REVIEW OF LITERATURE

1. INTRODUCTION

Turmeric (Curcuma longa L.) is an important spice crop grown on commercial scale in India, covering of an area of 1045000 ha. of which Maharashtra contributes about 8200 hectares (Anonymous, 1987) which is 7.8% is on country's total. Sangli, Solapur, Parbhani, Nanded, Usmanabad and Chandrapur are the leading districts in turmeric production. Considering the suitability of climate for growing quality turmeric in Maharashtra, a scheme for turmeric improvement was sanctioned in third plan during 1963 at Digraj, district Sangli. Since then the research activities were mainly on collection and evaluation of germplasm to identify suitable types for the agroclimatic zone, and to standardise the package of practices for the maximisation of production of elite types identified through the assessment programme. The major achievements of the project are presented and discussed in this chapter.

2. HISTORY

The history of the cultivation and use of spice is perhaps the most romantic story of any vegetable product. Spices are natures own production (Shankaracharya and Natarajan, 1971). In the art of cooking, these are the magic constituents without which all culinary creations would be dull and lifeless.

Turmeric (Curcuma longa L.) the best known spice as well as the condiment belongs to the family Zingiberaceae and the order Scitamineae. It is an indespensable constituents of curry powder

and is used as colouring mater in pharmacy, confectionary and food industries (Pruthi, 1976 and Purseglove et al, 1981). The turmeric is native of South-East Asia and is cultivated in India, Indonesia, China, Formosa, Peru, Haiti, Jamaica, Bangladesh, Sri Lanka, Taiwan and other tropical and sub tropical countries (Parry, 1969 and Leuis 1982).

Shankaracharya and Natarajan, 1973 stated that in India nearly 30 species of turmeric have been recognised by botanist. Curcuma longa L is the most important, though C.aromatica salisb (Kasturi or wild turmeric) C.oamada, C.onguistifolia and C.caesia are also cultivated (Murilidharan et al. 1977).

A large no of varieties exists in turmeric and they have been classified on the basis of their duration, curcumin, content, appearance, weight, length and thickness colour intensity of the core and aroma of rhizome (Philip et al. 1980 and Shukla, 1980).

3. CHEMICAL COMPOSITION

Spices though have little nutritive value, play an important role in the human diet. They give an agreeable flavour aroma to the food and add greatly to the pleasure of eating. The chemical composition of turmeric as reported by Shankaracharya and Natarajan 1973 is as given under :

Composition	Content
Moisture	5.8 %
Protein	8.6 %
Fat	8.9 %

Total Carbohydrate	69.9 %
Fiber carbohydrate	6.9 %
Ash	6.8 %
Calcium	0.2 %
Phosphorus	0.26%
Sodium	0.01%
Potassium	2.5 %
Iron	47.5 mg/100 gm
Thiomine	0.09mg/100 gm
Riboflavin	0.19mg/100 gm
Niacin	4.8 mg/100 gm
Ascorbic	49.8 mg/100 gm
Vitamin A	175II.U

India is the largest producer and exporter of turmeric in the world and plays a prominent role in the national economy. In the foreign exchange earnings it ranks 4th among the spices i.e. next to black paper, cardamon and ginger (Philip, 1985). Among the turmeric producing states, Andhra Pradesh, Tamilnadu, Maharashtra and Orrisa account for more than 80% of the total production. The major portion of production is used within the country and only about 7-8 % of the produce is exported. Indian turmeric is imported by as many as 64 countries, Major being U.S.A., U.K., England, France, Iran and Japan (Aiyadurai, 1966, Devakaran Nair, 1980 & Ridley 1983-84). An area of 88.6 thousand hectares was under turmeric while the production was 194.3 thousand metric tones of which 14.164 metric tones was exported earnings Rs.10.34

crores as foreign exchange (Anonymous 1986).

Maharashtra is an important turmeric growing state in the country. During 1982-83, the state has an area of 83,000 hectares with a production of 13,200 metric tones. (Pujari et al 1986). In Maharashtra it is grown in Satara, Sangli, Solapur, Parbhani, Nanded, Usmanabad and Chandrapur districts of which 36% area and 50% production are contributed by Sangli and Satara districts.

4. MORPHOLOGICAL CHARACTERS

With a view to compare the results of the present review of literature available on the performance of different varieties of turmeric and the relevant literature is presented in this chapter under the following heads :-

i) Vegetative growth parameters.

1. Plant height :-

Anonymous (1979) studied the performance of some of the high yielding clones of turmeric viz - I C 29937, 26897, 29931, 29933, 29941, 30073, 29792, 29960 & 30083 and observed that the clones IC 29931 attained maximum plant height (149.0 cm) whereas the clone IC 29960 recorded the minimum height (88.0 cm).

Nambiar (1979) stated that plant height in turmeric is a single important morphological character which can be used as selection criterion for yield.

Philip and Nair (1983), while studying the morphological and yield characters of 19 turmeric types under Kerala conditions,

reported the maximum plant height in "Chayapasupa" (41.1 cm) closely followed by "Nandya" (40.2cm) whereas minimum in the C. aromatica types viz "Dindrigam ca-69" (22.1cm) and Amalapuram (23.5 cm) respectively. The difference in height due to variety was significant.

Yadav (1983) observed significant differences in plant height among six varieties of turmeric viz. Mannuthy Local, Kuchupudi,Armar, Chayapasupa, G L Puram and Duggirala collection No.325 as 80.92, 78.55, 76.1, 86.8, 90.90 cm respectively.

Prasad (1983) studied the yield and morphological characteristics of 9 different varieties of turmeric at Nagaland and noticed that the variety 'Ca-68 Deghi' (2.34 m) had maximum plant height followed by "Meghalaya Local" (1.7m) while variety (No-24) had minimum (1.13m) with significant difference in plant height of different varieties.

According to Balashanmugam et al. (1986) the plant height of high yielding turmeric mutant 'BSR-1' varied from 41.4 to 106.2 cm.

NO OF LEAVES PER PLANT

Pillai (1977) while studying the performance of selected turmeric clones found that the average no of leaves per plant varied from 10 (clones No. 158 and IC) to 17 (clones No. 21 A)

Anonymous (1979) studied the performance of high yielding clones of turmeric and found that the average no of leaves per plant varies from 7.0 in IC 29941 to 25.0 in IC 30073.

Philip and Nair (1983) reported that the average no of leaves per plant in various turmeric types under study ranged from 11.2 ('Dindrigam, Ca-69') to 20.7 (Mannuthy Local'). The difference in no. of leaves per plant due to variety was significant.

Rao and Swamy (1984) revealed that the average no. of leaves per plant in 'Gorakhpur' and 'Mydukur' varieties of turmeric were 7.633 to 9.333 and 8.20 to 9.50 respectively with significant differences in the leaves per plant of the two varieties.

LEAF LENGTH, BREADTH AND LEAF AREA :-

Pillai, (1977) observed that the length of leaves varied from 42 cm. (clone No. 3D) to 46 cm. (clone No. 158 & 21 A) in turmeric.

Randhawa et al, (1982) noticed wide differences between geometrical leaf area and graphical (actual) leaf area. However the correlation coefficient between leaf area obtained by these two methods was significantly high (r = 0.95).

Philip (1983) evaluated different types of turmeric for their growth, yield and quality components and observed that the types 'Amruthapani Kothapeta' produced the largest leaves with maximum breadth at center (15.7cm) and leaf area (973.4 cm^2) maximum leaf length was recorded in the type. 'Chayapasupa' (61.90 cm) and it was significantly superior to all other types except 'Amruthapani Kothapeta' (61.7 cm). The type 'NBPGR/T 17' produced the smallest leaves with minimum leaf length (42,6cm). Leaf breadth (112-85cm) and an average leaf area of 547.9 cm^2.

Philip and Nair (1983) recorded the variations in leaf length, breath of leaf at centre and leaf area index of different turmeric types as 50.2 cm to 76.3 cm, 13.9 to 17.5 cm and 696.8 cm^2 to 1214.3 cm^2 respectively. The differences due to these characters were statistically significant.

Rao and Swamy (1984), observed the average leaf area per plant by multiplying the product of length and breadth of leaf with a conversion factor of 0.72 in the 'Gorakhpur' and 'Mydukur' varieties as 163.88 to 247.38 and 149.54 to 231.48 respectively. Difference in the varieties were found to be significant.

ii) **RHIZOME CHARACTER (PRIMARY AND SECONDARY FINGERS)**

1) No of primary and secondary fingers per plant:-

Philip and Nair (1983) observed that in 19 varieties of turmeric studied, the range in the no. of primary fingers per plant was 4.2 ('Tekurpeta') to 7.2 ('Mannuthy Local') comparatively more no. of secondary fingers per plant were produced in the types 'Mannuthy' (20.9), 'Chayapasupa' 'Kuchipudi' and 'Armoor' (19.8 each) where as the types Armoor C11 324 (7.9) and G L Puram-I (8.3) produced comparatively less no. of secondary fingers per plant.

Prasad (1983) reported that the variation in no. of finger rhizome per clump was from 5.8 ('Nagland Local') to 11.9 ('Kasturi Tanka' and No. 24')

However, the difference in the varieties with respect to no. of fingers was not significant.

2) Length

Ghosh and Govind (1977) assessed the performance of 8 different varieties of turmeric and reported that the average length of finger varied from 5.5 cm ('Meghalaya Local') to 7.46 cm (Dehradun Local).

Dhander and Varde (1985) noticed maximum length of 10.6 cm of mother rhizome in CI-IC and maximum length of 7.4 cm in CI-20A varieties of turmeric under Goa conditions.

Govind and Gupta (1982) from the varietal evaluation of 4 turmeric varieties reported that the length of finger rhizome was maximum in 'Manipur Local' (7.28 cm) followed by 'Ca-69' ' Dindrigam (5.50 cm) and 'Duggirala' (4.60 cm).

Muthuswamy and Shah (1982), pointed out that the mother rhizome of Salem type were slightly larger that Erode type (4.74, 4.54 cm respectively) but the finger rhizome of Salem type was much larger (5.34 cm) than that of Erode type (4.15 cm).

Shah et al., (1982) while studying the performance of Co-1 turmeric recorded a mean length of pri and sec. rhizome are 10.92 cm and 5.54 cm respectively.

Philip and Nair (1983) reported that the length of secondary fingers was 4.5 cm in 'Rajapuri' to 8.6cm in 'Kuchipudi'. The data on length of primary and secondary fingers were statistically significant.

Balashanmugam et al., (1986), identified a new high yielding mutant turmeric 13.5 cm. In this they recorded the mean length of primary and secondary rhizomes as 9.7 to 9.9 to 2.1 cm respectively.

GIRTH AT CENTRE

The girth of rhizome in turmeric under Goa condition varied form 4.9 cm in c1-24 D to 8.0 cm in C1-9 A (Dhandar and Varde, 1980).

According to Govind and Gupta (1982) the maximum thickness of finger rhizome was found in case Manipur Local (2.02 cm) followed by Ca-69 'Dindrigam' (1.1.5 cm) and 'Duggirala (1.66 cm) in turmeric varieties.

Muthuswamy and Shah (1982) observed only slight difference in the girth of finger rhizome of Salem was more (4.34 cm) as compared to Erode type (3.03 cm).

Shah et al. (1982) found the girth of primary and secondary rhizome of high yielding mutant turmeric 1.41 cm and 1.52 cm respectively.

Philip and Nair (1983) reported the variation in girth at centre of rhizome. The girth at centre of primary and secondary varied from 7.1 cm ('Dindrigam' Ca-69) to 10.5 cm. (Chayapasupa) and 5.1 cm (Amalapuram) to 7.4 cm (Kuchipudi) respectively. The girth of primary and secondary fingers in 19 turmeric types showed statistically significant differences.

Balashanmugam et al., (1986) recorded the average girth of 2.7 to 2.9 cm 1.8 to 1.9 cm and 0.9 to 1.02 cm respectively in primary and secondary rhizome of 'BSR' - I variety of turmeric.

5) **NUTRITION** :-

Nair (1964) reported significant effect of N and K_2O on plant height, tiller production and yield while the response to P_2O_5 was negligible. Muralidharan and Balkrishnan (1972) obtained significantly higher yield over the yield control by the application of 40Kg P_2O_5 and 80Kg. K_2O/ha. The addition of higher doses failed to give response probably due to the supply of necessary nutrients by the farm yard manure and green leaf mulch.

The Kerala Agricultural University (1986) recommends 30 to 40 tones of farm yard manure/ha. supplemented with N, P_2O_5 and K_2O at 30:30:60 Kg/ha. The full dose of P_2O_5 and dose of K_2O is applied as basal dose. One month after planting 2/3 rd of N is applied and the rest of N, K_2O will be given 60 days after planting.

6) **CURCUMIN CONTENT** : -

K.G. Mehta, D.V. Raghava Rao, and S.H.Patel were estimated the curcumin content during various growth stages in the leaves and rhizomes of three cultivares of Curcuma longa and C.amada.

They have studied about the curcumin in leaves and rhizomes of three cultivars of Curcuma longa and one type of C.amada (Mango Ginger) was estimated during various stages of growth. Starting

from 100th day of planting upto final harvest. They found that curcumin content of leaf decreased and that rhizome increased with increased maturity. The pattern of distribution of dry matter in leaves and rhizomes at different growth stages and their relationship with rhizome yield have been explained. A knowledge of the pattern of curcumin accumulation in rhizomes and leaves during active plant growth period will be useful in understanding its relative biosynthetic pattern and the mode of translocation and storage. Variation in curcumin content in different cultivars and at different fertilizer dosage (NPK) was reported by Reddy and Rao (1978).

Pigment level in leaves was highest in Kesar followed by that CLL.326 and Duggirala during the initiation of rhizomes whereas very minute quantity only was observed in mango ginger. In general, curcumin content of leaves of all the cultivars was found to decrease with the advancement in age. Rate in fall of curcumin was steep in Kesar as compared to other cultivars in mango ginger, fall was more gradual.

Highest curcumin content in rhizomes was observed in Duggirala followed by that Kesar and CLL-326 whereas in mango ginger only microquantities were recorded.

These results are in partial agreement with those of Reddy and Rao (1978) who reported that curcumin content in CLL-326 varies from 0-1 1.2 % similarly curcumin content upto 1 % in rhizomes of turmeric has been reported by Shankaracharaya and Natarajan

(1974) curcumin level in rhizomes in general increased with age. Rate of increase was rapid in Kesar and Duggirala as compared to others. However, in case of mango ginger, rate of accumulation was very slow.

The data presented by K.G. Mehta, D.V. Raghava and S.H. Patel showed a gradual decline of curcumin content in leaves with age. The site of biosynthesis of curcumin in turmeric plants seems to be from leaves to rhizome.

Dry weight of shoots consisting of leaves and rhizomes was recorded at the same intervals. Dry matter continued to accumulate in case of CLL-326 till 150 days and fell thereafter. In Kesar, the fluctation in dry matter content was more or less steady as compared to the rest. The fall in the dry matter content after the active growth period is mainly attributed to the process of aging and senescence.

In the case of rhizome the dry matter content fluctuated through out. However, the highest dry matter content recorded at the time of harvest Kesar and Duggirala whereas dry matter content of the remaining of two cultivars was found highest after 150 days of planting.