Original Research Article

Comparative effect of bioagents and Microalgae against anthracnose (*Colletotrichumcapsici*) disease of chilli (*Capsicum annum* L.)

ABSTRACT

A survey was conducted during Rabi 2020 to know the severity of Anthracnose of chilli in fields ofeight villages in Krishna district of Andhra Pradesh. The disease severity ranged from 13.30 to 29.65 per cent irrespective of location surveyed. The disease severity was least in Tadikilapudi village (13.3%) and highest in kamavarapukota village (29.65%) during the month of December 2020. To manage the disease severityevaluate the efficacy of bio-agents viz.., Seed Treatment with Pseudomonas fluorescens, Trichodermaviride and Microalgae.The foliar application of Neem oil is given to all the treatments. Among the Treatments disease intensity (%) was significantly decreased in treatment T_6 - Pseudomonas fluorescens + Trichodermaviride + microalgae (16.03%).The plant height (cm) was significantly increased in treatment T_6 – Pseudomonas fluorescens + Trichodermaviride + microalgae (62.2cm) respectively, fruit length (cm) was significantly increased (15.96cm), yield was significantly increased in treatment T_6 (128.33 q/ha) as compared to control T_0.

Keywords: Anthracnose, *Colletotrichumcapsici*,microalgae, neem oil,*Pseudomonasfluorescens, Trichodermaviride.*

Introduction

Chilli(Capsicum annuum L.), belong to family Solanaceae, is one of the most important spice crop used worldwide. Chillies are widely used as vegetables, spices, condiments, sauces and pickle. comprises numerous chemicals including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, protein, fiber and mineral elements [1].India is the top most producer of chilli260.48tonnesfollowed by China 98.479 tonnes(**FAO 2021**).Andhra Pradesh ranks first in list of chilli producing states in India and it alone produces 49% of chilli production in India. One of the most damage causing fungal

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disease in chilliis Anthracnose which can occur on leaves, stems and both pre and post harvested fruits. Anthracnose of chilli caused by *Colletotrichumcapsici*is one of the most economically important disease reducing marketable yields from 10 to 80 percent of the crop production in some developing countries, particularly in Thailand.Concentric rings of acervuli, circular or angular, depressed, sunken lesions, and pink to orange conidial masses on fruits and foliage are the hallmarks of anthracnose. That is one of the major reasons for the post-harvest degradation of chillies and damages them not only during the field as well as during storage. Disease-affected ripe fruits that are becoming red change from typical red to a straw colour. In more severe cases, a mat of fungus hyphae covers the seeds; these hyphae eventually turn rusty in colour. The pathogens are suppressed by *P. fluorescens* in a number of ways, including competition for nutrients as well as space, antibiosis through the production of several antibiotics, siderophores, and lytic enzymes. Other mechanisms include of production of hydrogen cyanide (**Defago*et al.*, 1992**) and degeneration of toxins (**Borowitz*et al.*, 1993**).Trichoderma species possess many qualities and they have great potential use in agriculture such as amend abiotic stresses, improving physiological response to stresses, alleviating uptake of nutrients in plants, enhancing nitrogen-use efficiency in different crops, and assisting to improve photosynthetic efficiency. Because they have an antagonistic effect against several plant pathogens, including bacteria, fungi, and nematodes, microalgae, in particular cyanobacteria, are also thought of as potential biocontrol agents. This is primarily because they produce hydrolytic enzymes and biocidal substances like benzoic acid, majusculonic acid, etc. **Chaudhary *et al.*, (2012)**. Neem oil foliar application is applied following the appearance of symptoms in order to increase output and return on investment while minimizing danger to human health and environmental damage.

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MATERIALS AND METHODS:

A Survey was performed during Rabi season 2020 to understand the incidence of Anthracnose of chilli in farmer's fields in Krishna district of Andhra Pradesh. Eight villages were selected and in each village two fields were surveyed.The present work was carried out at farmer's field in Kaikaluru, Krishna district, Andhra Pradesh during Rabi season 2020-21.The experiment was conducted in Randomized Block design (RBD) in field consisting of seven treatments *viz.*, Seed treatment with *Pseudomonas fluorescens*@20gm/kg of seeds, *Trichodermaviride*@20 gm/kg of seeds, Microalgae @ 20gm/kg of seeds, *P.flurorescens @ 10gm/ kg + T. viride*@10gm /kg of seeds, *T. viride*@ 10 gm /kg + microalgae @10gm/ kg and *P.flurorescens* @5gm/ kg + *T. viride* @ 5gm/kg + microalgae @5gm/ kg of seeds and each treatment were replicated three times with plot size of 4×2m^2 each and seeds were shade dried and sown in seed trays . After 45 days after sowing the seedlings were transplanted into the plots with spacing of 60×60cm. Plant growth parameters and disease intensity were recorded at 15 days interval at 30, 45, 60 and 45, 60, 75 days after transplanting.The foliar application of Neem oil @0.5% was done ~~given~~ after 45days of ~~after~~ transplanting. ~~The records have been subjected to the statistical analysis.~~

At 45, 60, and 75 days after transplanting the characteristic symptoms developed on fruits were collected from the experimental field. A small portion of the infected fruit part was taken and placed on a glass slide and finely chopped. Further it was stained using lactophenol and cotton blue and covered with the cover slip and observed under compound microscope.

The records have been subjected to the statistical analysis.

In the fruit, the initial symptoms were water soaked lesion on the surface of fruits which leades to necrotic tissue formation and further develops into elliptical spot. The acervuli are subepidermal and break out through the surface of the plant tissue.Aseptate, typically elongated, hyaline, guttulatephialoconidia with pointed to rounded ends, produced in acervuli. Masses of conidia appear

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pink or salmon coloured. Dark, long, hair like hyphae called setae often are found in acervuli.

RESULTS AND DISCUSSION:

Village wise disease severity has been presented in Table 1. In Krishna district, maximum disease incidence was recorded in Kamavarapukota (29.65%).However, least disease incidence was recorded in Tadikilapudi(13.3%).There is a large variation in disease severity across a wide range of locations, primarily due to the climate, such as temperatures and relative humidity, rainfall distribution, cultivar types, and cultural practices such as sanitation. Chilli with older crops, cooler nights, and drier climates were more likely to improve *Colletotrichum* levels. This survey provides statistics about some of the pathogens that influence the yield and quality of fruits mainly based on agro-climatic zones and depth. A scientific survey is vital to determining disease outbreaks, endemic areas, and hot spots, as well as their sources. The result presented in Table2revealed that all the treatments were statistically significant and increased plant height (cm) as compared to control. Among the bio agents used, the treatment T_6- *P.fluorescence(0.5*%)+*T. viridae*(0.5%)+Microalgae(0.5%)+foliar spray with neem oil(0.5%) (62.2cm) significantly increased the plant height (cm), Fruit length and yield ofChilli and significantly decreased the disease intensity when compared to other treatments and control. The advantages of using bio-agents such as Trichoderma species in agricultural production include their capacity to reduce nutrient uptake by plants, enhance physiological responses to stress, boost nitrogen-use efficiency in certain crops, and enhance photosynthetic efficiency. Pseudomonas stimulates plant development by inhibiting pathogenic microorganisms, producing hormones that encourage plant growth, and enhancing plant disease resistance. It has been demonstrated that *Pseudomonas fluorescens* has the ability to act as a biocontrol agent, suppressing plant diseases by preventing

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fungal infection of the seeds and roots. They have a reputation for promoting plant development and easing the severity of certain fungal infections. Microalgae, particularly cyanobacteria are also considered a potential biocontrol agents as they exhibit antagonistic effects against many plant pathogens. Spirulina platensis is a biostimulant which contains protein, amino acids, minerals and vitamins. It contains 6.7% N, 2.47% P and 2.14% K as well as adequate amounts of microelements needed for plant nutrition.

Conclusion

Based on the findings above, bio-agents, microalgae, and neem oil are effective antimicrobial agents against *Colletotrichumcapsici*. The study showed that disease intensity (%) was significantly lower at 45, 60, and 75 DAT, plant height (cm) in chilli reached 30, 45, and 60 DAT, fruit length (cm) and yield (q/ha) were all higher in treatment T6 - *Pseudomonas fluorescens* + *Trichodermaviride* + microalgae. Compared with other bio-agents and control treatment, *Pseudomonas fluorescens* + *Trichodermaviride* + microalgae were superior against *Colletotrichumcapsici*.

Study Area: Kaikaluru ,Andhra Pradesh .

Ethical Approval : This article does not contain any studies with human participants or animals performed by any of the authors.

REFERENCES:

Bosland, P.W. and Votava, E.J.(2000) Peppers, Vegetables and spice Capsicums. CAB international,UK, 233

FAOSTAT (Food and Agriculture Organization Corporate Statistical Database) (2021) 2019 Food and Agricultural Organization-statistical Database, Recorded Data for Pineapples Production Quantity in Benin. FAO (FAO United Nations), Rome.

Hassan Javed Chaudhary, WardaShahid, AsghariBano, Farman Ullah, Farooq Munis, Shah Fahad and Izhar Ahmad (2012) In vitro analysis of Cupressussempervirens L. plant extracts antibaterial activity J*ournal of Medicinal Plants Research,* Vol 6(2), pp. 273-276

Michael J. Borowitz (1993) Immuno phenotyping of acute leukemia by flow cytometry,*Clinical Immunology Newsletter*,13(5–6) ;P 54-60,

Padmanaban, K ., Sahu, P.K. and Narsimhaiah, L. (2016) Production Performance of chilli in India- A Statistical approach. *Advances in Life Sciences* ;**5(10)**.

Poonpolgul, S. and Kumphai, S.(2007) Chilli Pepper Anthracnose in Thailand. Country Report. In: Oh DG, Kim KT, editors. *Abstracts of the First International Symposium on ChilliAnthracnose*; 23.

Christoph Keel, Ursula Schnider', Monika Maurhofer', Christophe Voisard, Jacques Laville', Ulrich Burger', Philippe Wither, Dieter Hass', and Geneviève Défago (1992) Suppression of Root Diseases by *Pseudomonas fluorescens* CHAO: Importance of the Bacterial Secondary Metabolite 2,4-Diacetylphloroglucinol *MOLECULAR PLANT-MICROBE INTERACTIONS* 5(1), pp. 4-13

Nirmal Renuka, Abhishek Guldhe, Radha Prasanna, Poonam Singh, Faizal Bux.(2018) Microalgae as multi-functional options in modern agriculture: current trends, prospects and challenges, *Biotechnology Advances*;36(4), pp.1255-1273

Table 1: Survey for the disease Incidence of Anthracnose of chilli in Krishna district region of Andhra Pradesh during Rabi 2020-2021

S.no	Location	Area	Variety	Stage of the crop	Percent Disease Incidence (%)
1	DharmaraoPeta(DP)	0.5 acre	Shivagami	Fruiting	26.75
2	Medinaraopalem (MP)	0.6acre	Tadapally big long	Flowering	17.9
3	Gopannapalem (GP)	0.5acre	Shivagami	Bud formation	16.15
4	Kamavarapukota (KK)	1.0acre	(G-3)	Harvest	29.65
5	Gandigudem(GG)	0.75acre	Byadagi	First harvest	24.3
6	Kallacheruvu(KC)	1.0acre	Byadagi	Second Harvest	23.85
7	Tadikilapudi(TP)	0.7acre	Shivagami	Flowering	13.3

8	Chinthalapudi (CP)	1.0acre	Guntur Sannam -S4	Flowering	19.1

Table 2: Effect of treatments on plant growth parameters, Disease intensity and yield of Chilli.

S.no	Treatment detail	Plant height(cm)	Disease intensiy(%)	Fruit length(cm)	Yield(q ha^{-1})
T_0	**Control**	**51.467**	**31.36**	**8.667**	**75.33**
T_1	***Pseudomonas fluorescence*(2%) +Foliar Spray Neem oil (0.5%)**	**58.533**	**20.8**	**14.567**	**109.33**
T_2	***Trichodermaviride(2*%) + Foliar spray neem oil**	**55.333**		**12.73**	**91**

	(0.5%)		**25.26**	**3**	
T_3	**Microalgae(2%)+ Foliar spray Neem oil(0.5%)**	**53.400**	**27.2**	**10.767**	**83.66**
T_4	***P.fluorescence*(1%)+*T.viridae*(1%)+Foliar Spray Neem oil (0.5%)**	**60.900**	**19.1**	**15.567**	**119.66**
T_5	***Pseudomonas fluorescence*(1%)+Microalgae(1%) +Foliar Spray Neem oil (0.5%)**	**56.600**	**23**	**13.800**	**100.66**
T_6	***P.fluorescence(0.5%)+T. viridae*(0.5%)+Microalgae(0.5%)+foliar spray neem oil(0.5%)**	**62.267**	**16.03**	**15.967**	**128.33**
	SE(d)	**1.19**	**0.73**	**0.15**	**1.75**
	CD (5%)	**2.59**	**1.59**	**0.33**	**3.81**