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EVALUATION OF BIOAGENTS AND FUNGICIDES IN INTEGRATED MANAGEMENT OF DISEASES IN TURMERIC *CURCUMA LONGA* L.

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ABSTRACT

Turmeric *Curcuma longa* L. is an important spice and commercial crop**,** belong to family Zingiberaceae and a native of South Asia particularly India. The present investigation entitled integrated management of rhizome rot in turmeric *Curcuma longa* L. was undertaken during 2016-18 to find out the response of bio agents and fungicides in management of rhizome rot disease in turmeric crop. Experimental findings indicate that among 10 treatments with bioagents and fungicides, the treatment viz. rhizome treatment with Carbendazim 2g./kg rhizome followed by Rhizome treatment with Chirayu@ 50g/kg rhizome and soil application of *Trichoderma harzianum* @ 5kg/ha. enriched with neem cake and FYM at planting along with after receiving 2mm. rainfall, 1st spray with Carbendazim 12%+ Mancozeb 63%WP (0.2%) + micronutrient (Rexonil) spray@ 0.2%, 2nd spray with Propiconozole @0.1% and 3rd spray with Tebuconazole 50% + Trifloxystrobin 25% W @0.5 g/L at 15 days interval was more effective in controlling rhizome rot, leaf spot and leaf blotch diseases. Lowest per cent disease incidence of rhizome rot (8.90) and lowest per cent disease index of leaf spot (18.58), lowest per cent disease index of leaf blotch (15.79) and highest fresh rhizome yield (36.85t/ha) was recorded and more cost benefit ratio 1:2.37 was recorded.

KEYWORDS: IDM, turmeric, bioagents.

INTRODUCTION

In India, the total area under cultivation is 233 thousand hectares with a production of 1190 thousand tones during 2014-15 (Anonymous, 2014-15). A.P, tops in production of turmeric in India. In A.P, the total area under cultivation is 17.82 thousand ha with a production of 151.90 thousand tonnes during 2014-15 (Spice Board, 2015). Turmeric occupies about 6% of the total area under spices and condiments in India.

It was intensively cultivated in the districts of Guntur, Kadapa, Kurnool, West Godavari and parts of Visakhapatnam in Andhra Pradesh (AP) in India. Turmeric is affected by a number of fungal diseases of both soil and air borne nature. The important diseases affecting the crop are rhizome rot, leaf spot, leaf blotch. Crop loss can be as much as 50%, as reported in the Telengana and Andhra Pradesh in India (Rao and Rao, 1988; Sankraiah *et al*, 1991). Rhizome rot is the most destructive disease causing enormous economic damage (Rathaiah, *et al*, 1982). So far Turmeric Rhizome rot was recorded with only two fungus genus namely *Fusarium* (Dohroo, 1988; Li. Y,2014) and *Pythium* (Ramakrishna *et al*, 1954.). The rhizome of this important herb while rotting were recorded with a new fungi of genus *Staphylotrichum* and species named *Staphalotrichum curcumae* after the host name. (Ruth *et al*, 2018).\

MATERIALS AND METHODS

A field experiment was conducted at College of Horticulture, Anantharajupeta, Kadapa, Kurnool (A. P.) to study the management of rhizome rot and foliar diseases in Mydukur variety of turmeric. The experiment was laid out with 10 treatments replicated thrice in Randomized Block Design (RBD). The plot size is 3x2 M. with a spacing of 30x15cm.

The crop was raised as per the recommended package of practices, except plant protection measures. The rhizome treatment with Carbendazim, Mancozeb, Chirayu and soil application of bioagent and dipping of rhizomes in dual contact and systemic fungicide were done at the timing of sowing in the field. After onset of monsoons and receiving two mm. rainfall spraying was conducted with contact & systemic action fungicide along with micronutrients and second spray with recommended fungicide and third spraying with combination fungicide which has systemic broad spectrum action at 15 days interval.

Treatment details

T1 - Rhizome treatment with Chirayu @ 50g/kg seed + soil application of *Trichoderma harzianum* @ 5kg/ha. multiplied in neem cake and FYM at Planting.

T2 –After receiving rainfall, 1st spray with Carbendazim 12%+ Mancozeb 63%WP 0.2% + micronutrient (Rexonil) spray@ 0.2%, 2nd spray with Propiconozole @0.1% and 3rd spray with Tebuconazole 50% + Trifloxystrobin 25% W @0.5 g/L at 15 days interval

T3 – Dipping of rhizomes in Fenamidone (10%) + Mancozeb(50%) @0.1% + application of Carbofuron granules @10kg/ha.

T4 : Dipping of rhizomes in Fenamidone (10%) + Mancozeb(50%) @0.1% + application of Carbofuron granules @10kg/ha +T2

T5 : T1+T2

T6 : Rhizome treatment with Carbendazim @0.2%

T7 : Rhizome treatment with Mancozeb@0.3%

T8 : T1 + T2+ Carbendazim@0.2%

T9 : T1 +T2 + Mancozeb@0.3%

T10 : Control

Observations were recorded on ten plants on disease severity in each treatment before three sprays and after completion of schedule sprays as per the standard method. Finally, the turmeric yield per plot was recorded and converted into quintals/ha and data was analyzed statistically. The observations of turmeric disease severity of rhizome rot and foliar diseases were recorded using different disease rating scales given as below.

Disease rating scale: Rhizome rot disease incidence is determined on the basis of disease score an estimate of the area decayed using 0-4 scale as follows.

0 = No disease (none affected);

1 = slight rot or discoloration (less than 30% affected tissue);

2 = moderate rot or discoloration (30-70% affected tissue);

3 = severe rot or discoloration (more than 70% affected tissue);

4 = complete rot.

The percentage of disease incidence was calculated as described by Guo *et al.*

Rot incidence = ([scale× number of plants infected]/[highest scale× total number of plants])×100

- The turmeric leaf spot and leaf blotch diseases rating was recorded by adopting 0-6 scale (Palarpawar and Ghurde, 1989)
- 0 = no infection,
- 1= 0.1 to 10.0% necrotic leaf area

- 2 = 10.1 to 20%necrotic leaf area
- 3 = 20.1 to 30% necrotic leaf area
- 4 = 30.1 to 40% necrotic leaf area
- 5 = 40.1 to 50% necrotic leaf area
- 6 = More than 50% necrotic leaf area

The percent disease index of leaf spot and leaf blotch were calculated using the following formula:

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of the individual diseases grade x 100}}{\text{Number of Branches or fruits observed x Maximum Disease grade}}$$

RESULTS AND DISCUSSION

Among 10 treatments with bioagents and fungicides, the treatment T8 viz. rhizome treatment with Carbendazim 2g./kg rhizome followed by Rhizome treatment with Chirayu@ 50g/kg rhizome and soil application of *Trichoderma harzianum* @ 5kg/ha. enriched with neem cake and FYM at Planting along with after receiving 2mm. rainfall, 1st spray with Mancozeb + Carbendazim (0.2%) + micronutrient (Rexonil) spray@ 0.2%, 2nd spray with Propiconozole @0.1% and 3rd spray with Tebuconazole 50% + Trifloxystrobin 25% W @0.5 g/L at 15 days interval was more effective in controlling rhizome rot, leaf spot and leaf blotch diseases. Lowest per cent disease incidence of rhizome rot (8.90) and lowest per cent disease index of leaf spot (18.58), lowest per cent disease index of leaf blotch (15.79) and highest fresh rhizome yield (36.85t/ha) was recorded and more cost benefit ratio 1:2.37 was recorded (Table-1). In case of T9 treatment also more yield (35.24 t/ha) was recorded. All the treatments T1 to T9 were significantly superior in reducing disease incidence over control T10. Dipping of rhizomes in Fenamidone (10%) + Mancozeb(50%) @0.1% + application of Carbofuron granules @10kg/ha along with T2 treatment spraying with three selective fungicides reduced the disease incidence of rhizome rot, leaf spot and leaf blotch (18.69, 25.93,21.78) respectively.

Table 1: Evaluation Of Bioagents And Fungicides In Integrated Management Of Diseases In Turmeric *Curcuma Longa* L.

S. No	Treatments	Rhizome rot (Per cent Disease Incidence)	Leaf spot (Per cent Disease Index)	Leaf blotch (Per cent Disease Index)	Yield t/ha	Cost Benefit (CB) ratio
1.	T1	16.02 (23.58)	22.79 (28.45)	20.91 (27.20)	29.97	1:1.9
2.	T2	21.32 (27.49)	21.63 (27.69)	19.36 (26.06)	28.85	1:1.8
3.	T3	19.58 (26.21)	27.32 (31.50)	22.63 (28.38)	27.24	1:1.7
4.	T4	18.69 (25.55)	25.93 (30.59)	21.78 (27.76)	30.06	1:1.9
5.	T5	11.79 (20.00)	20.93 (27.20)	18.60 (25.55)	34.55	1:2.2
6.	T6	25.65 (30.40)	30.17 (33.27)	27.03 (31.31)	21.54	1:1.3
7.	T7	27.90 (31.88)	31.23 (33.96)	28.69 (32.33)	20.15	1:1.2
8.	**T8**	**8.90 (17.36)**	**18.58 (25.48)**	**15.79 (23.34)**	**36.85**	**1:2.37**
9.	T9	10.86 (19.19)	19.35 (26.06)	16.38 (23.81)	35.24	1:2.2
10.	T10	36.70 (37.29)	41.00 (39.82)	30.98 (33.77)	15.54	
	SEm	0.57	1.05	0.70		
	CD at 5%	1.68	3.11	2.09		
	CV (%)	3.81	6.20	4.29		

Figures in parenthesis are angular transformed values

The important diseases affecting the turmeric crop are rhizome rot, leaf spot, leaf blotch, leaf blast and leaf blight (Joshi and Sharma, 1980; Ravindran, 2007). Sekhar Bandyopadhyaya *et al* (2014) reported that the disease was controlled by rhizome treatment and foliar spray with Carbendazim + Mancozeb @0.1% at 45 and 90 days after planting. Narasimha Rao *et al* (2012) stated rhizome treatment with Carbendazim + Mancozeb (0.1%) gave the best results for germination (90.52%) and rhizome treatment and foliar application of Propiconazole (0.1%) at 45 and 90 days after planting (DAP) were significantly superior in reducing the disease index (20.01%) of leaf spot disease and increasing the fresh rhizome yield (17.13 t ha-1) as compared to other fungicides tested. The high cost – benefit ratio was achieved in rhizome treatment and foliar application of Carbendazim + Mancozeb at 45 and 90 DAP (1:1.92). These findings were accordance with the present study in which this fungicide is useful at early stages of the crop. Akhilesh Singh (2003) reported three sprays of Dithane M-45 was found effective in reducing the *Taphrina* leaf spot. Narasimhudu *et al* (2002) found that Topsin-M@0.1% was effective in reducing the leaf spot intensity.

Leaf blotch disease usually appears on lower leaves in winter season starting period. This disease caused by *Taphrina maculans* (Butler and Bisby) and appears as small, oval, rectangular or irregular brown spots on either side of the leaves which soon become dirty

yellow or dark brown. The leaves turn chlorosis to necrosis. The disease is characterized by the appearance of several spots on both the surfaces of leaves. The fungus is mainly air borne and primary infection occurs on lower leaves with the inoculum surviving in dried leaves of host, left over in the field. The ascospores discharged from successively maturing asci infect fresh leaves without dormancy, thus causing secondary infection. Secondary infection is most dangerous than primary one causing profuse sprouting all over the leaves. The integrated approach taken in field demo trials includes selection of seed material from disease free areas, treating the seed material with Mancozeb @ 3g/litre of water for 30 minutes and shade dry before sowing. Spraying of Mancozeb @ 2.5 g/L of water or Hexaconzole @ 1ml/litre; two sprays at fortnightly intervals and at heavy mist-fog season spraying of Copper oxy chloride 3 g/litre effective against leaf blotch disease. During the month of August to October more rain fall disease severity is high.(Zaheer Ahamed *et al*, 2016).

Naramsimuhdu and Balasubramanian (2003) recommended spray of lndofil -45, Topsin M-45 and Bavistin for disease management. These findings are in agreement with the present observation for efficacy of Carbendazim in reducing the disease index in turmeric.

According to Mishra R. S. and Pandey V.P. (2015) foliar application of Propiconazole (0.1%) at 45 and 90 DAP was significantly superior in minimizing per cent disease intensity (27.61 PDI) in comparison to foliar spray + rhizome treatment with Hexaconazole (28.50 PDI) and Tricyclazole (33.73 PDI). The fresh rhizome yield ranged from 33.96 - 34.33 t ha-1 with Propiconazole and 31.15 - 33.22 t ha-1 with Hexaconazole as compared to the control (28.17 t ha-1). C: B ratio was found to be highest (1:2.65) with foliar spray of Propiconazole. This finding was conformity with the present investigation, in which second spray of Propiconozole o.1% was effective in reducing the diseases in turmeric. Seed treatment with Chirayu or seed pro decreased the disease incidence by providing protective shield at early stage of the crop and increased beneficial microorganisms. Soil application of *Trichoderma harzianum* enriched with FYM was efficiently managed rhizome rot disease. *Trichoderma harzianum* has shown effective control of root infecting fungi nad root –knot nematodes.(Spiegel and Chet,1998: Sun and Liu, 2006). Application of Carbofuron granules @10kg/ha.was effective against secondary spread of rhizome fly attack under integrated disease management. So it is evident that there lies in the potential of biocontol agents to be used along with plant protection chemicals as a control of integrated control packages. However, the performance of the selected bioagents in different turmeric growing areas is to

be ascertained before recommending to the farming community as an eco-friendly management practice against the disease. Fungicides those are inhibitory against a narrow spectrum of plant pathogen but not against biocontrol agent offer a chance for integration of chemical and biocontrol agents.

REFERENCES

1. Anonymous (2014-15) Anuual report of National Horticulture Board, 6 and 288.
2. Akhilesh Singh, Aswani K., Basandrai and Sharma B.K (2003) Fungicidal management of *Taphrina* leaf spot of turmeric. Indian Phytopath, (1): 119-120.
3. Joshi C.G. and Shrma N.D. (1980) Disease of Ginger and turmeric Proc. National seminar on ginger and turmeric held at Calicut, April 8-9: 104-119
4. Li. Y., Chi, L.G; Mao, D; Yan, Z; Wu, F; Ma T. T; Guo, M. X; Wang,Q. X; Ouyang, C. B and Cao A. C. (2014). First report of ginger rhizome rot caused by *Fusarium oxysporum* in China. Plant disease, 48(2): 282.
5. Mishra R S and Pandey VP (2015) Management of *Colletotrichum* leaf spot of turmeric through fungicides.Journal of Spices and Aromatic Crops, [S.l.], v. 24, n. 2: 153-156.
6. Narasimha Rao, Kumar K. Ravindra and Anandraj M. (2012) Management of leaf spot of turmeric (*Curcuma longa* L.) incited by *Colletotrichum capsici* through fungicides. Journal of Spices and Aromatic crops, 21: 151-154.
7. Narasimhudu Y. and K.A. Balasubramanian (2002). Fungicidal management of leaf spot of turmeric incited by *Colletotrichum capsici*. Indian Phytopath, 55: 527-528.
8. Palarpawar M.Y. and V.R. Ghurde (1989). Fungicidal control of leaf spot of turmeric incited by *Colletotrichum curcumae*. Indian Phytopath, 42: 578-579.
9. Rathaiah, Y (1982) Rhizome rot of turmeric. *Indian Physiopathology*, 35: 415-417.
10. Rao P.S. and Rao T.G.N. (1988). Disease of turmeric in Andhra Pradesh. In: *Proceedings of the Nationl Seminar on Chillies, Ginger and Turmeric.* Spices Board, Cochin, Kerela, India, 162-167.
11. Ravindran P.N., Nirmalbabu K. and Sivaraman K. (2007) *Turmeric, The genus Curcuma. Medicinal and aromatic plants-Industrial profiles*. CRC press, Taylor and Francis group, Florida, USA.
12. Ruth C, Gopal K, Srinivasulu B. and Ramakrishna M. (2018) a novel species of *staphylotrichum curcumae* causing rhizome rot of turmeric. World Journal of Pharmacy and Pharmaceutical Sciences, 7(7): 1030-1032.

13. Spiegel and Chet I. (1998) Evaluation of Trichoderma spp. as a biocontrol agent against soil borne fungi and plant parasitic nematodes in Israel. Integrated Pest Management Reviews, 3: 169-175.
14. Sun M.H.and Liu XZ, (2006) Carbon requirements of some nematophagous, entomopathogenic and mycoparasitic hyphomycetes as fungal biocontrol agents. Mycopathologia, 2006; 161: 295-305.
15. Zaheer Ahamed B, Siddaray Allolli, Anand Naik and Raju G Teggelli (2016) Management of Taphrina leaf blotch in turmeric caused by *Taphrina maculans* (Butler and Bisby, Environ. Life Sci, 9(10): 1286-1287.