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PRODUCTION POTENTIAL AND ECONOMIC FEASIBILITY OF CHEWING TOBACCO (*NICOTIANA TABACUM*) - BASED INTERCROPPING SYSTEM

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ABSTRACT

A field experiment was conducted during 2001-02 to 2004-05 at Vedasandur to study the production potential and economic feasibility of various intercrops in two cycles viz. *aggregatum* onion[*Allium cepa* (L.) var. *aggregatum*], bellary onion [*Allium cepa* (L.) var. cepa] , beet root [*Beta vulgaris* (L.)] + radish [*Raphanus sativus* (L.)] , Annual *moringa* [*Moringa olefera* (Lam.)] , ratoon *moringa* + fodder crops (*Pillipesara* + bajra) in comparison with sole chewing tobacco. First grade leaf yield (3.21 t/ha) and total cured leaf yield (4.18 t/ha) of chewing tobacco was higher with chewing tobacco + *aggregatum* onion over sole tobacco during the first cycle. Increase in total cured leaf yield was 7% over the sole tobacco. Whereas, in the second cycle, the growth attributes, first grade leaf yield (3.41 t/ha) and total cured leaf yield (4.18 t/ha) increased with chewing tobacco + radish. Increase in TCLY was 8 % over sole tobacco. Tobacco equivalent yield was significantly higher with chewing tobacco + annual *moringa* during the first cycle (6.60 t/ ha) and second cycle (5.82 t/ha) over sole tobacco. Net return was higher with chewing tobacco + annual *moringa* in the first cycle (Rs.76,500/ha) as well as in the second cycle (Rs.71,400/ha). Soil residual fertility decreased with chewing tobacco + beet root. It was concluded that higher tobacco equivalent yield and net returns could be achieved with chewing tobacco + annual *moringa* , an economically viable intercropping system for the chewing tobacco belt of Tamil Nadu.

Key words: Chewing tobacco, Inter crops, Tobacco equivalent yield.

INTRODUCTION

In Tamil Nadu, chewing tobacco is a cash crop mostly grown in *rabi* season. The other crops grown in the chewing tobacco belt of Tamil Nadu depends on the rainfall and water availability in the wells. Generally drought tolerant crops are preferred in this region. As there is frequent price fluctuation chewing tobacco, there is a need to increase the profitability per unit area through intercropping. The total soluble salts of water is > 1000 ppm and the performance of short duration pulses are poor and whereas the vegetable crops are successful in this region. Intercropping is a viable agronomic practice for increasing the productivity and profitability from a unit area. Earlier studies revealed that *aggregatum* onion would be a profitable intercrop in chewing tobacco under Tamil Nadu condition. In Bihar, garlic intercropped with chewing tobacco recorded the maximum total cured leaf yield, net returns and benefit: cost ratio (Singh *et al*. 1998). But in recent years, vegetables have good marketing potential and many type of vegetables grown as sole crops are profitable in these region. Hence an attempt was made to include the vegetable crops as intercrops in chewing tobacco, for higher system productivity and profitability per unit area.

MATERIALS AND METHODS

The field experiment was conducted during 2001-02 to 2004-05 at the farm of Central Tobacco Research Institute –Regional Station, Vedasandur to study the suitability and economic feasibility of intercrops in chewing tobacco. The soil type was sandy gravel with a pH 8.3, low in organic carbon content (0.45%), medium in available P (11.1 kg/ ha) and available K (127 kg/ha). The various chewing tobacco based intercropping systems in the first cycle were, T 1,chewing tobacco [*Nicotiana tabacum* (L.)] + *aggregatum* onion[*Allium cepa* (L.) var. *aggregatum*] ; T 2,chewing tobacco + bellary onion [*Allium cepa* (L.) var. cepa] ; T 3,

chewing tobacco + beet root [*Beta vulgaris* (L.)] ; T 4, chewing tobacco + radish [*Raphanus sativus* (L.)] ; T 5, chewing tobacco + annual *moringa* [*Moringa olefera* (Lam.)] ; T 6, chewing tobacco + annual *moringa* and T 7, Sole chewing tobacco. In the second cycle the treatment T 6 was ratooned and fodder crops were raised as intercrops *viz.* Ratoon *moringa* + fodder crops { *Pillipesara* [*Vigna trilobata* (L.)] + bajra [*Pennisetum typhoides* (L.)] }. The other treatments T 1 to T 5 and T 7 remained same as that of the first cycle. The experiment was conducted in a randomized block design with three replications.

Farm yard manure 25 t/ha was applied to the experimental field and ridges at a spacing of 75 cm was formed. *Aggregatum* onion variety 'CO 4' bulbs 600 kg/ha were planted at a spacing of 10 cm. A fertilizer dose of 100+65+75 NPK kg / ha was applied for the crop. Chewing tobacco was planted on the opposite ridges at a spacing of 75 cm, 30 days after planting (DAP) the *aggregatum* onion bulbs. *Aggregatum* onion was harvested at 75 DAP the bulbs, when the chewing tobacco reaches 45 DAP . After harvesting the *aggregatum* onion , first top dressing of 37.5 kg N/ha as ammonium sulphate was done for tobacco. The second topdressing of 37.5 kg N/ha as urea was done at 60-65 days. Bellary onion variety 'Nasik red' seeds were sown at 6 kg/ha in raised seed beds and seedlings of 30 days old were planted in the ridges formed at 75 cm at a spacing of 10 cm. After 30 DAP bellary onion seedlings, chewing tobacco was planted on the opposite ridges. The fertilizer schedule followed for bellary onion was 60+60+30 NPK kg/ha. Beet root variety 'DD red' seeds were sown at 2 kg/ha in raised seed beds and the seedlings of 20-25 days old were planted in the ridges formed at 75 cm at spacing of 10 cm. Radish variety 'Pusa chatki' seeds were dibbled in the ridges formed at 75 cm at a spacing of 10 cm. The fertilizer schedule followed for beet root and radish were 120+70+83 and 50+44+50 NPK kg/ha respectively.

Annual *moringa* variety 'PKM 1' seeds were sown in polythene bags and one month old seedlings were planted at a spacing 2 x 2 m along with chewing tobacco. The fertilizer schedule followed was 160+140+80 NPK kg /ha. The fodder crops *viz. Pillipesara* 'local' variety and bajra 'CO 22' were mixed and sown as intercrops in ratoon *moringa*. A seed rate of 40 kg/ha was followed for the fodder crops. The fertilizer schedule followed for pillipesara and bajra fodder were 25+40+20 and 30+20+ 20 NPK kg/ha respectively.

Chewing tobacco was given 44 kg P/ha as super phosphate mixed with four times of sieved FYM and spot applied. Topping was done keeping 12 leaves at 60 days after planting and decanol, a suckericide, @ 6% concentration was used for controlling the suckers. The tobacco based intercropping systems were irrigated once in 4 days and chewing tobacco was harvested at 120 days by stalk cut method. The first grade leaf yield (FGLY) and total cured leaf yield (TCLY) were recorded after sun-curing and standard fermentation process. The quality in terms of chewability was evaluated by various parameters *viz.* body of the leaf (10), aroma (10), whitish incrustation (10) , taste (10), pungency (10), saliva secretion (10), retention of pungency (10), stiffness in mouth, totaling to 80 (Palanichamy and Nagarajan, 1999). Samples of the cured leaves were given to three tobacco chewers and scores were recorded. A score of 60 and above was considered to indicate preferably the better quality for chewing purposes.

The chewing tobacco leaf samples were collected and analyzed for N, P and K content, nicotine and reducing sugars. The soil samples were collected at a depth of 0-22.5 cm and analyzed for organic-C, available P and available K. Chewing tobacco variety 'Meenakshi' was used for the four years. The production efficiency was calculated as per the method suggested by Tomar and Tiwari (1990). Economics was calculated based on the prevailing market rate. The crop received a total rainfall of 355.4, 613.2, 362 and 476.2 mm during the seasons 2001-02, 2002-03, 2003-04 and 2004-05 respectively. The maximum temperature recorded during four crop periods were 30.6, 32.8, 33.6 and 31.5 oC respectively. The minimum temperatures recorded were 19.2, 19.4, 19.4 and 19.1 °C respectively.

RESULTS AND DISCUSSION

Growth and yield

Leaf length ,leaf width and stem girth of chewing tobacco with chewing tobacco + *aggregatum* onion was comparable with the other chewing tobacco based intercropping systems and

sole tobacco except chewing tobacco + beetroot of the first cycle (Table 1). In the second cycle, higher leaf length, leaf width and stem girth was observed with the sole tobacco and with other chewing tobacco based inter cropping systems except chewing tobacco + beet root. Intercropping beet root with chewing tobacco reduced the growth of tobacco. The higher competition for light, nutrients and moisture could be attributed for lower growth attributes.

First grade leaf yield of chewing tobacco in the first cycle during 2001-02 did not show significant yield differences between various chewing tobacco based intercropping systems. Whereas during 2003-04, FGLY of sole tobacco was comparable with the chewing tobacco based intercropping systems except chewing tobacco + beet root. Similar trend was noticed with the mean FGLY also. The increase in FGLY with chewing tobacco + *aggregatum* onion, chewing tobacco + radish and sole chewing tobacco was 41, 40 and 32 % respectively over chewing tobacco+ beet root. The TCLY during 2001-02 and 2003-04 with chewing tobacco + *aggregatum* onion was comparable with the other chewing tobacco based intercropping systems and sole tobacco except chewing tobacco + beetroot. The mean TCLY also showed a similar trend. The increase in TCLY with Chewing tobacco + *aggregatum* onion, chewing tobacco + bellary onion, chewing tobacco+ annual *moringa* were 47, 46 and 42 % respectively over chewing tobacco+ beet root. The yield of chewing tobacco increased when *aggregatum* onion was raised as an intercrop in chewing tobacco (Manoharan *et al.*, 2002). The less competitiveness between chewing tobacco and intercrops could be attributed for the comparable yield with sole tobacco. The TCLY was significantly lower with chewing tobacco + beet root. Lower growth attributes due to higher competition of resources resulted in lower yield of chewing tobacco.

In the second cycle , FGLY and TCLY were better with sole tobacco and in the intercropping system except chewing tobacco + beetroot (Table 2).The mean FGLY and TCLY increased by 54 and 16 % respectively with radish over beetroot as an intercrop. Beet root being an exhaustive crop suppressed the chewing tobacco crop there by reduction in FGLY and TCLY of tobacco.

The yield of different intercrops was not affected by the chewing tobacco. During the year 2002-03 and 2003-04, reduction in yield of radish was noticed as compared to 2001-02 and 2004-05, which is due to the unfavorable weather and pest incidence in radish. The mean yield of the intercrops were higher with the first cycle compared to the second cycle, which could be attributed to the favorable weather prevailed during the season.

Preferable quality (chewability) score *viz.* more than 60 of chewing tobacco was observed with all the intercropping systems which indicated that various intercrops did not affect the chewing quality.

Tobacco equivalent yield and economics

Tobacco equivalent yield (TEY) was significantly higher with chewing tobacco + annual *moringa* over sole tobacco during first as well as second cycle. The increase in TEY during first and second cycle was 144 and 56 % respectively over sole tobacco .The yield advantage from intercropping compared to sole cropping is attributed to mutual complementary effects of component crops, such as better use of available resources like soil N, moisture etc. (Mandal *et al.*, 1990).

Net return was higher by 277% and 50% with chewing tobacco + annual *moringa* over sole tobacco in the first and second cycle respectively. The additional yield advantage from annual *moringa* resulted in increased net returns. Ragavaiah *et al.*(1985) reported an increased monetary returns with various tobacco types under intercropped situation. Chewing tobacco + annual *moringa* significantly increased the benefit :cost (B:C) ratio by 170% over sole tobacco. Higher net returns and lower cost of cultivation resulted in increased B:C ratio. During the second cycle, ratoon *moringa* + fodder crops (Pillipesara + bajra) significantly increased the B:C ratio by 32%.over sole tobacco. Benefit: cost ratio with ratoon *moringa* + fodder crops was comparable with tobacco + beet root (Table 3).

Production efficiency was significantly higher with tobacco + beet root by 77 and 47% during first and second cycle respectively. Production efficiency with tobacco + beet root during first cycle was comparable with tobacco + *aggregatum* onion. Higher tuber yield of the beet root per unit area in a

TABLE 1: Growth , yield and chewing quality of chewing tobacco under intercropping system during first cycle (Mean of 2001-02 & 2003-04).

Treatments	Leaf length (cm)	Leaf width (cm)	Stem girth (cm)	FGLY* (t/ha)			TCLY** (t/ha)			Yield of intercrops (kg/ha)	Chewing quality Score (out of 80)
				2001-02	2003-04	Mean	2001-02	2003-04	Mean		
Chewing tobacco + *aggregatum* onion	71.0	42.7	11.0	2.36	4.07	3.21	3.43	4.93	4.18	6.67	75
Chewing tobacco + bellary onion	70.5	41.0	10.4	2.09	4.08	3.09	3.09	5.22	4.15	4.95	75
Chewing tobacco + beet root	61.1	35.4	8.8	1.72	2.84	2.28	2.11	3.58	2.84	15.21	61
Chewing tobacco + radish	70.0	42.0	10.4	2.01	4.37	3.19	2.89	4.96	3.92	7.89	75
Chewing tobacco + annual *moringa*	69.0	39.8	10.5	1.70	3.93	2.90	3.13	4.92	4.02	11.75	69
Chewing tobacco + annual *moringa*	70.6	41.6	10.8	1.70	4.19	2.94	2.93	4.96	3.95	10.98	69
Chewing tobacco (Sole)	68.5	40.0	10.1	2.03	3.98	3.00	2.90	4.93	3.92	-	67
CD(P=0.05)	4.52	2.91	0.61	NS	0.44	0.31	0.54	0.54	0.36	-	-

*First grade leaf yield, **Total cured leaf yield.

TABLE 2: Growth, yield and chewing quality of chewing tobacco under intercropping system during second cycle (Mean of 2002-03 & 2004-05).

Treatments	Leaf length (cm)	Leaf width (cm)	Stem girth (cm)	FGLY (t/ha)			TCLY (t/ha)			Yield of intercrops (kg/ha)	Chewing quality Score (out of 80)
				2002-03	2004-05	Mean	2002-03	2004-05	Mean		
Chewing tobacco + *aggregatum* onion	78.7	48.4	12.4	3.30	3.10	3.20	3.74	3.82	3.78	5.36	76
Chewing tobacco + bellary onion	78.1	47.3	12.4	3.19	2.83	3.01	3.73	4.18	3.96	3.63	72
Chewing tobacco + beet root	77.7	46.5	12.0	3.04	2.40	2.22	3.72	3.45	3.59	24.17	63
Chewing tobacco + radish	78.9	49.1	12.4	3.59	3.22	3.41	4.28	4.08	4.18	7.16	74
Chewing tobacco + annual *moringa*	78.0	48.0	12.2	3.17	2.63	2.90	3.97	3.70	3.84	10.2	70
Ratoon *moringa* + fodder crops	-	-	-	-	-	-	-	-	-	16.6 (20.5)*	-
Chewing tobacco (Sole)	78.5	46.8	12.2	3.15	2.68	2.92	3.99	3.75	3.87	-	69

*Figure in the parentheses indicate the fodder yield of *pillipesara* & bajra

TABLE 3. Tobacco equivalent yield (TEY) and economics of chewing tobacco based intercropping system.

Treatments		Tobacco equivalent yield (t/ha)		Net returns (Rs/ha) (x10^3)		Benefit :Cost ratio		Production efficiency (Rs/day/ha)	
1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle
Chewing tobacco + *aggregatum* onion	Chewing tobacco + *aggregatum* onion	5.49	5.73	60.7	63.8	1.35	1.27	405	426
Chewing tobacco + bellary onion	Chewing tobacco + bellary onion	4.74	4.95	52.4	53.4	1.35	1.22	349	356
Chewing tobacco + beet root	Chewing tobacco + beet root	5.02	5.36	57.2	67.8	1.44	1.82	477	566
Chewing tobacco + radish	Chewing tobacco + radish	4.26	4.90	46.4	59.8	1.27	1.66	386	499
Chewing tobacco + annual *moringa*	Chewing tobacco + annual *moringa*	6.60	5.82	76.5	71.4	1.78	1.35	210	196
Chewing tobacco + annual *moringa*	Ratoon *moringa* + fodder crops	6.28	4.62	72.3	68.5	1.67	2.05	199	187
Chewing tobacco (Sole)	Chewing tobacco (Sole)	2.70	3.73	20.3	47.7	0.66	1.55	172	386
CD (P= 0.05)		0.99	0.56	18.7	NS	0.45	0.23	82.6	53.8

Cost of fertilizers: urea and muriate of potash Rs.4.6/kg,superphosphate Rs.3.10/kg; Sale price of produce :Chewing tobaccoRs.18.36/kg,radish and beet root Rs.3.50/kg, *aggregatum* onion, bellary onion and annual *moringa*Rs.6/kg during 2001-02; Chewing tobacco Rs.23.70/kg, radish Rs.2/kg, beet root Rs.3/kg, *aggregatum* onion and bellary onion Rs.6/kg and annual *moringa* Rs.4/kg, fodder Rs.0.60/kg during 2002-03; Chewing tobacco Rs.20.12/kg, radish Rs.2/kg, beet root Rs.2.50/kg, *aggregatum* onion and bellary onion Rs.6/kg and annual *moringa* Rs.4/kg during 2003-04; Chewing tobacco Rs.15.89/kg, radish Rs.2/kg, beet root Rs.2.50/kg, *aggregatum* onion , bellary onion and annual *moringa* Rs.6/kg , fodder Rs.0.60/kg during 2004-05.

TABLE 4: Nutrient uptake, chemical quality of chewing tobacco leaf lamina and residual soil fertility status after the intercropping system of first cycle (Mean of 2001-02 & 2003-04).

Treatments	(Nutrient uptake (kg/ha)			Chemical quality		Residual soil fertility		
	N	P	K	Nicotine %	Reducing sugars %	OC (%)	Available P (Kg/ha)	Available K (Kg/ha)
Chewing tobacco + *aggregatum* onion	78.4	5.18	60.2	2.51	1.58	0.56	11.6	118
Chewing tobacco + *bellary* onion	76.8	5.61	59.2	2.48	1.58	0.56	11.3	112
Chewing tobacco + beet root	50.0	4.25	32.4	2.32	1.54	0.36	10.0	108
Chewing tobacco + radish	68.6	4.73	51.3	2.55	1.41	0.54	11.2	125
Chewing tobacco + annual *moringa*	70.1	5.15	59.9	2.38	1.47	0.44	10.3	124
Chewing tobacco + annual *moringa*	72.2	5.53	51.3	2.27	1.70	0.44	10.9	120
Chewing tobacco (Sole)	68.3	4.32	53.0	2.52	1.60	0.53	11.2	132
CD (P=0.05)	1.73	0.30	1.37	-	-	0.06	0.69	8.66
Initial fertility status	-	-	-	-	-	0.45	11.1	127

short period resulted in increased production efficiency. Lower production efficiency was observed with sole tobacco and ratoon *moringa* + fodder crops during first and second cycle respectively.

Lamina nutrient uptake and residual soil fertility

The uptake of N by the chewing tobacco leaf lamina was significantly higher with chewing tobacco+ radish during both the cycles .The micro-climatic conditions prevailed in this treatment and the less competition for N is responsible for the increased chewing tobacco lamina N content. As N is positively correlated with nicotine and negatively correlated with reducing sugars, there was an increased nicotine and decreased reducing sugars in the lamina of chewing tobacco when radish was intercropped with chewing tobacco. Giridhar *et al.* (1998) reported that an increased N content in the lamina of FCV tobacco increased the nicotine and decreased the reducing sugars .

The uptake of P by chewing tobacco lamina during first and second cycle was higher with chewing tobacco+ bellary onion and chewing tobacco+ radish respectively. The uptake of K by chewing tobacco lamina was higher with chewing tobacco+ *aggregatum* onion and chewing tobacco+ radish during the first and second cycle respectively. Higher available P and K with these treatments could be attributed for increased P and K content of chewing tobacco lamina. Since the uptake of nutrient is a function of dry matter of lamina and nutrient content, the increased lamina yield together with higher N and K content resulted in greater uptake of these nutrients.

Soil organic-C values ranged between 0.44 to 0.56 % during the first cycle. Soil organic- C improved with beet root, radish and annual moringa as intercrops and with Sole chewing tobacco (Table 4). During the second cycle the soil organic-C values ranged between 0.44 to 0.54 %. Soil organic-C improved at all the treatments except with chewing tobacco + *aggregatum* onion (Table 5). The residual P increased with the intercrops *viz. aggregatum* onion, bellary onion, radish and sole tobacco as compared to initial soil available P in both the cycles. The less competition for soil nutrients could be attributed for increased available P over initial soil nutrient status. The available K decreased in all the intercropped treatments as compared to the initial

available K. Exhaustiveness of soil K by the vegetable crops could be attributed for the lower residual K. The less uptake of K by the chewing tobacco crop might have increased the available K status in the soil.

It was concluded that higher tobacco equivalent yield and net returns could be achieved with chewing tobacco + annual *moringa*, an economically viable intercropping system for the chewing tobacco belt of Tamil Nadu.

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