Comparative effect of bioagents and Microalgae against anthracnose (*Colletotrichum capsici*) 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 severity evaluate 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, *Colletotrichum capsici*,microalgae, neem oil,*Pseudomonas fluorescens, Trichoderma viride.*

Introduction:

Chilli(*Capsicum annuum* L.), belong to family Solanaceae, is one of the most important spice crop, are widely used as vegetable, condiments, sauces and pickle.Comprises numerous chemicals including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, protein, fiber and mineral elements.There is immense potential in India to grow and export various types of chillies to many different markets around the world. In 2005-06, India produced about 1014.60 million tonnes of chilli, spread over 654 million acres, with a productivity of 1551 kilograms per ha .Of the total area under chilli in India, nearly 75 percent is covered by Andhra Pradesh (49%), Karnataka (15%), Maharashtra (6%) and Tamilnadu (3%) states **(P.P.Jagatap *et al.*, 2012)**.One of the most damage causing fungal disease in chilli is Anthracnose which can occur on leaves, stems and both pre and post harvested fruits. Anthracnose of chilli caused by *Colletotrichum capsici* 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 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. Microalgal extracts are known to stimulate multiple mechanisms, including seeding, flowering,

fruiting, nutrient uptake, tolerance of biotic and abiotic stress, and plant biomass **(Garcia-Gonzalez and Sommerfeld, 2016)**. 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)**.

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. Five plants per treatment per replication were selected randomly and tagged; three Fruits (bottom, middle and top) from main branch on each observation plant were selected for recording observations. 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 after 45days after transplanting. 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 leads 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, guttulate phialoconidia with pointed to rounded ends, produced in acervuli. Masses of conidia appear pink or salmon coloured. Dark, long, hair like hyphae called setae often are found in acervuli. Observations on Fruit, anthracnose disease incidence and intensity were recorded applying standard 0-9 grade disease rating scale (Mayee and Datar, 1986) one day before each spraying and last observation was recorded at 15 days after last spraying.

RESULTS AND DISCUSSION:

A Survey was performed during Rabi season 2020 to evaluate the incidence of Anthracnose of chilli in farmer's field in Eight villages in Krishna District. A field experiment was conducted at Farmer's field, Kaikaluru, Krishna district in Andhra Pradesh during Rabi season 2020-2021 to evaluate the bio-efficacy of Bioagents and microalgae. Plant growth parameters and disease intensity were recorded at 15 days interval at 30, 45, 60 and 45, 60, 75 days after transplanting.

3.1 The comparative effect of Disease Incidence of Anthracnose in chilli:

Village wise disease incidence has been presented in Table 1. Among the Eight Villages, maximum disease incidence was recorded in Kamavarapukota (29.65%). However, least disease incidence was recorded in

Tadikilapudi(13.3%). 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. 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. Combined with crop geometry, inoculum spread, rainfall intensity and duration, and prevailing temperature and humidity, the environment promotes disease development as well (**Saxena *et al.*, 2016**). Furthermore, surface wetness, competitive microbiota, and high temperature also assist in promoting disease development (**Royle and Butler, 1986**). It has been reported that a temperature of 27°C with a relative humidity of 80% is ideal for successful establishment of the disease (**Roberts *et al.*, 2001**). A scientific survey is vital to determining disease outbreaks, endemic areas, and hot spots, as well as their sources.

3.2 The Comparative effect of Treatments on Plant Growth and Yield characters:

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 of Chilli and significantly decreased the disease intensity when compared to other treatments and control.

Trichoderma species enhance physiological responses to stress, boost nitrogen-use efficiency in certain crops, and enhance photosynthetic efficiency. Trichoderma strains are very successful as BCAs because of their high reproductive capacity, their ability to survive in very adverse conditions, their ability to utilize nutrients efficiently, their ability to modify rhizospheres, their aggressiveness against phytopathogenic fungi(**Chet *et al.*, 2001).** 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 fungal infection of the seeds and roots. They have a reputation for promoting plant development and easing the severity of certain fungal infections**(Christoph *et al.*,1992).**

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(**Nirmal *et al.*,2018).** The Biostimulants are organic compounds or microbial mixtures which enhance nutrient use efficiency, increase soil water retention capacity, and protect plants against biotic and abiotic stress **(Rouphael and Colla, 2018; Yakhin *et al.*, 2017**).

Neem oil enchances, the plant growth and development by controlling the pathogen growth and also acts as antibiotic **(Jeyalakshmi *et al.*,1998).**

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* + *Trichoderma viride* + microalgae. Compared with other bio-agents and control treatment, *Pseudomonas fluorescens* + *Trichoderma viride* + microalgae were superior against *Colletotrichum capsici*.

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Study Area: Kaikaluru ,Andhra Pradesh .

Conflict of Interest : None.

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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 (0.5%)	55.333	25.26	12.733	91
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