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Effect of intercrops on growth and yield of turmeric (*Curcuma longa* L.)

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Abstract

The initial growth of turmeric is rather slow and takes about 4-5 months to cover the inter space. 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 the experiment on effect of intercrops on growth and yield of turmeric was conducted at Agricultural Research Station, Bhavanisagar. Among the different intercrops, turmeric with cowpea recorded the maximum fresh rhizome yield per hectare (30.78 t ha^{-1}) while turmeric + bhendi registered the maximum B:C ratio (2.68:1). Monocropping of turmeric recorded the lowest B:C ratio (1.67:1) among all the treatments.

Keywords: intercropping, rhizome yield, turmeric, vegetables

Turmeric (*Curcuma longa* L.) also known as the "golden spice" is an herbaceous perennial spice crop. Turmeric is cultivated in an area of 2.19 lakh hectares with an annual production of 11.67 lakh tonnes (NHB 2012). The turmeric productivity in Tamil Nadu (5.75 t ha^{-1}) is the highest 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. Turmeric is slow growing crop at its early growth phase, so it does not cover the soil very fast and the solar energy remains unutilized. It offers good scope of growing an intercrop which helps in utilizing the solar radiation during period of slow growth rate in the initial growth stage of turmeric. Hence, the space between turmeric rows can be efficiently utilized by growing short duration crops like annual spices, vegetables, cereals and pulses. Therefore, an experiment was undertaken to study the effect of intercrops on growth and yield of turmeric.

The field experiment was conducted at Southern Farm, Agricultural Research Station, Tamil Nadu Agricultural University, Bhavanisagar during 2011–12 to 2012–13. The experiment was conducted to find out a suitable intercrop and its effect on the growth and yield 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

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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. Distance between two rows was 0.45 m and plants with 0.15 m spacing 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 + Bhendi (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 & Sukhatme 1985).

Growth and yield parameters showed significant differences in all treatments and the pooled data are presented in Tables 1, 2 & 3. Sole turmeric recorded significantly higher plant height (138.00 cm) over other treatments. Among the treatments, intercropping onion and chilli recorded significantly higher plant height over the other treatments. Significantly lower plant height of turmeric (92.82 cm) was recorded when it was grown with maize. Different treatments had significant effect on the number of leaves per plant. Sole crop of turmeric produced the highest number of leaves (14.13) and was on par when it was grown along with onion (12.53) followed by bhendi (11.87) and green gram (11.87) and lowest number (10.93) of leaves were produced when cowpea was intercropped. The lowest plant height and number of leaves of turmeric crop in the intercrop system 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).

Among the treatments, significantly higher values for leaf length (59.73 cm) and leaf breadth (14.87 cm) were recorded in the treatment with turmeric as pure crop which

Table 1. Morphological characters of turmeric as influenced by different intercrops (Mean of two years)

Treatments	Plant height (cm)	No. of leaves $plant^{-1}$	Leaf length (cm)	Leaf breadth (cm)
T_1-Onion	125.52	12.53	57.83	14.73
T_2-Black gram	109.23	11.73	53.57	13.53
T_3-Green gram	112.50	11.87	56.44	14.53
T_4-Cowpea	107.60	10.93	52.53	13.39
T_5-Chilli	117.96	11.53	52.53	14.50
T_6-Bhendi	117.63	11.87	54.00	13.95
T_7-Maize	92.82	10.60	47.70	12.60
T_8-Turmeric as pure crop	138.00	14.13	59.73	14.87
Mean	115.16	11.90	54.29	14.01
SEd	5.099	0.187	1.713	0.128
CD (P<0.05)	10.938	0.401	3.675	0.277

Table 2. Yield of intercrops, main crop and their economics in turmeric based intercropping system (Mean of two years)

Treatments	Main crop yield		Inter crop yield		Turmeric equivalent yield (t ha^{-1})	Gross returns (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
	Yield $plot^{-1}$ (6 sq.m) (kg)	Yield ha^{-1} (t)	Yield $plot^{-1}$ (6 sq.m) (kg)	Yield ha^{-1} (t)					
T_1-Onion	17.85	29.94	7.52	5.80	35.74	2,14,440	71,500	1,42,940	2.00
T_2-Black gram	18.11	29.98	2.40	1.85	36.15	2,16,880	71,300	1,45,580	2.04
T_3-Green gram	17.33	28.72	2.07	1.60	34.05	2,04,320	71,450	1,32,870	1.86
T_4-Cowpea	18.57	30.78	1.30	1.00	33.28	1,99,680	71,400	1,28,280	1.79
T_5-Chilli	17.70	29.33	10.75	8.30	43.16	2,58,980	71,300	1,87,680	2.63
T_6-Bhendi	18.24	30.21	17.72	13.67	43.88	2,63,280	71,450	1,91,830	2.68
T_7-Maize	16.85	27.92	10.11	7.80	33.12	1,98,720	71,100	1,27,620	1.79
T_8-Turmeric as pure crop	19.04	31.51	-	-	31.51	1,89,060	70,800	1,18,260	1.67
Mean	17.96	29.80	-	-	36.38	-	-	-	-
SEd	0.199	0.400	-	-	1.19	-	-	-	-
CD (P<0.05)	0.427	0.859	-	-	2.55	-	-	-	-

was followed by T_1 (turmeric + onion) which recorded a leaf length of 57.83 cm and leaf breadth of 14.73 cm. Choudhuri & 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.

With respect to yield, turmeric as pure crop recorded highest rhizome yield (31.51 t ha^{-1}) and was on par with turmeric + bhendi intercropping which recorded 30.21 t ha^{-1}. The highest yield in turmeric monocropping could be due to zero competition from the other crops for space, light, water, nutrients *etc.*. When turmeric was grown along with bhendi, cowpea and onion, the yield of turmeric was significantly higher over 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 + bhendi, turmeric + cowpea and turmeric + onion systems was mainly because of availability of more space, nutrients, moisture and better interception of sunlight for better growth. Similar results were obtained by Narayanpur & Sulikeri (1996) and Balashanmugam *et al*. (1988) in turmeric.

The lowest rhizome yield of turmeric (27.92 t ha^{-1}) was recorded in turmeric + maize intercropping system. Intercropping turmeric with pigeon pea, maize or green gram reduced the availability of incident light, which in turn adversely affect rhizome formation and enlargement (Singh & Randhawa 1988). Maize also provided the requisite shade for the turmeric crop in its initial stages of growth. Reduction in turmeric rhizome yield when intercropped with maize has also been reported earlier (Kumar & Reddy 2000; Sivaraman & Palaniappan 1994). The decrease in yield of turmeric with the other intercrops may be due to more competition between the plants and also lower photosynthetic efficiency of turmeric leaves due to high degree of shading. Similar results were obtained by Narayanpur & Sulikeri (1996), Singh & Randhawa (1988) in

turmeric. Intercropping with crops such as onion, okra, black gram and green gram increased rhizome yield, especially in the case of the latter two crops, which can fix a considerable amount of atmospheric N and thereby enhance the soil fertility status, unlike maize and finger millet which reduced turmeric yield, as these compete with the main turmeric crop for both water and plant nutrients from the soil (Rethinam *et al.* 1984).

Among the different intercrops bhendi recorded the highest fruit yield of 13.67 t ha^{-1} followed by chilli (8.30 t ha^{-1}). The equivalent yield of turmeric was registered highest (43.88 t ha^{-1}) in T_6 (Turmeric + bhendi) followed by T_5 (Turmeric + chilli) (43.16 t ha^{-1}). The higher yield of bhendi in different crops, might be due to least competition between turmeric and bhendi for space, nutrients, moisture and sunlight. Similar trends were obtained by Sivaraman & Palaniappan (1994), Singh & Randhawa (1988) in turmeric.

Among the different intercropping systems, turmeric + bhendi resulted in maximum B:C ratio (2.68:1) followed by turmeric + chilli (2.63:1) and turmeric + black gram (2.04:1) which might be due to the highest yield of both main crop and intercops. Sole cropping of turmeric recorded a B:C ratio of 1.67:1 since there is no additional income from the intercrops. Singh & Randhawa (1988) obtained similar results in turmeric.

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