of cassava tuber.

Adequate biomass production, better nutrient uptake and improvement in yield parameters might have resulted in higher tuber yield consequent to application of composted poultry manure either alone or in combination with FYM followed by poultry manure in conjunction with FYM. Enrichment of soil N and P in available form by the addition of composted poultry manure might be responsible for good performance by CPM besides their higher NPK content compared to FYM. Jayanthi (1995) reported a similar result of higher yield of rice due to composted and recycled poultry manure. Increased castor seed yields due to the application of 10 t ha^{-1} of poultry manure was reported by Ugbaja (1996) and increased egg plant yields up to 15 t ha^{-1} of poultry manure was reported by Opara and Asiegbu (1996). Ponsica *et al*. (1983) observed a higher efficiency of poultry manure than cattle manure in increasing the yield of maize. Even though poultry manure had higher N than composted poultry manure, it did not record higher yield over composted poultry manure. The immediate mineralization of N after application, at the stage, the plant had not even sprouted and the resultant loss of N by ammonia volatilisation might be the reason for the relatively lesser yield recorded under poultry manure. Wolf *et al*. (1988) reported that 37% of N in poultry manure was volatilized in 11 days after application, which might reduce the availability of N for plant uptake and this is concomitant to this result. Another ostensible reason might be the narrower C: N ratio of poultry manure. Low C: N ratio might have favoured aerobic fermentation in the field resulting in loss of CO_2 and ammonia, thus reducing the nutrients especially N for plant uptake. Similar result was also reported by Simpson (1986).

CONCLUSIONS

The results revealed that intercropping in Cassava recorded lesser weed DMP compared to sole Cassava especially in the early stages of growth. Intercropping also registered higher weed smothering efficiency. The tuber yield of Cassava was not reduced significantly due to cowpea intercrop. All the manurial treatments had lesser WDMP due to better growth of Cassava especially in the early growth stages. The tuber yield also increased due to application of organic manures and the highest yield obtained by application of composted poultry manure.

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