International Journal of Agricultural Sciences
Volume 14 | Issue 2 | June, 2018 | 308-312 ■ e ISSN-0976-5670
☞DOI:10.15740/HAS/IJAS/14.2/308-312
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RESEARCH PAPER

Studies on compatibility and profitability of intercrops in turmeric

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Abstract : Turmeric occupies about 6 per cent of the total area under spices and condiments in India. It is a long duration crop and the initial growth of turmeric is rather slow and takes about 4-5 months to cover the interspace. Therefore, the available space between the rows of turmeric could be effectively utilized by growing short duration crops like, vegetables, cereals etc. Hence, it is worthwhile to explore the possibilities of growing compatible crops with turmeric. With this background, this research project was formulated to find out the best compatible intercrop with turmeric, to study the effect of intercrops on growth and yield of turmeric and to determine the economic feasibility of turmeric based intercropping. In a nutshell, taking into consideration of the performance of various treatments in this experiment, it can be concluded that growing onion as an intercrop was found to be the best with respect to turmeric growth characters like plant height, number of leaves per plant, leaf length and leaf breadth. Although intercropping turmeric with cowpea is found compatible with maximum fresh turmeric rhizome yield per hectare (31.03 t/ha), the maximum B : C ration (2.53:1) was registered by turmeric intercropped with okra followed by turmeric + chilli (2.51:1). The monocropping of turmeric recorded the lowest B:C ration (1.70:1) among all the treatments.

Key Words : Intercrops, Turmeric, Compatibility, Equivalent yield, Benefit cost ratio

View Point Article : Hemalatha, P. and Chitra, R. (2018). Studies on compatibility and profitability of intercrops in turmeric. *Internat. J. agric. Sci.*, **14** (2) : 308-312, **DOI:10.15740/HAS/IJAS/14.2/308-312.**

Article History : Received : 07.03.2018**; Revised :** 20.04.2018**; Accepted :** 06.05.2018

INTRODUCTION

In India, turmeric (*Curcuma longa* L.) also known as "golden spice" is a very important spice, which produces nearly entire whole world's crop and consumes 80 per cent of the total production. Turmeric is cultivated in an area of 2.19 lakh hectares with an annual production of 11.67 lakh tonnes (NHB, 2012). Tamil Nadu holds the highest productivity (5.75 t ha^{-1}) among the various turmeric growing states of the country. In Tamil Nadu, the total area under turmeric is 60,230 hectares with production of 3.26 lakh tonnes rhizomes. Turmeric is a long duration crop and the initial growth phase of turmeric is rather slow and takes about 4-5 months to cover the interspace. Now-a-days with growing population and increasing pressure on land, possibility of extensive cultivation is limited. Therefore, the available space between the rows of turmeric could be effectively utilized by growing some short duration crops like annual spices, vegetables, cereals etc. Growing different species of crops having different rooting habit will help in utilizing soil moisture and nutrients at different depths of soil.

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Hence, an experiment was conducted to study the compatibility and economic feasibility of vegetable and other intercrops in turmeric.

MATERIAL AND METHODS

The field experiment was conducted at Southern Block of Agricultural Research Station, Tamil Nadu Agricultural University, Bhavanisagar during 2011–2014. The experiment was conducted to find out a suitable intercrop and its effect on the growth and yield economic feasibility of turmeric. The field is located at 11° 29" N latitude and longitude of 77° 80' E at 256 m above mean sea level. The mean annual rainfall was 717 mm and mean temperature was 33.9°C. The soil of the experimental area was sandy clay loam in texture. Turmeric variety BSR-2 was used for raising main crop of the experiment. The planting distance was 0.45 m between rows and 0.15 m between plants in a row. The plot size of the experiment was 3 × 2 m and the intercrops were sown/planted in the furrow in between two rows of turmeric. A fertilizer dose of 25:60:106 NPK kg ha^{-1} was uniformly applied to all the plots. Three hand weedings on 30th, 60th and 90th day after planting was done for all the plots. The experiment was laid out in a Randomized Block Design with eight treatments and replicated thrice.

The treatment details are,

T_1: Turmeric + Onion (var. Local type)
T_2: Turmeric + Black gram (var. ADT-3)
T_3: Turmeric + Green gram (var. CO-6)
T_4: Turmeric + Cowpea (var. CO-6)
T_5: Turmeric + Chilli (var. CO-4)
T_6: Turmeric + Okra (var. Arka Anamika)
T_7: Turmeric + Maize (var. CO-1)
T_8: Turmeric as pure crop

Observations on growth and yield parameters were recorded in five plants in each replication and the mean obtained were used for statistical analysis (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Compatibility of intercrops with turmeric :

Growth parameters :

The significant difference was found in all the growth and yield parameters and the pooled data are presented in Fig. 1 and Tables 1 and 2. The morphological characters of turmeric were found significantly influenced by various intercrops. The turmeric as pure crop recorded significantly higher values for plant height (138.00 cm), number of leaves per plant (13.97), leaf length (59.92 cm) and leaf breadth (14.99 cm) (Fig. 1). The lower values for the morphological characters in the treatments with intercrops could be attributed to competition for available growth resources in the intercrop environment. Amanullah *et al.* (2006) reported that intercropping reduced vegetative growth of cassava in line with the present findings. The same trend was found in elephant foot yam intercropping system (Ravikiran *et al*., 2015). Choudhuri and Jana (2015) reported that the higher values for all the growth parameters were obtained with sole cropping of potato and potato and mustard in 2:1 row ratio which might be due to better utilization of resources and less competition between both the component crops for solar radiation.

Main crop yield :

With respect to turmeric yield performance, Turmeric as pure crop (T_8) recorded highest rhizome yield (31.82 t ha^{-1}) and was at par with T_4 (Turmeric + cowpea) which recorded 31.03 t/ha (Table 1). The highest yield in turmeric monocropping could be due to zero competition from the other crops for space, light, water, nutrients etc. The lowest rhizome yield of turmeric (26.85 t ha^{-1}) was recorded in T_7 (Turmeric + maize). Singh and Randhawa (1988) also registered that the lowest rhizome yield of turmeric (27.92 t ha^{-1}) was recorded in turmeric + maize intercropping system. Similarly, the intercrops *viz.*, maize and finger millet reduced the turmeric yield, as these compete with the main turmeric crop for both water and plant nutrients from the soil (Rethinam *et al.*, 1984). Intercropping turmeric with pigeonpea, maize or greengram reduced the availability of incident light, which in turn adversely affect rhizome formation and enlargement. Similar results were obtained by Kumar and Reddy (2000); Narayanpur and Sulikeri (1996); Singh and Randhawa (1988) and Sivaraman and Palaniappan (1994) in turmeric.

Intercrop yield :

The yield of intercrops in turmeric based intercropping system differed significantly. Among the different intercrops, T_6 (Turmeric + okra) recorded the

highest fruit yield of 12.56 t ha^{-1} (Table 1). The higher yield of okra among different intercrops might be due to least competition between turmeric and okra for space, nutrients, moisture and sunlight. Similar trends were obtained by Singh *et al*. (2006), Sivaraman and Palaniappan (1994), Singh and Randhawa (1988) in turmeric.

The equivalent yield of turmeric was also registered highest (42.07 t ha^{-1}) in T_6 (Turmeric + okra) and was at par with T_5 (Turmeric + chilli) (41.75 t ha^{-1}). When turmeric was grown along with okra, cowpea and chilli, the yield of turmeric was significantly higher than with other intercrops. The difference in fresh rhizome yield of turmeric was mainly attributed to the influence of these intercrops. The higher yield of rhizomes in turmeric + okra, turmeric + cowpea and turmeric + chilli systems was mainly because of availability of more space, nutrients, moisture and better interception of sunlight for better growth. Islam *et al*. (2016) indicated that higher biomass production and consequently more efficient use of land and available resources under intercropping than under sole cropping contributed to the higher turmeric yield. Similar results were obtained by Balashanmugam *et al*. (1988) and Narayanpur and Sulikeri (1996) in turmeric and Kumar *et al*. (2018) in ginger. Paraye *et al*. (2014) reported that ginger equivalent yield and net return was higher in ginger (Raigarh local) + turmeric (Sudershana) in 1:1 row ratio intercropping system.

Economic feasibility of turmeric based intercropping :

In this experiment, the treatments containing both turmeric and intercrop were found to be economically feasible than the treatment with turmeric as pure crop. Among the different intercropping systems, T_6 (turmeric + okra) recorded maximum gross returns (Rs. 2,52,420 ha^{-1}), net returns (Rs. 1,80,970 ha^{-1}) and B:C ratio (2.53:1) followed by T_5 (turmeric + chilli) (Rs. 2,50,500 ha^{-1}, Rs. 1,79,200 ha^{-1} and 2.51:1, respectively) (Table 2). The result was also confirmed in ginger intercropped with okra by Diksha (2016). The turmeric as pure crop (T_8) recorded the lowest gross returns (Rs. 1,90,920 ha^{-1}),

Table 1 : Yield of intercrops and main crop in turmeric based intercropping system

Treatments	Main crop yield		Inter crop yield		Turmeric equivalent yield (t/ha)
	Yield per plot (6 sq.m) (kg)	Yield per ha (t)	Yield per plot (6 sq.m) (kg)	Yield per ha (t)	
T_1 – Turmeric + Onion	17.51	29.27	5.34	5.54	34.81
T_2 – Turmeric + Black gram	17.68	29.37	1.69	1.74	35.17
T_3 – Turmeric + Green gram	16.94	28.15	1.42	1.45	32.97
T_4 – Turmeric + Cowpea	18.67	31.03	0.90	0.92	33.32
T_5 – Turmeric + Chilli	17.28	28.71	7.58	7.83	41.75
T_6 – Turmeric + Okra	17.77	29.52	12.29	12.56	42.07
T_7 – Turmeric + Maize	16.16	26.85	8.31	9.32	33.06
T_8 - Turmeric as pure crop	19.16	31.82	-	-	31.82
Mean	17.64	29.34	-	-	36.38
S.E.±	0.439	0.620	-	-	1.19
C.D. (P=0.05)	0.927	1.312	-	-	2.55

Table 2 : Economics of turmeric based intercropping system

Treatments	Main crop yield (t/ha)	Intercrop yield (t/ha)	Turmeric equivalent yield (t/ha)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BCR
T_1 – Turmeric + Onion	29.27	5.54	34.81	71,500	2,08,860	1,37,360	1.92
T_2 – Turmeric + Black gram	29.37	1.74	35.17	71,300	2,11,020	1,39,720	1.96
T_3 – Turmeric + Green gram	28.15	1.45	32.97	71,450	1,97,820	1,26,370	1.77
T_4 – Turmeric + Cowpea	31.03	0.92	33.32	71,400	1,99,920	1,28,520	1.80
T_5 – Turmeric + Chilli	28.71	7.83	41.75	71,300	2,50,500	1,79,200	2.51
T_6 – Turmeric + Okra	29.52	12.56	42.07	71,450	2,52,420	1,80,970	2.53
T_7 – Turmeric + Maize	26.85	9.32	33.06	71,100	1,98,360	1,27,261	1.79
T_8 - Turmeric as pure crop	31.82	-	31.82	70,800	1,90,920	1,20,120	1.70

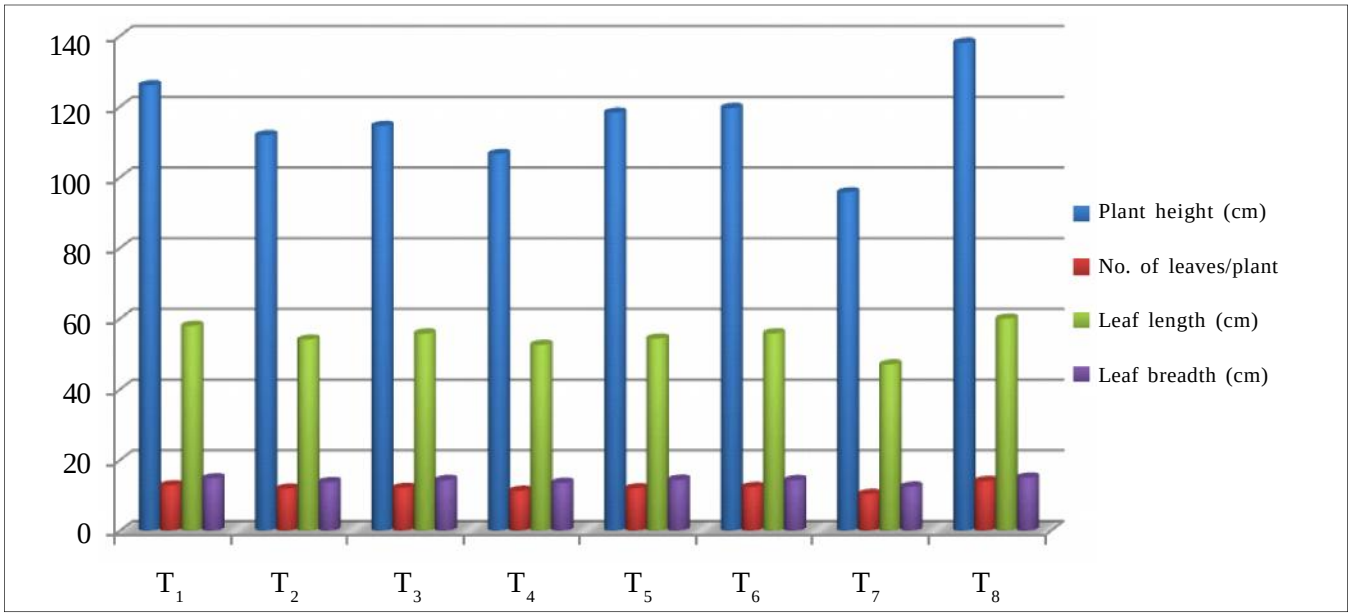

Fig. 1 : Morphological characters of turmeric as influenced by different intercrops

net returns (Rs. 1,20,120 ha^{-1}) and B:C ratio (1.70:1). Similar results were obtained by Leong (1990) in ginger intercropped with long bean and cucumber, Behera *et al.* (2008) in turmeric intercropped with pigeonpea and Prasad *et al.* (2004) in turmeric + rice + peas combination. Yamgar *et al.* (2006) also confirmed that when French bean was compared with cowpea as an intercrop with turmeric, the former combination proved to be better both in terms of rhizome yield and cost-benefit ratio.

Conclusion :

Among the different inter cropping systems, monocropping of turmeric was found to be significantly superior for all the growth parameters *viz.*, plant height, number of leaves per plant, leaf length and leaf breadth and also estimated rhizome yield (31.82 t ha^{-1}). Among the different intercrops, growing onion as an intercrop was found to be the best with respect to turmeric growth characters like plant height, number of leaves per plant, leaf length and leaf breadth. Intercropping turmeric with cowpea recorded the maximum fresh rhizome yield per hectare (31.03 t ha^{-1}) while turmeric with okra recorded the highest equivalent yield (42.07 t ha^{-1}) followed by turmeric + chilli (41.75 t ha^{-1}). Among the different intercropping systems, turmeric + okra registered the maximum B:C ration (2.53:1) followed by turmeric + chilli (2.51:1). The monocropping of turmeric recorded the lowest B:C ration (1.70:1) among all the treatments. Hence okra was concluded as compatible intercrop for turmeric which increases the equivalent yield of turmeric and thereby enhancing the net profit of turmeric growing farmers.

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