Diseases of turmeric (*Curcuma longa* L.) and their management

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ABSTRACT

Turmeric (*Curcuma longa* L.) is severely affected by soil borne as well as foliar diseases. Rhizome rot takes a heavy toll in majority of turmeric areas. Among foliar diseases, leaf blotch and leaf spot are important. Several minor diseases have also been reported on the crop. Future studies on crop loss assessment due to these diseases, their epidemiology under different cropping systems and the role of biocontrol agents and organic amendments in disease suppression need a thorough investigation to develop appropriate disease management strategies. The present status of turmeric diseases and future strategies for their management are outlined in this paper.

Key words : *Curcuma longa,* diseases, management, turmeric

Introduction

Turmeric (*Curcuma longa* L.) is one of the most important commercial spice crop grown in India over an area of 1,23,379 ha with a production of 3,90,000 t (Anonymous 1992). The crop is grown predominantly in Andhra Pradesh, Orissa, Tamil Nadu, Assam, Maharashtra and West Bengal. Turmeric, native to South East Asia, is a herb with underground rhizomes which constitute the turmeric of commerial value.

Several diseases, mostly fungal, have been recorded on turmeric. Bacterial and viral diseases are of minor importance. The most important of them are rhizome rot, leaf spot and leaf blotch diseases (Rao, Reddy & Sasikumar 1993). The details of diseases recorded on turmeric, their management and future lines of work are outlined in this paper.

Rhizome rot

Rhizome rot caused by *Pythium graminicolum* is the most destructive disease of turmeric reported from Andhra Pradesh and Tamil Nadu (Ramakrishnan & Sowmini 1954).

Symptoms

The disease is seen on isolated plants or

may involve several adjacent clumps resulting in diseased patches. The infected plants show gradual drying up of leaves along margins; later the entire leaf dries. The symptoms appear at the base of the pseudostem as water soaked spots. The root system is adversely affected and it gets reduced to few decaying and rotten ones. In advanced stages, the infection progresses into the rhizomes which become soft and rotten. The colour of rhizome changes from bright orange to different shades of brown. The infection gradually spreads to all the fingers and mother rhizomes and eventually the plants die. When the affected rhizomes are split open, brown to dark brown fibrovascular tissues are seen. In a majority of diseased rhizomes examined, active maggots of *Mimegrella coerulifrons* were found. This fly was found to be the primary causal agent of rhizome rot in Maharashtra State (Ajiri, Ghorpade & Jadhav 1982). However in Kerala, it was found to be associated with rotten rhizomes only and does not play a significant role in causing the disease (Premkumar Sarma & Gautam 1982). At Rudrur (Nizamabad District, Andhra Pradesh) the fly infestation was preceeded by rhizome rot incidence (Sankaraiah *et al.* 1991).

Pathogen

Different species of *Pythium* were recorded as pathogens involved in rhizome rot. *P. graminicolum* was reported as the causal organism of the disease (Ramakrishnan & Sowmini 1954); *P. aphanidermatum* was reported from Sri Lanka (Park 1934). In addition to *P. aphanidermatum,* rhizome rot of turmeric caused by *P. myriotylum* was reported from Assam (Rathaiah 1982 a). The pathogen is soil and seed borne.

Disease resistance

Sixty two turmeric germplasm lines were screened for their reaction to the incidence of rhizome rot under endemic areas in Andhra Pradesh and most of them were found to be susceptible to rhizome rot. However, PCT-13 and PCT -14 were found to be tolerant to rhizome rot (Rao *et al.* 1992). The cultivars Mydukur, Tekurpet and Duggirala were susceptible and Ca 69 and Shillong were resistant to rhizome rot in Assam (Rathaiah 1982 b).

Disease management

Dipping seed rhizomes and soil drenching with Ridomil at the first appearance of symptoms controlled rhizome rot and increased the yield (Rathaiah 1982 b).

Foliar disease

Among the foliar diseases of turmeric, leaf blotch caused by *Taphrina maculans* and leaf spot caused by *Colletotrichum capsici* are important. Besides, leaf spots caused by *Corticium sasaki, Phyllosticta zingiberi, Myrothecium* sp., *Cercospora* sp. and *Pyricularia curcumae* were also reported.

Leaf blotch

Leaf bloch disease caused by *Taphrina maculans* was reported for the first time (Butler 1911) from Gujarat, Saharanpur (Uttar Pradesh) and Rangapur (East Pakistan). Later, it was observed from all turmeric growing regions of the country (Upadhyay & Pavgi 1967). Severe outbreaks of this disease were reported during 1955-57 from Rayalaseema area of Andhra Pradesh (Sarma & Murthi 1962).

Symptoms

The disease is characterized by the appearance of several spots on both the

surfaces of leaves and being generally more numerous on upper surface (Joshi & Sharma 1982). The leaf spots first appear as pale yellowish discolouration which become dirty yellow and then deepen to the colour of old gold and some times to bay shade (Butler 1911). The individual spots are small, 1-2 mm in diameter and coalesce freely. In severe cases of attack, hundreds of spots appear on both the sides of leaves. The spots are discrete brownish black and mostly confined to lower leaves.

Disease resistance

A variant clone of *C. longa* selected from a local susceptible variety was immune to the disease for three successive seasons (Upadhyay & Pavgi 1967). Almost all short duration cultivars were resistant to leaf blotch. However the intermediate duration types like CLL cultures were susceptible to leaf blotch (Rao *et al.* 1992). Sarma & Dakshinamurthy (1962) reported that 'Bontha' types are attacked by *Taphrina* sp. and the varieties that are susceptible to *Colletotrichum* leaf spot are practically unaffected by *T. maculans.*

Philip & Nair (1981) reported high degree of heritability and genetic advance as percentage of mean for leaf blotch infection (0.82 and 94.4 per cent) indicating the scope for selection of turmeric types with low intensity of leaf blotch infection. Nambiar, Sarma & Brahma (1977) reported that the intensity of attack by the pathogen was more in *C. longa* types. The varieties CLL 324, Amalapuram, Mydukur, Karhadi local, CLL 326, Ochira 24 and Alleppey among *C. longa* group and Ca 68, Ca 67, Dahgi and Kasthuri among *C. aromatica* types were free from infection.

Disease management

Destruction and burning of diseased leaves would prevent the further spread of the disease. In field trials, spraying with Dithane - Z 78 (0.2%) gave best control of the disease followed by Dithane - M 45, Blitox 50, Bavistin and Cuman L (Srivastava & Gupta 1977).

Leaf spot

Leaf spot disease of turmeric caused by *Colletotrichum capsici* was reported for the first time from Coimbatore District of Madras by Mc Rae in 1917. Later, it was reported from turmeric growing regions like Cuddapah, Kurnool, Guntur, Krishna and Godavari districts of Andhra Pradesh and Coimbatore of Madras State (Ramakrishnan 1954).

Symptoms

The disease appears usually during August and September, when there is high and continuous humidity in the atmosphere. It was also observed during October and November. The pathogen attacks mostly leaves. The infection is usually confined to leaf blades and may occasionally extend to leaf sheaths. The disease manifests in the form of elliptic or oblong spots of variable size. In the initial stages, they are small and may measure 1.5-2.0 inches in length and 1.0-1.5 inches in breadth but very soon many of them increase in size. Two or more such spots coalesce developing into irregular patches often involving a major portion of the leaf which eventually dries up. Each individual spot has a characteristic appearance. The centre is greyish white and thin with numerous black dot like acervuli on both surfaces. These are arranged in concentric rings. Beyond the greyish white portion, is a brown

margin all round the spot. Outside there is an indefinite yellowish region forming a halo round the spot. The spots though visible on both surfaces are more marked on the upper surface in new leaves. When the incidence of disease is heavy, most of the leaves dry up and the field presents a parched up appearance. The central region of the spot may become papery and easily torn. Stromatoid bodies are formed even on the scales of rhizomes (Ramakrishnan 1954). The infection is also noticed on turmeric flowers as spots (Palarpawar & Ghurde 1989b).

Pathogen

The pale brownish hyphae accumulate inside the epidermal cells and form the basis of stromatal development. The stromata are made up of light to dark brown pseudo - parenchymatous cells. The outer wall of the epidermis is ruptured and the setae and condiophores are exposed.

Toxins isolated from the culture filtrate could produce similar symptoms (Nair & Ramakrishnan 1973). Turmeric leaves infected with *C. capsici* exhibit higher respiratory rate with augmentation of the terminal oxidative system. Ascorbic acid oxidase and polyphenol oxidase activity were higher in infected leaves and toxin treated leaves compared to healthy leaves (Nair & Ramakrishnan 1975).

The pathogen survives on infected leaf debris for one year, which forms the source of primary infection. The pathogen also infects pigeon pea, *Cyamopsis tetragonoloba,* sorghum, ginger, and pa - wpaws (Palarpawar & Ghurde 1989 c).

Disease resistance

Reddy, Dakshinamurthy & Sarma (1963) found that the varieties Nallakatla, Sugandham, Duvvur and Gandikota were resistant to leaf spots. Sarma & Dakshinamurthy (1962) reported that long duration *C. longa* types were highly susceptible to *Colletotrichum* sp. while the early duration P73 types were found to have some resistance. Palarpawar & Ghurde (1989 a) found the sources of resistance in the varieties Bhendi, Gadhavi and Krishna to three isolates of *C. curcumae* in Vidarbha region of Maharashtra. Of the 19 varieties screened for their reaction to leaf spot, 'Mannuthy local' showed high degree of field tolerance (Philip & Nair 1981). Of the 150 germplasm lines screened at Coimbatore for leaf spot, Sugantham was highly resistant and about 14 accessions were moderately resistant (Thamburaj 1991).

Disease management

The growth of the fungus was strongly inhibited by carbendazim and benomyl when applied to the medium @ 100,250 and 1000 ppm. Carbendazim inhibited protein, DNA and RNA synthesis during germination (Raja 1989). The disease could be managed by spraying Bordeaux mixture before the appearance of the disease (Ramakrishnan 1954). Dakshinamurthy *et al.* (1966) recommended four sprays of Captan (0.2%) or Dithane Z-78 at monthly intervals. Rao & Rao (1987) recommended six sprays of Dithane M - 45 @ 0.25% at 15 days interval for controlling leaf spot and increasing the yield. Carbendazim and Edifenphos sprays gave very good control of leaf spot of turmeric (Palarpawar & Ghurde 1989d). Two sprays of carbendazim at disease initiation and 15 days latter was found to control the disease effectively (Thamburaj 1991).

Leaf blight

Leaf blight of turmeric caused by *Corticium sasakii* was observed in the vicinity of Jorhat, Assam (Saikia & Roy 1975) and in Meghalaya (Maiti, Chandra & Sahambi 1980).

Symptoms

The disease manifests as water soaked spots of varying shapes and sizes on the lower leaves which gradually increase in size during warm and humid weather resulting in bligtening of entire leaf area. The blighted leaf area is divided or banded into various sectors which are characteristic symptoms for early diagnosis. The fungus thrives well in a wide range of temperature varying from 15 to 30°C.

Storage diseases

The extent of damage due to storage rots of rhizomes of turmeric is more than 60 per cent in some districts of Andhra Pradesh (Reddy & Rao 1973). Storage rots were reported to be caused by several pathogens (Rathaiah 1982 a). Of the different organisms reported to cause storage rots, *Aspergillus flavus* was associated with more than 70 per cent of the samples in Uttar Pradesh (Sharma & Roy 1984). *Macrophomina phaseolina* and *Cladosporium cladosporiodes* (Sharma & Roy 1981) and also species of *Aspergillus, Fusarium, Rhizoctonia and Sclerotium* (Kumar & Roy 1990) were associated with decay of rhizomes during storage.

Minor diseases

Leaf spots of turmeric were reported to be caused by *Thirumalacharia curcumae* (Rathiah 1980), *Phaeodactylium alpinae* (Srivasthava & Verma 1987), *Phyllosticta zingiberi* (Summanwar & Bhide 1962) and *Pestalotiopsis* sp. (Borbura 1988). Root rot of turmeric caused by *Fusarium solani* was reported from Himachal Pradesh (Dohroo 1988). Leaf blast of turmeric caused by *Pyricularia curcumae* was reported from Assam (Rathaiah 1986). Bacterial wilt of turmeric caused by *Pseudomonas solanacearum* Biovar III from Indonesia (Mulya, Shiomi & Oniki 1990) and turmeric ragged stunt (Rathaiah 1987) were also reported.

Future strategies

The epidemiology of these diseases under different cropping systems and the role of biocontrol agents and organic amendments in suppression of diseases needs thorough investigations. Integrated disease management strategies involving healthy seed material, crop rotation, need based chemical application, use of disease resistant varieties coupled with biocontrol agents needs to be evolved.

References

Ajiri D A, Ghorpade S A & Jadhav S S 1982 Research on rhizome fly *Mimegrella coerulifrons* on turmeric and ginger in Maharashtra. ICAR Report.

Anonymous 1992 Agricultural Situation in India 47 : 296.

Barbura A 1988 *Pestalotiopsis* leaf spot of turmeric. Indian J. Mycol. & Plant Path. 17 : 236.

Butler E J 1911 Leaf spot of turmeric *Taphrina maculans* sp. nov. Anal. Mycol. 9 : 36-39.

Dakshinamurthy V, Reddy G S, Rao D K & Rao P G 1966 Fungicidal control of turmeric leaf spot caused by *Colletotrichum capsici*. Andhra

Dohroo N P 1988 *Fusarium solani* on *Curcuma longa*. Indian Phytopath. 41 : 504.

Joshi L K & Sharma N D 1982 Diseases of ginger and turmeric. In: Nair M K, Premkumar T, Ravindran P N & Sarma Y R (Eds.) Proc. National Seminar on Ginger and Turmeric, 8-9 April 1980, Calicut (pp. 104-109). Central Plantation Crops Research Institute, Kasargod, Kerala, India.

Kumar H & Roy A N 1990 Occurrence of fungal rot of turmeric (*Curcuma longa* L.) rhizome in Delhi market. Indian J. agric. Sci. 60 : 189-191.

Maiti S, Chandra S & Sahambi H S 1980 A new leaf blight of arrow root and turmeric in Meghalaya. Indian Phytopath. 33 : 492-493.

Mc Rae W 1917 Notes on South Indian fungi. Year book, Madras agric. Dept.

Mulya K, Shiomi T & Oniki M 1990 Bacterial wilt disease on industrial crops in Indonesia. Industrial Crops Res. J. 2 : 30-36.

Nair M C & Ramakrishnan M 1973 Production of toxic metabolites by *Colletotrichum capsici* (Syd) Butler & Bisby and its role in leaf spot disease of turmeric. Curr. Sci. 42 : 362-363.

Nair M C & Ramakrishnan K 1975 Respiratory and enzymatic changes in the *Colletotrichum* leaf spot of turmeric. Proc. Indian Acad. Sci. 81 B : 170-173.

Nambiar K K N, Sarma Y R & Brahma R N 1977 Field reaction of turmeric types to leaf blotch disease. J. Plant. Crops 5 : 124-125.

Palarpawar M Y & Ghurde V R 1989 a Sources or resistance in turmeric against leaf spots incited by *Colletotrichum capsici* and *C. curcumae*. Indian Phytopath. 42 : 171-173.

Palarpawar M Y & Ghurde V R 1989 b New record of turmeric flower infection by *Colletotricum curcumae*. Indian Phytopath. 42 : 203.

Palarpawar M Y & Ghurde V R 1989 c Perpetuation and host range of *Colletotrichum curcumae* causing leaf spot disease of turmeric. Indian Phytopath. 42 : 576-578.

Palarpawar M Y & Ghurde V R 1989 d Fungicidal control of leaf spot of turmeric incited by *Colletotrichum curcumae*. Indian Phytopath. 42 : 578-579.

Park M 1934 Report on the work of the Mycology Division pp. 126-133. Admn. Rept. Dir. Agric., Ceylon.

Philip J & Nair P C S 1981 Field reaction of turmeric types to important pests and diseases. Indian Cocoa Arecanut & Spices J. 4 : 107-109.

Premkumar T, Sarma Y R & Gautam S S S 1982 Association of dipteran maggots in rhizome rot of ginger. In Proc. National Seminar on Ginger and Turmeric. Nair M K, Premkumar T, Ravindran P N & Sarma Y R (Eds.) 8-9 April 1980, Calicut (pp.128-130). Central Plan-

tation Crops Research Institute, Kasargod, Kerala, India.

Raja K T S 1989 *In vitro* effect of some fungicides on mycelial growth and macro molecular synthesis during spore germination of *Colletotrichum capsici* causing leaf spot disease of turmeric. Pestology 13 : 28-31.

Ramakrishnan T S 1954 Leaf spot disease of turmeric (*Curcuma longa* L.) caused by *Colletotrichum capsici* (Syd) Butl. & Bisby. Indian Phytopath. 7 : 111-117.

Ramakrishnan T S & Sowmini C K 1954 Rhizome and root rot of turmeric caused by *Pythium graminicolum* Sub. Indian Phytopath. 7 : 152-159.

Rao T G N, Reddy B N & Sasikumar B 1993 Production constraints of turmeric in Andhra Pradesh. Spice India. 6 : 8-13.

Rao P S & Rao T G N 1987 Leaf spot of turmeric caused by *Colletotrichum capsici,* yield loss and fungicidal control. J. Plantn. Crops 15: 47-51.

Rao P S, Reddy M L N, Rao T G N, Krishna M R & Rao A M 1992 Reaction of turmeric cultivars to *Colletotrichum* leaf spot, *Taphrina* leaf blotch and rhizome rot. J. Plantn. Crops 20 : 131-134.

Rathaiah Y 1980 A new leaf spot of turmeric. Mycologia 72 : 1210-1213.

Rathaiah Y 1982 a Ridomil for control of rhizome rot of turmeric. Indian Phytopath. 35 : 297-299.

Rathaiah Y 1982 b Rhizome rot of turmeric. Indian Phytopath. 35 : 415-417.

Rathaiah Y 1986 Turmeric cultivation in Assam. Indian Cocoa Arecanut & Spices J. 9:91-93.

Rathaiah Y 1987 Diseases of turmeric in Assam. Pesticides 21 : 15-17.

Reddy G S, Dakshinamurthy V & Sarma S S 1963 Notes on varietal resistance against leaf spot diseases in turmeric. Andhra agric. J. 10 : 146-148.

Reddy G S & Rao P G 1973 Storage rot in seed rhizomes of turmeric in Andhra Pradesh. Indian Phytopath. 26 : 24-27.

Saikia U N & Roy A K 1975 Leaf blight of turmeric caused by *Curcuma sasakii.* Indian Phytopath. 28 : 518-520.

Sarma S S & Dakshinamurthy D 1962 Varietal resistance against leaf spot diseases of turmeric. Andhra agric. J. 9 : 61-64.

Shankaraiah V, Zaheeruddin S M, Reddy L K & Vijaya 1991 Rhizome rot complex on turmeric crop in Nizamabad District in Andhra Pradesh. Indian Cocoa Arecanut & Spices J. 14 : 104-106.

Sharma M P & Roy A N 1981 Rhizome rot of turmeric (*Curcuma longa* L.) caused by *Aspergillus flavus.* Indian Phytopath. 34 : 12-8.

Sharma M P & Roy A N 1984 Storage rot in seed rhizomes of turmeric (*Curcuma longa* L.) and its control. Pesticides 18 : 26-28.

Srivastava V P & Gupta J H 1977 Fungicidal control of turmeric leaf spot incited by *Taphrina maculans*. Indian J. Mycol. Pl.Path. 7 : 76-77.

Srivastava L S & Verma R N 1987 A new leaf spot of *Curcuma longa* in Sikkim. Curr. Sci. 56 : 673.

Summanware A S & Bhide V P 1962 Leaf spot of turmeric (*Curcuma longa* L.) caused by *Phyllosticta zingiberi* Ramk. J. Indian Bot. Sci. 41 : 313-315.

Thamburaj S 1991 Research in spice crops at TNGDNAU. Spice India 4 : 17-18.

Upadhyayay R & Pavgi M S 1967 Perpetuation of *Taphrina maculans* Butler, the incitant of turmeric leaf spot disease. Phytopath Z. 59 : 136-140.