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EVALUATION OF TURMERIC AND SWEET POTATO TO MANURING IN ARECANUT GARDENS

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ABSTRACT

Response of turmeric and sweet potato to manuring as intercrops in arecanut gardens and as pure crops was evaluated by studying the growth attributes like number of leaves, tillers, LAR, RLGR, RGR, NAR, bio-mass production and yield of economic end products. Response behaviour of turmeric and sweet potato was the same as inter crops and pure crops. Number of functional leaves, tillers or branches/plant and biomass production showed increase with manuring; but these were not reflected in yield of economic end products.

INTRODUCTION

Intercropping in arecanut plantations is a common practice and farmers generally have their preferences in choosing seasonal crops in the interspaces especially when the plantations are young. Crops such as turmeric, ginger, sweet potato, elephant foot yam, dioscorea, banana, betelvine, pineapple, cacao and other crops are raised in arecanut gardens. Abraham (1956) reported that ginger, turmeric, black pepper and cardamom could be grown successfully as intercrops in arecanut gardens. Bhandary (1974) showed that the additional income could be obtained by intercropping. Turmeric responds to manuring and 70:60:120 kg NPK/ha have been recommended (Anonymous, 1977). Response of sweet potato to manuring has been inconsistent. Studies were undertaken to study the response of these two crops to manuring as intercrops as compared to those of pure crops so that appropriate recommendations could be made for different situations.

MATERIALS AND METHODS

The experiment was conducted during 1978–'80 at the Central Plantation Crops Research Institute, Research Centre, Hirehalli in a 8 x 3 Randomised Block Design with four levels of fertilizer, (i) 0, 70, 140, 210 kg N/ha, (ii) 0, 60, 120, 180 kg P_2O_5/ha, (iii) 0, 120, 240, 360 kg k_2O/ha to turmeric and (i) 0, 70, 140, 210 kg N/ha, (ii) 0, 50, 100, 150 kg P_2O_5/ha, and (iii) 0, 70, 140, 210 kg K_2O/ha to sweet potato. The intercropping experiment was laid out in a 15 year old arecanut garden. The pure crop experiment was laid out separately. Turmeric and sweet potato were planted in June, 1978 and again in May 1979 on ridges adopting a spacing of 25 x 15 cm for turmeric and 25 x 20 cm for sweet potato both as pure crops and as intercrops in arecanut. In arecanut garden, the total population of intercrops in one hectare was one third of the total population of pure crop. The soil of the experimental site was clayey loam with a pH of 6.3 and EC of 0.25 m.mhos/cm. It had an organic matter of

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0.95%, total N of 2.06%, P_2O_5 of 0.30% and total K_2O of 0.62% for a depth of 25 cm. Biometric observations of turmeric and sweet potato both as intercrops and pure crops were recorded. Sampling procedure and processing were made according to Kvet et al (1971). The plant parts were separated into leaves, stem, root/tuber and then were dried at 80–85°C to constant weight. The data were used to compute net assimilation rate (NAR), leaf area ratio (LAR), relative growth rate (RGR) and relative leaf growth rate (RLGR) using the formulae suggested by Power et al. (1947) and Krishnamurthy et al. (1973). For other morphological characters five plants were randomly selected and tagged for making observations during the crop growth.

RESULTS AND DISCUSSION

Leaf production in turmeric during 1978–79 either as intercrop or pure crop did not show any significant change due to different levels of fertilizers (Table I). During 1979–80, fertilizer levels produced significantly more number of leaves when compared to control (0 level). Fertilizer levels did not influence the functional leaves of

Table I. *Number of functional leaves produced by intercrops and pure crops of turmeric and sweet potato as influenced by fertilizer levels*

Crop	Treatment			Inter crop			Pure crop		
	Fertilizer applied								
	N	P_2O_5	K_2O	78–79	79–80	Mean	78–79	79–80	Mean
	kg ha^{-1}			No. plant^{-1}					
Turmeric	0	0	0	13	12	13	14	16	15
Turmeric	70	60	120	16	14	15	15	22	19
Turmeric	140	120	240	16	14	15	15	22	19
Turmeric	210	180	360	15	16	15	14	19	16
Mean				15	14	—	15	20	—
F. Test				NS	S	NS	NS	S	S
C. D.				—	2	—	—	3	2
CV %				16	9	10	17	8	5
Sweet potato	0	0	0	232	147	189	239	165	202
Sweet potato	70	50	70	217	170	194	302	198	250
Sweet potato	140	100	140	205	185	195	235	194	214
Sweet potato	210	150	210	211	159	185	334	203	268
Mean				216	165	—	277	190	—
F. Test				NS	NS	NS	NS	NS	S
C. D.				—	—	—	—	—	58
CV %				19	20	10	21	9	12

S = Significant at 5% NS = Not significant

sweet potato either as a pure crop or as an intercrop in both the years. The mean data indicated that the number of functional leaves in the intercrop sweet potato increased with the increase in the fertilizer schedules upto second level (195) and thereafter declined, whereas in pure crop there was a significant increase in the number of functional leaves (268) over the 0 level (202).

In turmeric, there were no marked difference in the pattern of production of tillers either as a pure crop or as an intercrop during 1978–79 (Table II). During 1979–80, turmeric when grown as an intercrop produced significantly higher number of tillers at all levels of fertilizers (4.6 to 4.8) compared to 0 level (3.8). However, there were no differences among the fertilizer levels. Sweet potato did not exhibit any improvement in branching with the increase in the level of fertilizers either as intercrop or as pure crop during 1978–79. Pure crop of sweet potato at 70:50:70 kg NPK/ha produced significantly higher number of branches (21.7) compared to all other treatments in 1979–80.

Turmeric as an intercrop in 1978–79 did not show any significant differences in the production of biomass to varying levels of

Table II. *Number of tillers/branches produced by the inter and pure crops of turmeric and sweet potato as influenced by fertilizer levels*

Crop	Treatment			Inter crop			Pure crop		
	Fertilizer applied								
	N	P_2O_5	K_2O	78–79	79–80	Mean	78–79	79–80	Mean
	kg ha^{-1}			No. plant^{-1}					
Turmeric	0	0	0	3.2	3.8	3.5	3.8	4.9	4.3
Turmeric	70	60	120	3.1	4.8	3.9	3.6	4.5	4.0
Turmeric	140	120	240	4.5	4.6	4.6	4.0	5.3	4.6
Turmeric	210	180	360	3.4	4.7	4.0	3.5	4.5	4.0
Mean				3.5	4.5	—	3.7	4.8	—
F. Test				NS	S	S	NS	NS	NS
C. D.				—	0.5	0.8	—	—	—
CV %				20.5	5.0	12.8	32.6	13.4	23.0
Sweet potato	0	0	0	17.5	13.8	15.7	22.3	20.0	21.1
Sweet potato	70	50	70	17.9	16.4	17.1	24.3	21.7	23.0
Sweet potato	140	100	140	14.5	15.1	14.8	21.8	19.3	20.5
Sweet potato	210	150	210	16.6	13.9	15.2	23.7	19.7	21.7
Mean				16.6	14.8	—	23.0	20.2	—
F. Test				NS	NS	NS	NS	S	NS
C. D.				—	—	—	—	2.4	—
CV %				21.2	12.5	12.4	20.3	5.8	13.5

S = Significant at 5% NS = Not significant

fertilizers whereas a fertilizer level of 140:120:240 kg NPK/ha produced significantly higher amount of biomass (10.4 tonnes) than the other levels of fertilizers during 1979–80 (Table III). In the pure crop of turmeric in both the years it is observed that there was no significant difference in the biomass production due to different levels of fertilizers. In sweet potato the difference due to various levels of fertilizers both in pure as well as intercropping systems did not bring significant differences in biomass production.

Leaf area ratio (LAR) in the intercrop of turmeric was found to be three times higher (0.04 to 0.09) than the pure crop of turmeric (0.01 to 0.03) (Table IV). LAR was highest under fertilizer dose of 210:180:360 kg NPK/ha both under sole crop (0.03) as well as intercrop (0.09). In case of sweet potato also the LAR values were nearly two times higher (0.07 to 0.08) in the intercrop than under pure crop (0.03 to 0.04). There is no marked difference in LAR values among the fertilizer treatments in both the aspects of cropping systems.

The Relative Leaf Growth Rate (RLGR) in turmeric ranged from 4.0 to 8.9 in the intercrop whereas in pure crop it varied from

Table III. *Biomass production of inter and pure crops of turmeric and sweet potato as influenced by fertilizer levels*

Crop	Treatment			Inter crop			Pure crop		
	Fertilizer applied								
	N	P_2O_5	K_2O	78–79	79–80	Mean	78–79	79–80	Mean
	kg ha^{-1}			Ton ha^{-1}					
Turmeric	0	0	0	8.1	9.3	8.7	7.5	9.5	8.5
Turmeric	70	60	120	7.8	8.0	7.9	7.5	9.0	8.2
Turmeric	140	120	240	7.8	10.4	9.1	8.1	9.7	8.9
Turmeric	210	180	360	8.8	9.6	9.2	8.2	11.1	9.7
Mean				8.1	9.3	—	7.8	9.8	—
F. Test				NS	S	NS	NS	NS	NS
C. D.				—	0.2	—	—	—	—
CV %				26.7	11.3	8.1	16.89	21.9	16.8
Sweet potato	0	0	0	14.9	12.6	13.7	25.6	27.5	26.5
Sweet potato	70	50	70	13.3	11.9	12.6	29.2	26.1	27.6
Sweet potato	140	100	140	18.1	14.1	16.1	24.4	30.4	27.4
Sweet potato	210	150	210	16.0	12.9	14.4	28.5	30.0	29.0
Mean				15.6	12.8	—	26.9	28.5	—
F. Test				NS	NS	NS	NS	NS	NS
C. D.				—	—	—	—	—	—
CV %				30.6	10.6	14.3	27.2	7.9	4.4

S = Significant at 5% NS = Not significant

Table IV. *Effect of fertilizer levels on the growth attributes of inter and pure crop of turmeric and sweet potato*

Crop	Treatment: Fertilizers applied N	P_2O_5	K_2O (kg ha^{-1})	Intercrop LAR $cm^2 g^{-1}$	RLGR $gg^{-1} d^{-1}$	RGR $gg^{-1} d^{-1}$	NAR $gm^{-2} d^{-1}$	Pure crop LAR $cm^2 g^{-1}$	RLGR $gg^{-1} d^{-1}$	RGR $gg^{-1} d^{-1}$	NAR $gm^{-2} d^{-1}$
Turmeric	0	0	0	0.04	4.0	15.4	3.4	0.01	5.8	20.0	6.6
Turmeric	70	60	120	0.04	6.2	15.4	3.8	0.02	5.9	20.1	7.7
Turmeric	140	120	240	0.08	8.2	17.3	3.8	0.02	6.4	22.5	8.7
Turmeric	210	180	360	0.09	8.9	18.1	4.2	0.03	6.2	26.3	8.9
Sweet potato	0	0	0	0.07	2.7	20.9	2.8	0.03	8.8	22.3	6.3
Sweet potato	70	50	70	0.08	4.6	25.1	3.1	0.04	9.4	22.3	5.8
Sweet potato	140	100	140	0.08	4.5	27.1	3.0	0.04	9.6	23.6	6.6
Sweet potato	210	150	210	0.07	5.7	26.5	3.8	0.04	9.8	25.1	7.6

LAR = Leaf area ratio
RLGR = Relative leaf growth rate
RGR = Relative growth rate
NAR = Net assimilation rate

5.8 to 6.2. In the intercrop of turmeric RLGR values increased as the fertilizer levels increased whereas in the pure crop of turmeric it increased upto the third level (6.4) afterwards it decreased (6.2). In the case of sweet potato the values of RLGR in both the cropping systems increased as the fertilizer dose increased. RLGR values almost doubled in the pure crop of sweet potato when compared to intercropping sweet potato.

The Relative Growth Rate (RGR) in turmeric was higher in pure crop compared to intercrop. Highest level of fertilizer (210: 180:360 kg NPK/ha) recorded RGR value of 26.3 compared to the values of 20.0 to 22.5 in other treatments in the pure crop. The RGR values in the intercrop ranged from 15.4 to 18.1 whereas it ranged from 20.0 to 26.3 in the pure crop. In both the cropping systems RGR values increased as the fertilizer dose increased. In sweet potato, the pure crop recorded a range of RGR values of 22.3 to 25.1. In the intercrop, the highest dose of fertilizer provided a RGR of 26.5 compared to 25.1 to 27.1 in other fertilized treatments.

Net Assimilation Rate (NAR) in the pure crop of turmeric was nearly two times (6.6 to 8.9) that of the intercrop (3.4 to 4.2). In case of sweet potato also the NAR values in the pure crop were nearly two times (6.3 to 7.6) those of intercrop (2.8 to 5.8). NAR values in pure crop as well as intercrop increased with the increase of fertilizer levels both in turmeric as well as sweet potato.

Application of fertilizer to turmeric when grown as pure crop or intercrop in arecanut did not have any significant impact on turmeric yield during 1978–79 (Table V). During 1979–80, fertilizer application had a significant difference in yield of turmeric in both the systems of cropping. Turmeric as intercrop with 140:120:240 kg NPK/ha provided the maximum yield of 2.2 tonnes/ha

Table V. *Effect of fertilizer levels on the yield on inter and pure crops of turmeric and sweet potato*

Crop	Treatment: Fertilizer applied N	P_2O_5	K_2O	1978–79 IC	1978–79 P	1979–80 IC	1979–80 P	Mean IC	Mean P
	kg/ha			Tonnes/ha					
Turmeric	0	0	0	2.8	6.5	1.5	5.3	2.4	5.9
Turmeric	70	60	120	2.7	6.8	2.0	7.7	2.5	7.2
Turmeric	140	120	240	3.1	7.9	2.2	6.6	2.6	7.3
Turmeric	210	180	360	3.1	6.8	2.1	10.2	2.8	8.5
Mean				2.9	7.0	1.9	7.4	2.6	7.2
F. Test				NS	NS	S	S	NS	S
CD				—	—	0.4	3.7	—	2.3
CV %				11.8	18.6	10.9	25.5	8.4	16.4
Sweet potato	0	0	0	5.1	17.8	2.9	16.3	4.1	17.1
Sweet potato	70	50	70	1.6	14.8	1.0	15.8	1.3	15.3
Sweet potato	140	100	140	1.5	19.7	1.0	15.8	1.2	14.5
Sweet potato	210	150	210	1.6	18.5	0.9	17.6	1.2	18.1
Mean				2.4	17.7	1.4	16.4	1.9	16.2
F. Test				NS	NS	S	NS	S	NS
CD				—	—	0.6	—	1.6	—
CV %				63.3	32.6	23.4	6.9	41.6	16.9

IC = Intercrop
P = Pure crop
S = Significant at 5%
NS = Not significant

whereas turmeric as pure crop provided an yield of 10.2 tonnes with the highest dose of fertilizer application. No significant variation amongst the treatments were observed in the mean values of the intercropping system. However, a significant difference was observed in the pure cropping system. The yield of turmeric was increased as the fertilizer doses increased. Maximum yield of 8.5 tonnes/ha was obtained with the highest fertilizer level of 210:180:360 kg NPK/ha but this was on par with other low fertilizer level applications. Intercropping sweet potato in arecanut with different levels of fertilizer had a significant effect on the yield of tubers only in the second year of cropping. Highest yield of 2.9 tonnes/ha was obtained with no fertilizers in the intercropping system which was significantly superior to all other fertilizer treatments. Fertilization did not have any influence either in the intercrop or pure cropping system. Mean data showed that all levels of fertilizers to intercrop brought down the tuber yield (1.3 to 1.2 tonnes/ha) when compared to control (4.1 tonnes/ha). As a pure crop, sweet potato did not respond to applied fertilizers significantly.

From this study it is very clear that both turmeric and sweet potato either as intercrop in arecanut or pure crop did not respond to the fertilizers applied. Probably nutrient that is available in the soil is optimum to get economic yields of turmeric and sweet potato.

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