*Frontiers in Crop Improvement, Vol. 6 (1) : 13-17 (2018)*
*Print ISSN : 2393-8234, Online ISSN : 2454-6011*
*ASTHA FOUNDATION*
*Meerut (U.P.) INDIA*

# EFFECT OF DIFFERENT INTERCROPS ON GROWTH AND YIELD OF TURMERIC

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## ABSTRACT

Turmeric is the important long duration spice crop of India. It requires nine months for harvesting; however, rhizome development in turmeric starts after 4 to 5 months after planting. Therefore, the available space between the rows of turmeric could be effectively utilized by growing short duration flower and vegetable crops. Hence, it is worthwhile to explore the possibilities of growing compatible crops with turmeric. With this background the experiment on effect of intercrops on yield and economics of turmeric was conducted. Among the different intercrops, significantly highest dry yield (73.72 q $ha^{-1}$) and number of leaves per plant (10.87) was recorded by the sole crop of turmeric which was followed by intercropping with French bean (68.43 q $ha^{-1}$ and 9.85, respectively). The highest height of plant was observed in intercropping with Radish (101.86 cm) which was at par with sole turmeric (100.67 cm) and intercropping with marigold (100.52 cm). The highest number of tillers per plant was recorded by sole turmeric (4.73) which was at par with intercropping with coriander (3.96). The highest gross as well as net monetary returns were recorded by intercropping with french bean (Rs. 317772 $ha^{-1}$ and Rs.186519 $ha^{-1}$, respectively which was at par with intercropping with Marigold. The highest LER (1.25) as well as B:C ratio (2.44) was recorded by intercropping with French bean which was at par with intercropping with Marigold. Opening of ridges and furrows at 75 cm apart and planting of turmeric on both sides at 30 cm and intercropping of French bean at 15 cm spacing on top of the ridge is recommended for higher yield and net monetary returns in turmeric.

***Key words :*** *Intercropping, rhizome yield, turmeric, LER.*

Turmeric (*Curcuma longa* L) is one of the important export earning herbaceous, perennial spice crop of India known as “Golden Spice.” It is mainly cultivated in tropics and sub tropics of India. Turmeric is a certified natural food colour and has several uses in traditional Indian medicine as well as modern medicines for various human ailments. India is the largest producer, consumer and exporter of turmeric in the world. It is cultivated on an area of 2.32 lakh ha with annual production of 11.89 lakh MT (1) in more than 20 states. Turmeric is the long duration slow growing crop. Being a rhizomatic crop, the development of rhizomes will be started after four to five months of planting. During early growth phase, it does not cover the soil very fast due to which solar energy remains unutilized. Harvesting of unutilized solar radiations by growing intercrops in initial stage will be helpful to compensate the initial cost on seed and other inputs. The space between turmeric rows can be efficiently utilized by growing short duration vegetables and flower crops before development of rhizomes. Turmeric is mainly susceptible to rhizome rot melody, if due care is not taken complete failure of crop is occurred. Intercropping will help to overcome the risks associated with crop failures due to rhizome rot melody. Therefore, an experiment was undertaken to study the effect of different intercrops on growth and yield of turmeric.

## MATERIALS AND METHODS

The field experiment was conducted at Turmeric Research Scheme, Agricultural Research Station, Kasbe Digraj, Sangli, Maharashtra during 2008-09 to 2011–12. 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 16°08’ N latitude and longitude of 74°08’ E at 580 m above mean sea level with mean annual rainfall was 692.4 mm. The soil of the experimental area was medium deep black type. Turmeric variety Salem was used for raising main crop of the experiment. Distance between two rows was 0.375 m and plants with 0.30 m spacing between plants in a row. The plot size of the experiment was 6 × 3.75 m and the intercrops were sown/planted on the ridge in between two rows of turmeric. A fertilizer dose of 200:100:100 NPK kg $ha^{-1}$ was uniformly applied to all the plots. Three hand weeding’s on $30^{th}$, $60^{th}$ and $90^{th}$ day after planting was done for all the plots. The experiment was laid out in a Randomized Block Design with seven treatments and replicated thrice. The treatment details are, $T_1$: Turmeric + French bean (Var. Contender) $T_2$: Turmeric + Bell pepper (Var. California Wonder) $T_3$: Turmeric + Marigold (Var. Maxima yellow) $T_4$: Turmeric + Radish (Var. Pusa Deshi) $T_5$: Turmeric + Coriander (Var. Local) $T_6$: Turmeric + Chilli (Var. Pusa Jwala) $T_7$: Turmeric as sole crop. Observations on growth and yield parameters were recorded in five plants in each replication and the mean obtained were used for statistical analysis (2).

The economic analysis is done by taking the average prices of the turmeric during presiding year from the Agricultural Produce Market Committee, Sangli. The

**Table-1:** Effect of different inter crops on growth of Turmeric cv. Salem.

| Treatments | Height Plant (cm) | | | | | No. of leaves/Plant | | | | | No. of tiller/ plant | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean |
| $T_1$ : Turmeric + French bean | 102.6 | 100.8 | 101.00 | 91.00 | 98.85 | 8.2 | 8.2 | 12.0 | 11.00 | 9.85 | 3.2 | 3.2 | 3.6 | 3.25 | 3.31 |
| $T_2$ : Turmeric + bell pepper | 98.5 | 97.8 | 96.55 | 88.55 | 95.35 | 6.4 | 6.5 | 10.5 | 9.50 | 8.22 | 2.1 | 2.2 | 3.3 | 2.95 | 2.63 |
| $T_3$ : Turmeric + Marigold | 105.3 | 105.3 | 100.25 | 91.25 | 100.52 | 8.5 | 8.5 | 10.7 | 9.75 | 9.36 | 4.1 | 4.0 | 3.0 | 2.60 | 3.42 |
| $T_4$ : Turmeric + Radish | 104.5 | 104.2 | 103.92 | 94.82 | 101.86 | 8.4 | 8.2 | 9.5 | 8.50 | 8.65 | 4.2 | 4.2 | 2.9 | 2.50 | 3.45 |
| $T_5$ : Turmeric + Coriander | 101.7 | 101.2 | 101.60 | 92.60 | 99.27 | 7.8 | 7.7 | 10.5 | 9.50 | 8.87 | 4.7 | 4.7 | 3.4 | 3.05 | 3.96 |
| $T_6$ : Turmeric + Chilli | 96.6 | 96.3 | 96.45 | 88.45 | 94.45 | 5.6 | 5.5 | 8.2 | 7.25 | 6.63 | 2.3 | 2.5 | 2.2 | 1.87 | 2.21 |
| $T_7$ : Turmeric sole crop. | 105.5 | 104.0 | 101.10 | 92.10 | 100.67 | 9.8 | 9.7 | 12.5 | 11.50 | 10.87 | 5.2 | 5.7 | 4.2 | 3.85 | 4.73 |
| S.E.+ | | | | | 0.623 | | | | | 0.276 | | | | | 0.287 |
| C.D. 5% | | | | | 1.85 | | | | | 0.82 | | | | | 0.85 |

**Table-2 :** Yield and LER of turmeric and intercrops as influenced by various intercrops in Turmeric.

| Treatments | Yield of cured turmeric (q/ha) | | | | | Yield of Inter crops (q/ha) | | | | | Land Equivalent Ratio (LER) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean |
| $T_1$ : Turmeric + French bean | 67.3 | 68.87 | 69.79 | 67.79 | 68.43 | 48.60 | 48.02 | 46.86 | 47.84 | 47.83 | 1.27 | 1.20 | 1.25 | 1.27 | 1.25 |
| $T_2$ : Turmeric + bell pepper | 62.5 | 57.87 | 58.30 | 56.05 | 58.68 | 29.19 | 28.87 | 27.14 | 26.12 | 27.83 | 1.12 | 0.98 | 1.01 | 1.00 | 1.03 |
| $T_3$ : Turmeric + Marigold | 64.12 | 64.10 | 63.64 | 61.54 | 63.35 | 52.40 | 54.12 | 52.10 | 49.20 | 51.95 | 1.25 | 1.18 | 1.20 | 1.19 | 1.20 |
| $T_4$ : Turmeric + Radish | 63.20 | 58.07 | 56.55 | 54.35 | 58.04 | 58.20 | 57.25 | 52.75 | 50.40 | 54.65 | 1.18 | 1.12 | 1.11 | 1.09 | 1.12 |
| $T_5$ : Turmeric + Coriander | 65.00 | 64.97 | 61.77 | 59.65 | 62.84 | 13260* | 13202* | 12845* | 12636* | 12985* | 1.18 | 1.09 | 1.09 | 1.08 | 1.11 |
| $T_6$ : Turmeric + Chilli | 55.20 | 52.70 | 48.77 | 46.27 | 50.73 | 62.40 | 59.95 | 55.17 | 56.19 | 58.42 | 1.19 | 1.07 | 1.02 | 1.02 | 1.07 |
| $T_7$ : Turmeric sole crop. | 71.00 | 78.17 | 74.12 | 71.62 | 73.72 | | | | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| S.E.+ | | | | | 1.10 | | | | | | | | | | 0.015 |
| C.D. 5% | | | | | 3.30 | | | | | | | | | | 0.047 |

* Coriander yield in bundles

**Table-3 :** Gross monetary returns and Cost of cultivation Rs/ha as influenced by various intercrops in Turmeric.

| Treatments | Gross monetary returns (Rs/ha) | | | | | Cost of cultivation (Rs/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean |
| $T_1$ : Turmeric + French bean | 241245 | 261352 | 299559 | 468932 | 317772 | 94426 | 103868 | 131744 | 194975 | 131253 |
| $T_2$ : Turmeric + bell pepper | 207440 | 206810 | 235532 | 369211 | 254748 | 96260 | 101886 | 134303 | 198762 | 132802 |
| $T_3$ : Turmeric + Marigold | 233100 | 257244 | 287865 | 435168 | 303344 | 97628 | 107390 | 136211 | 201586 | 135703 |
| $T_4$ : Turmeric + Radish | 217620 | 215430 | 237223 | 364404 | 258669 | 92211 | 101432 | 128653 | 190401 | 128174 |
| $T_5$ : Turmeric + Coriander | 208390 | 214713 | 235462 | 380013 | 259644 | 92528 | 101780 | 133174 | 197092 | 131143 |
| $T_6$ : Turmeric + Chilli | 197520 | 209057 | 221727 | 332405 | 240177 | 92401 | 102641 | 129336 | 191412 | 128947 |
| $T_7$ : Turmeric sole crop. | 205900 | 234510 | 259420 | 429720 | 282387 | 90000 | 110245 | 125569 | 185837 | 127912 |
| S.E.+ | | | | | 8082 | | | | | 3541 |
| C.D. 5% | | | | | 24013 | | | | | NS |

**Table-4 :** Net monetary returns and B: C Ratio as influenced by various intercrops in turmeric.

| Treatments | Net monetary returns (Rs/ha) | | | | | B : C Ratio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Pooled Mean |
| $T_1$ : Turmeric + French bean | 146819 | 157484 | 167815 | 273957 | 186519 | 2.55 | 2.52 | 2.27 | 2.40 | 2.44 |
| $T_2$ : Turmeric + bell pepper | 111180 | 104924 | 101229 | 170449 | 121945 | 2.15 | 2.03 | 1.75 | 1.85 | 1.94 |
| $T_3$ : Turmeric + Marigold | 135472 | 149854 | 151654 | 233582 | 167640 | 2.39 | 2.39 | 2.11 | 2.16 | 2.26 |
| $T_4$ : Turmeric + Radish | 125409 | 113998 | 108570 | 174003 | 130495 | 2.36 | 2.12 | 1.84 | 1.91 | 2.05 |
| $T_5$ : Turmeric + Coriander | 115862 | 112933 | 102288 | 182921 | 128501 | 2.25 | 2.11 | 1.76 | 1.93 | 2.01 |
| $T_6$ : Turmeric + Chilli | 105119 | 106416 | 92391 | 140993 | 111229 | 2.14 | 2.04 | 1.71 | 1.74 | 1.90 |
| $T_7$ : Turmeric sole crop. | 115900 | 124265 | 133851 | 243883 | 154474 | 2.29 | 2.13 | 2.06 | 2.31 | 2.19 |
| S.E.+ | | | | | 8288 | | | | | 0.04 |
| C.D. 5% | | | | | 24625 | | | | | 0.12 |

land equivalent ratio is calculated by the sum of the fractions of the intercropped yields divided by the sole-crop yields.

## RESULTS AND DISCUSSION

**Growth parameters :** The pooled effect of different intercrops on growth of turmeric is presented in Table 1. The maximum height of turmeric (101.86 cm) was recorded by planting of radish as intercrop which was at par with sole turmeric (100.67 cm) and in marigold (100.52 cm) while minimum height of turmeric was noticed in turmeric planted with chilli (94.45 cm) which was at par with bell pepper (95.35 cm). Different treatments had significant effect on number of leaves. Significantly more number of leaves per plant (10.87) was recorded by sole turmeric while lowest number of leaves was noticed when turmeric planted with chilli (6.63). The maximum number of tillers per plant (4.73) was recorded in sole turmeric which was at par with turmeric grown with coriander (3.96) while lowest number of tillers per plant observed in intercropping with chilli (2.21). 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. Production of more number of leaves and tillers and better exposure of turmeric leaf canopy to sunlight which might have resulted in the more transpiration and thereby more and more uptake of nutrients from the soil. All these factors resulted in the production of significantly higher dry matter and its accumulation in different plant parts (3) 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 (4).

**Yield :** The yield of turmeric and intercrops as influenced by various intercrops in turmeric is presented in Table 2. The significantly maximum dry yield of turmeric (73.72 q $ha^{-1}$) was observed in sole turmeric. Among the various intercrops the maximum yield was recorded in turmeric grown with french bean (68.43 q $ha^{-1}$) while the lowest yield was observed when turmeric intercropped with chilli (50.73 q $ha^{-1}$). The significantly maximum land equivalent ratio (LER) was observed in the turmeric + french bean (1.25) which was followed by turmeric + marigold (1.20). The highest yield in sole turmeric cropping could be due to lack of competition from other crops for space, light, water, nutrients and better interception of sunlight for better growth compared to other intercrops. 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. Intercrops like french bean and marigold offer least competition with turmeric plants for nutrients and moisture which might be due to different rooting habits and different feeding zone. These intercrops also offer least competition for space which lead to more growth of turmeric plants. (5) reported that the higher values for all the growth parameters were obtained with sole cropping of potato as well as 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. Similar results were obtained by (6) in turmeric.

Intercropping turmeric with pigeon pea, maize or green gram reduced the availability of incident light, which in turn adversely affect rhizome formation and enlargement (7). 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 (8). 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 (9) 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 (10).

**Economics :** The economics of turmeric as influenced by various intercrops is presented in Table 3 and 4. Among the different intercropping systems, the maximum net monetary returns were recorded by turmeric + french bean (Rs. 186519 $ha^{-1}$) which was at par with turmeric + marigold (Rs. 167640 $ha^{-1}$) while the lowest net monetary returns were recorded by turmeric + chilli (Rs.111229 $ha^{-1}$). The turmeric + french bean recorded maximum B:C ratio (2.44:1) followed by turmeric + marigold (2.26:1) which might be due to the highest yield of both main crop and intercrops. Sole cropping of turmeric recorded B:C ratio of 2.19:1 which is less than french bean and marigold intercropping since there is no additional income from the intercrops. (7) obtained similar results by intercropping in turmeric.

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Received : September-2017 Revised : October-2017 Accepted : October-2017