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ECO FRIENDLY DISEASE MANAGEMENT OF WILT OF CHICKPEA CAUSED BY FUSARIUM OXYPORUM CICERI THROUGH PLANT EXTRACT AND BIO AGENT

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ABSTRACT

The third-most significant pulse crop in the world, behind dry beans (*Phaseolus vulgaris L.*) anddry peas (*Pisum sativum L.*), is the chickpea (*Cicer arietinum L.*) (Vishwa Dhar and Gurha,1998). In many nations,chickpeas are a key source of dietary protein derivedfrom plants.Chickpea is advantageous for managing soil fertility, especially in arid and semiarid regions ofthetropics. Fusarium wiltis the one of these diseases that is seriously reducing chickpea yield. Fusariumwilt of chickpea caused yield losses that ranged from 40 to 60 percent (Singh et al., 2007).However, Fusarium wilt of chickpea was found to have caused output losses of 72.16 percent byKumarandBourai(2012).Plant extracts and bioagents have been identified as potential alternatives to chemical treatmentsfor eco-friendly diseasemanagementin agriculture, includingformanaging wiltdiseaseinchickpea caused by *Fusarium oxysporum*. These approaches are considered eco-friendly becausethey are derived from natural sources, and they have low environmental impact and fewer healthhazardscomparedtochemicaltreatments.The study was conducted at the Organic Research Farm, Karguanji, Bundelkhand UniversityJhansi (U.P.) between November 2022 and April 2023. The research farm is situated at 25.45°Nlatitude and 78.61°E longitude, with an elevation of 285 m above sea level, and experiences asub-tropical climate. Various measurements were taken to evaluate the vegetative growth andyieldparameters atthe researchfarm.Pathogenicity was demonstrated by seed, soil, and seed-soilinoculation methods. The approach used forseed cum soil inoculation has the highestdiseaseincidence(55.84%).the results indicate that the tested *Trichoderma* species, particularly *Trichodermaviride* and *Trichoderma harzianum*, exhibited significant growth inhibition effects on *Fusarium oxysporum cicri*. These findings highlight the potential of these biocontrol agents formanagingthe pathogenandreducingitsimpactonplanthealth.*TricodermaStrain I*showed the highest potential for enhancing crop yield, followed by Mustard oil cake and Thiramtreatments.

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Keywords : *Trichoderma spp., biocontrol agents, fusarium oxysporum, cicri,*

INTRODUCTION

The third-most significant pulse crop in the world, behind dry beans (Phaseolus vulgaris L.) and dry peas (Pisum sativum L.), is the chickpea (Cicer arietinum L.) (Vishwa Dhar and Gurha, 1998). In many nations, chickpeas are a key source of dietary protein derived from plants. Chickpea is advantageous for managing soil fertility, especially

in arid and semiarid regions of the tropics. 90% of the world's total production of chickpeas is produced on the Indian subcontinent (Juan et al., 2000). Around 42–47% of India's total production of pulses comes from the chickpea. Six states—Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka, and Andhra Pradesh—account for about 90% of the land and gram production (Arunodhayam et al., 2014).

The chickpea plant, C. arietinum L., is produced in India for dal production, food preparation, and human consumption. It constitutes the main source of protein and many amino acids hence; it is useful diet for human being. Legumes help to fix atmospheric nitrogen, which increases soil fertility and plays a big part in crop rotation. Due to its high nutritional value, high output potential, and affordable cultivation, chickpeas stand out among pulse crops.

Low chickpea yields can be attributed to a variety of factors, including inadequate technology, the adoption of regional varieties, the lack of irrigation systems, the cultivation of chickpeas on marginal soils, and insect and disease issues. Among these factors, illness has a significant impact on how much chickpeas can produce.

Many airborne and soil-borne diseases, some of which may be fatal, can affect the crop. The 172 pathogens that affect chickpeas include fungi, bacteria, viruses, and nematodes. 38 of these pathogens—representing 19 different fungus genera—are soil-borne. The most harmful pathogens are Rhizoctonia solani Taub, Sclerotium rolfsi Sacc., Fusarium oxysporum f. sp. ciceri Padwick Snyd., and Hans, which cause wet root rot, collar rot, and mature plant wilt, respectively. Combined they may cause losses as high as 60-70% when conditions encourage disease (Nene, 1985). Other minor soil-borne illnesses include black root rot, dry root rot, root and seed rot, and those brought on by Rhizoctonia bataticola, Pythium ultimum, and Fusarium solani, respectively. Under favourable conditions, Ascochyta rabiei (Pass.) Labr.-caused blight and Botrytis cinerea Pers. ex Fr.-caused grey mould are the foliar diseases that can substantially harm chickpea. Ascochyta blight and Fusarium wilt are thought to be the two most devastating diseases of chickpea (Hamid et al., 2001).

Fusarium wilt is the one of these diseases that is seriously reducing chickpea yield. Fusarium wilt of chickpea caused yield losses that ranged from 40 to 60 percent (Singh et al., 2007). However, Fusarium wilt of chickpea was found to have caused output losses of 72.16 percent by Kumar and Bourai (2012).

Several plant species can become wilted due to Fusarium oxysporum, which is a common member of the rhizosphere microflora. Although some strains are thought to be non-pathogenic and all strains may exist saprophytically, many are widely known for causing wilt or root rots on a variety of plants (Fravel et al., 2003). A forma specialist term is typically added to isolates to indicate that they are frequently peculiar to particular hosts. For instance, F. oxysporum f. sp. cubense infects banana and F. oxysporum f. sp. lycopersici infects tomato. There are races of the pathogen in some formae speciales that are gene-for-gene exclusive to particular cultivars of hosts, such as F. oxysporum f. sp. lycopersici (Armstrong and Armstrong, 1981; Fravel et al., 2003).

Plant extracts and bioagents have been identified as potential alternatives to chemical treatments for eco-friendly disease management in agriculture, including for managing wilt disease in chickpea caused by Fusarium oxysporum. These approaches are considered eco-friendly because they are derived from natural sources, and they have

low environmental impact and fewer health hazards compared to chemical treatments.

Plant extracts are natural products that have been shown to possess antimicrobial properties against several plant pathogens, including Fusarium oxysporum. They can be extracted from various plant parts, including leaves, stems, and roots, and they contain different active compounds such as alkaloids, flavonoids, phenolics, and terpenoids. These compounds have been shown to have antifungal, antibacterial, and insecticidal activities that can suppress the growth and activity of plant pathogens. Bioagents are also potential eco-friendly alternatives to chemical treatments for disease management in agriculture. Bioagents are living organisms that can suppress the growth and activity of plant pathogens by various mechanisms such as competition for nutrients, antibiosis, and induced systemic resistance. Several bioagents, including Trichoderma spp. and Bacillus spp., have been investigated for their potential to manage wilt disease in chickpea caused by Fusarium oxysporum.

MATERIALS AND METHODS

A field experiment was conducted during the rabi season of 2022-2023 at the Organic Research Farm of the Institute of Agricultural Sciences at Bundelkhand University in Jhansi, Uttar Pradesh. Jhansi is located in the central region of India, and it has a semi-arid climate with hot summers and cool winters. The rabi season in Jhansi generally spans from October to March. During this season, the temperature gradually decreases, and the weather becomes more pleasant. The average temperature during the rabi season in Jhansi ranges from 12°C to 27°C, with occasional fluctuations due to cold waves or heat waves. The coldest months are December and January, with average minimum temperatures of around 8-9°C. Rainfall during the rabi season in Jhansi is typically low, with an average of around 100 mm of precipitation spread over a few days. Humidity is also relatively low, with average levels of around 50-60%. Wind speeds during the rabi season in Jhansi are generally moderate, with average speeds of around 10-15 km/h. Dust storms and thunderstorms are occasional weather phenomena during this season. Overall, the rabi season in Jhansi is characterized by cool temperatures, low humidity, and low rainfall, making it a suitable period for growing crops such as chickpea. However, the occasional weather fluctuations such as cold waves or heat waves may have an impact on crop growth and yield.

The study involved the use of three different plant extracts viz. Mustard oil cake, Neem Extract, Ginger Extract and a Biocontrol agent viz. Tricoderma harzianum, Tricoderma viride and Tricoderma Strain I, and two Fungicide these are Carbendazim and Thiram. All the treatments used as seed treatment to control the wilt disease caused by Fusarium oxysporum. The study included the isolation, identification, and pathogenicity testing of the pathogen, as well as in vitro evaluation of the bio-agent and botanicals against Fusarium oxysporum f. sp. ciceri. The effects of the bio-agent on disease control were also evaluated.

To investigate the effects of different treatments on chickpea growth and yield, an RBD design layout was employed. The experiment included nine treatments, including a control group, with three replications. The field size was 24 x 8.7 meters, with each experimental plot measuring 2.2 x 2.2 square meters. The plant spacing was set at 30 x 10 centimeters, with a total of 77 plants per plot. The chickpea variety used in the experiment was Pusa-372 (BG-372). The RBD design layout ensured that the treatments were randomly assigned to the plots and replicated across the experiment to account for any variability. The results obtained from the

experiment were analyzed statistically to determine the effects of the different treatments on chickpea growth and yield. Diseased plant samples were collected from the agriculture farm of Institute of Agriculture Science, Bundelkhand University, Jhansi during 2022-2023. All the glassware was cleaned with a potassium dichromate sulphuric acid solution, washed with sterilised water, and sterilised in a hot air oven at 160 °C for two hours prior to isolation and other laboratory experiments. The PDA medium (200 g potato extract, 20 g dextrose, 20 g agar, and 1 litre water) was autoclaved at 1.045 kg/ cm2 pressure for 20 minutes to sterilize it. Chickpea plant roots were first thoroughly cleaned under running water before being sliced into little pieces with a healthy percentage. By soaking them for a few minutes in a solution of 1% sodium hypochlorite, these pieces were given a surface sterilization. The pieces were inoculated to autoclaved Potato Dextrose Agar medium in Petri plates and cultured at 28°C in a B.O.D. incubator for 7 days after three successive washings with sterile distilled water. With the aid of a sterilized inoculating needle, mycelial growth from root bits was transferred aseptically to new PDA slants after 7 days of incubation. This was followed by another 7 days of incubation to get more mycelial growth and sporulation for their purification.

The pathogen was purified using the single spore method. After 7 days of incubation, spores from culture slant were collected and suspended in sterile distilled water for this. A loopful of the solution was diluted enough that 5–10 spores could be counted under the microscope's low power objective. In Petri plates with 20 ml of sterilized plain agar medium, one ml of the aforementioned suspension was spread out. The germinating spores were located under the microscope and marked with the aid of a dummy objective before being moved to a PDA slant and incubated in a B.O.D. incubator for additional growth after 12- to 24-hours of inoculation (301°C). The pure culture was kept alive by routinely transferring to PDA slants and using for more research.

To determine whether the bacteria can make a chickpea plant wilt. The virulence of the fungus that was isolated and purified from afflicted roots was examined. By using soil, seed, and seedcum-soil inoculation strategies under pot conditions, the pathogenicity of Fusarium oxysporum f.sp. ciceri was examined (Kataria and Grover, 1976; Radhakrishna and Sen, 1985).

Pathogenicity testing using the soil inoculation method was done in a pot. Sterilised dirt was used to fill the pots. By inoculating with a 7-day-old culture of Fusarium oxysporum f. sp. ciceri and incubating at a temperature of 28°C for 7 days, the inoculum was replicated on pre-soaked, sterilised sorghum grains in flasks. 20 g of inoculum per pot was used to inoculate the pots. Each pot included three replications of five chickpea seeds that appeared to be healthy and surface sterilised. As a control, surface sterilised seeds were planted in soil that had not been infected. They were routinely watered and housed in a cage home. Germination observations and illness incidence as a percentage were noted. Re-isolation was performed using infected chickpea plant pieces, and the resulting culture was compared to the original.

Supposedly healthy chickpea seeds were surface sterilised with sodium hypochlorite solution for a couple of minutes, then went through three sterilised distilled water washings. The seeds were rolled over a Fusarium oxysporum f. sp. ciceri culture that had been growing on PDA for seven days. Five seeds per pot with three replications of inoculated seeds were sown in pre-sterilized earthen pots with sterilised soil. The uninoculated, surface-

sterilized seeds were used as a control. They were routinely watered and housed in a cage home. Germination observations and illness incidence as a percentage were noted. Re-isolation was performed using infected chickpea plant pieces, and the resulting culture was compared to the original.

Pathogenicity tests using the seed-cum-soil inoculation approach were carried out in a pot. Sterilized dirt was used to fill the pots. Using a 7-day-old culture of Fusarium oxysporum f.sp. ciceri, the inoculum was multiplied on pre-soaked, sterilized sorghum grains in flasks and kept at 28°C for 7 days. 20 g of inoculum per pot was used to inoculate the pots. The surface-sterilized seeds were rolled on a Petri plate containing a 7-day-old sporulating culture of Fusarium oxysporum f. sp. ciceri living on Potato Dextrose Agar. Five inoculated seeds per pot with three replications of each were seeded in inoculated pots. As a check, surface sterilized seedlings were planted in pots without inoculation. They were routinely watered and housed in a cage home. Germination observations and illness incidence as a percentage were noted. Re-isolation was performed using infected chickpea plant segments, and the resulting culture was compared to the original.

This is how the percentage of disease incidence was determined:

$$\%\text{disease incidence} = \frac{\text{Number of diseased plants}}{\text{Total number of plants}} \text{X } 100$$

Through microscopic investigation of the fungus's physical and cultural traits, the sporulating pure culture was discovered. The fungus was provisionally recognised as a Fusarium species based on the size, colour, length, and width of the fungal conidia.

RESULTS AND DISCUSSION

Symptomatology :

A significant case of the chickpea wilt disease was discovered at the research farm at Kargawanji, B.U. Jhansi. It was discovered that the chickpea wilt disease can affect plants at any stage, from seedling to fruiting. A strange characteristic of chickpea wilt was the plant's yellowing and stunting.

Wilt typically first occurred at the two to three leaf stage in the seedling stage. Dry leaves are one of the symptoms, along with the upper sections of the plants being pale and more rigid than normal. The growth of the terminal bud was also inhibited. These leaves withered and turned yellow. The lower leaves of mature chickpea plants are often yellow and dry, while the upper leaves are wilted and dry green. In the direction of the midrib, the leaves and stipules were folded back.

The vascular tissue of wilted plants was discoloured in a variety of ways, ranging from light to bright to orange brown, with the hypocotyls and stem base being particularly affected.

The pathogen invaded the roots through the epidermis cortex and reached the heavily colonised xylem vessels, which produced conidia. The infection then steadily advances up the shoot. Xylem vessels become blocked as a result. Attacked seedlings exhibit black xylem vessel dilatation, above-collar stem shrinkage, and collar region blowing. 6–8 weeks after sowinig are attacked, the adult plant.

Isolation and purification of the pathogen :

The diseased pea specimens that were collected from various locations were examined using the methods described under "Material and method" in order to obtain pure cultures of the pathogen. The fungus was easily isolated from the infected stem and root portion on two percent potato dextrose agar medium using the usual method, and

the isolates were further purified by transferring a small amount of mycelial growth. On 2% potato dextrose agar medium, the pure culture was kept for further research. Morphologically identical isolates that were identified linked with naturally infected plant roots were produced after isolation from artificially afflicted roots. The pathogen's pathogenicity was therefore established in accordance with Koch's postulates. None of the illness signs appeared in the control plots.

Pathogenicity test :

On a "local variety of chickpea," a pathogenicity test was conducted to determine the pathogenic behaviour of the pathogen. Seven days prior to seeding, the fungus was inoculated into the sterilised soil. The inoculums were positioned close to the plant's base and pressed down in the second approach. when the plants were between 25 and 30 cm tall. The proportion of wilted plants was noted. The inoculate plots were monitored daily, and the symptom progression was noted. The findings are outlined in the section below. With the former strategy, the infection percentage was higher than with the latter. Thus showing an increase in the fungus' equal spread across the soil. One month after the seed is sown, the likelihood of infection and disease symptoms becoming apparent. Yellowing of the foliage and plant stunting were the signs that were most noticeable. For two months, the disease's signs could be seen.

Identification of Pathogen :

The pathogen's physical characteristics were found to closely resemble those of Booth's (1977) description of Fusarium oxysporum schlecht.

Morphological studies of the fungus :

For the purpose of examining the fungus' colony and mycelial characteristics, 2% potato dextrose agar medium was employed. After being incubated for 7 days at 25+ 1°C, poured Petri dishes were inoculated with the isolate and the following characters were investigated. The following list includes the key morphological traits of the fungus studied:

Mycelium and Colony :

The mycelium that the fungus produces is white, dense, and cottony. The hyphae were septate, obtrusively branched, and formed plectenchymatous stroma. The substrate's surface was white, and the colony was velvety. Pinnotes and sporodochia were absent.

Chlamydospores :

At high temperatures, chlamydospores developed in the ancient culture. They had globose shapes and were developed singly, in groups, intercalarily, or on short lateral branches.

Cultural studies of the pathogen :

To determine the minimum, ideal, and maximum growth requirements for the pathogen in culture, studies were undertaken.

Growth and sporulation of the pathogen on solid media :

For 3, 6, and 9 days at 25°C, the pathogen was cultured on the solid states of the media. The nature and sporulation on several fungal colonies, as well as their average diameter, were noted.

Evalution on dual culture technique against F. oxysporum.

3rd Day growth of pathogen

Trichoderma viride showed the highest percentage of F. oxysporum growth inhibition (44.84%), followed by Trichoderma harzianum (36.83%) and Trichoderma Strain I (31.56%). Mycelium growth in control (30.57) was discovered. All treatments greatly reduced the pathogen's regrowth as compared to the control sample.

6th Day growth of pathogen

Trichoderma harzianum showed the highest percentage of F. oxysporum growth inhibition (42.19%), followed by Trichoderma viride (40.87%) and Trichoderma Strain I (37.04%). Mycelium growth in control (43.16) was discovered. All treatments greatly reduced the pathogen's regrowth as compared to the control sample.

9th Day growth of pathogen

Trichoderma harzianum showed the highest percentage of F. oxysporum growth inhibition (43.1%), followed by Trichoderma viride (38.19%) and Trichoderma Strain I (35.67%). Mycelium growth in control (59.51) was discovered. All treatments greatly reduced the pathogen's regrowth as compared to the control sample.

Table 1.1. Effect of antagonistic fungi on radial growth inhibition of Fusarium oxysporum f.sp. ciceri in dual culture test

Mycelial growth (mm)							
Sr.no.	**Treatment**	**3rd day**		**6th day**		**9th day**	
		F.oxysporum	**Inhibition%**	**F.oxysporum**	**Inhibition%**	**F.oxysporum**	**Inhibition%**
1	*Trichodermaharzianum*	19.31	36.83	24.95	42.19	33.86	43.10
2	*Trichodermaviride*	16.86	44.84	25.52	40.87	36.78	38.19
3	*TrichodermaStrain I*	20.92	31.56	27.17	37.04	38.28	35.67
4	Control	30.57		43.16		59.51	
	CD	1.7		1.207		1.17	
	SE(d)	0.695		0.493		0.478	
	SE(m)	0.491		0.349		0.338	

In vivo evalution of bio-agents, fungicides, plant extract against *Fusarium oxysporum f.sp. ciceri* the wilted plant %, of branches and yield.

The data presents in table 1.2. shows that the results of different treatments on wilted plants percentage. The experiment was conducted to test the efficacy of various eco-friendly treatments on a specific disease. It is clear from the above table that each treatment was determined to be significantly better than the control. The control group had the highest wilted plants percentage (57.14%). Tricoderma harzianum treatment had the lowest wilted plants percentage (41.12%). The wilted plants percentage of other treatments ranged from 45.46% to 55.84%. Carbendazim and Thiram treatments had similar results with a wilted plants percentage of 46.75%. The data suggests that Tricoderma harzianum treatment is the most effective in reducing the wilted plants percentage.

The table 1.2. presents the results of different treatments on disease incidence percentage. The experiment was conducted to test the efficacy of various eco-friendly treatments on a specific disease. It is clear from the above table that each treatment was determined to be significantly better than the control. The control group had the highest disease incidence percentage (34.63%). Tricoderma viride treatment had the lowest disease incidence percentage (17.75%). The disease incidence percentage of other treatments ranged from 18.61% to 25.97%. Carbendazim and Ginger Extract treatments had similar results with a disease incidence percentage of 23.81%. The data suggests

that Tricoderma viride (filtrate) treatment is the most effective in reducing the disease incidence percentage.

The table 1.2 provides information on the yield (in grams) of treatments used for enhancing crop production. The experiment included nine different treatments, each applied to the same crop, and the yields for each treatment are recorded in the table 1.2.

The first treatment, labeled as the control, yielded 165 grams. The second treatment, which used Tricoderma harzianum, also yielded 165 grams, which is the same as the control. The third treatment used Tricoderma viride (filtrate), which resulted in a slightly higher yield of 181.67 grams. The fourth treatment, Tricoderma strain I, produced the highest yield of 206.67 grams. The fifth treatment, Mustard oil cake, yielded 200 grams, which is tied for the second highest yield with the ninth treatment, Thiram. The sixth treatment, Neem Extract, resulted in a yield of 163.33 grams. The seventh treatment, Ginger Extract, produced a yield of 186.67 grams. The eighth treatment, Carbendazim, resulted in a yield of 198.33 grams.

Table- 1.2 In vivo evalution of bio-agents, fungicides, plant extract against *Fusarium oxysporum f.sp. ciceri* on the wilted plant, disease incidence % and yield per plot (g)

Sr.no.	Treatment	Wilted Plants%	Disease incidence%	Yield (g)
1	Control	57.14	34.63	165.00
2	*Tricoderma harzianum*	41.12	25.11	165.00
3	*Tricoderma viride(filtrate)*	48.48	17.75	181.67
4	*Tricoderma Strain I*	45.46	19.91	206.67
5	Mustard oil cake	54.55	18.62	200.00
6	Neem Extract	53.68	25.97	163.33
7	Ginger Extract	55.84	23.81	186.67
8	Carbendazim (used fo rseed treatment)	46.75	23.81	198.33
9	Thiram (used for seed treatment)	46.75	18.61	200.00
	C.D.0.5%	4.887	6.8	-
	SE(m)	1.63	2.268	12.396
	SE(d)	2.305	3.208	17.531

CONCLUSION

Chickpea (Cicer arietinum L.), is one of the most significant winter-season pulse crops farmed in India, it is a member of the fabaceae family and is said to have originated in South West Asia and a rich source of proteins (21.1%), carbs (61.5%), and lipids (4.5%).

The study investigated the pathogen's growth on the 3rd, 6th, and 9th day after treatment with Trichoderma viride, Trichoderma hazianum, and Trichoderma Strain I, compared to a control sample. Overall, the results indicate that the tested Trichoderma species, particularly Trichoderma viride and Trichoderma hazianum, exhibited significant growth inhibition effects on Fusarium oxysporum cicri. These findings highlight the

potential of these biocontrol agents for managing the pathogen and reducing its impact on plant health.

Overall, the results suggest that Tricoderma strain I showed the highest potential for enhancing crop yield, followed by Mustard oil cake and Thiram treatments. From the data, it can be concluded that Tricoderma strainI produced the highest yield among all the treatments, followed by Mustard oil cake and Thiram, which tied for the second highest yield. The control treatment and the Tricoderma harzianum treatment produced the lowest yield. The results suggest that using certain bio-agents and organic inputs can increase crop yield, which may be a more sustainable and eco-friendly approach to farming.

The aforementioned findings are consistent with those of Somashekhara et al. (1996). Somashekhara et al. (2000), Gholve and Kurundkar (2002). Barhate, B. G. and Dake, G. N. 2007. and Mandhare, et al (2008). These findings are supported by these observations. It is determined that the bio agents, when combined with the right organic substrate, can be employed to manage chickpea wilt.

The current study's findings are consistent with those of Anand and Jayarama Reddy (2009), who found that all of the isolates had improved antagonistic potential in addition to promoting plant development.

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EFFECT OF DIETARY NUTRIENTS, ANTIOXIDANTS AND HERBAL EXTRACT OF SOLANUM NIGRUM ON OXIDATIVE STRESS INDUCED BY LEAD CHLORIDE IN ALBINO RATS

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ABSTRACT

The present study investigates the role of micronutrients in the detoxification of heavy metal (Lead chloride) in albino rats. Various nutritional factors have a significant influence on metal toxicity. Nutrients can affect the toxicity of a metal by interacting at its primary site of action. These nutrients are also expected to modify the body's response to a toxic metal by altering its metabolism and transport. Dietary nutrients can also behave as efficient chelaters. Therefore, the oxidizing property together with the chelating capacity of antioxidants makes them a strong factor to reduce oxidative stress of metals. The compounds like essential metals (zinc and selenium), amino acids (methionine and cystine), vitamins (B_1 and E) and antioxidants (N-actyl cysteine and melatonin) posses strong antioxidizing properties and are likely to be proved as a novel approach for long term and effective treatment of heavy metal poisoning.The present study also determines the possible beneficial role of micronutrients individually and in combinations for the treatment of lead chloride induced oxidative stress in albino rats.

Keywords : *S. nigrum, lead chloride, zinc, selenium, albino rats*

INTRODUCTION

Lead has no known biological function in the body and once it enters the body, it is known to cause severe health effects that might be irreversible. It affects almost all the major organ systems of the body like hematopoietic, renal, nervous and cardiovascular systems.Various molecular, cellular and intracellular mechanisms have been proposed to explain the toxicological profile of lead that includes generation of oxidative stress, ionic mechanism and apoptosis.Oxidative stress has been found to be more pronounced and much more severe. Lead causes generation of ROS which results in critical damage to various biomolecules like DNA, enzymes, proteins and membrane based lipids, while simultaneously it impairs the antioxidant defense system.Prevention is regarded as the best approach, involving incorporation of various natural and synthetic antioxidants.

Various naturally occurring antioxidants (nutrient antioxidants) like vitamins, flavonoids and herbal antioxidants have been reported for the prevention and treatment of lead induced toxicity

and oxidative stress in particular. They have the ability to scavange ROS at molecular level and chelate lead ions, thereby reversing the toxic effects. These antioxidants were also reported to provide an elevated therapeutic impact when administered with chelating agents like DMSA, which is a thiolchelator. Nevertheless, we do recommend that the presence and possible beneficial effects of antagonists be carefully considered, as an antioxidant may become a pro-oxidant in the presence of certain other molecules. However, chlorophylls may overwhelm the antioxidant effect of phenolics due to photosensitized oxidation, while transition metal ions, as those of iron and copper, may render conditions favoring oxidation. Synergism among different phenolic antioxidants and between phenolics and non-phenolics should also be considered in all application areas.

Medicinal plants are sources of important therapeutic aid for alleviating human ailments. With increasing realization of the health hazards and toxicity associated with the indiscriminate use of synthetic drugs and antibiotics, interest in the use of plants and plant-based drugs has revived throughout the world.This study revealed the anti-oxidative property of medicinal plants such as *Solarium nigrum and* essential metals (zinc and selenium), amino acids (methionine and cystine), vitamins (B_1 and E) and antioxidants (N-actyl cysteine and melatonin) against the toxicity of lead chloride in experimental albino rats. *Solarium nigrum* has some active constituents which can be extracted from it and used for production of synthetic drugs.

Solarium nigrum has protective effects as diuretic, anti-inflammatory, anti-oxidative and immuno-modulating properties of the active herbal components.*Solanum nigrum* seed oil extracts was also investigated in order to reduce its diebetic and nutritional advantage.*Solanum nigrum* is a constituent of LIV 52 tablet and safety of LIV 52 DS tablets was evaluated in acute viral hepatitis (Rajiv *et al.,* 2004). Researchers have demonstrated that chronic alcohol consumption induces lipid peroxidation in rats and that the degree of lipid peroxidation is related to the extent of liver injury (Nanji*et al.,* 1994). This protective effect is probably based on the antioxidant activity of the extract, which reduces the oxidative damage by blocking the production of free radicals and inhibits lipid peroxidation. In line with their findings, (Lin *et al.* 2008) have also reported that the *Solanum nigrum*extract inhibits the progress of lipid peroxidation on CCL_4administered rats.

MATERIALS AND METHODS

A. Collection and Extraction of the Plant Material:

The whole plants of *Solarium nigrum* except root were collected from the Meerut region and dried in shade. When dried it was powdered in an electric grinder which acted as crude extract. The powdered plant material was extracted in a Soxhlet apparatus using ethanol as solvent. Extract was kept in dessicator for the removal of remaining moisture.

B. Preparation of doses and their administration:

These doses were selected for the experimentation.

- **a.** 500 mg kg^{-1} of body weight of the ethanol extract of *S. nigrum*.
- **b.** 100 mgkg^{-1} of body weight of lead chloride.
- **c.** 10 mg and 0.1mg kg^{-1} of body weight of zinc and selenium respectively.
- **d.** 10 mg kg^{-1} of body weight of vitamins and antioxidants.

Above doses were prepared in gum acacia in distilled water. Single and daily administrations of these doses were done orally with the help of catheter for 45 days, 21 days and 5 days respectively. Simultaneously control animals were given vehicle

only for the same durations.

RESULTS AND DISCUSSIONS

After exposure of lead chloride the value of erythrocyte protein content in blood found reduced as least as (6.916g/dl) in comparison to control rats. It was significantly increased in *S. nigrum* extract treated rats and found high in long duration (13.122g/dl). Further it was also increased gradually in all the groups and found highest (14.775g/dl) in last group treated with all the supplements and antioxidants. This value of protein in blood erythrocytes showed significant elevation ($P< 0.05$) in comparison to control, *S. nigrum* alone dose and other group animals (Table -1).

Table - 1 : Effect of acute and chronic exposure of lead chloride and effective measures of *Solanum nigrum* and supplements on oxidative damage as Proteinin erythrocytes of albino rats.

(Values are Mean ±S.E. and expressed as (g/dl), N=6)

S. No.	Parameter/Group	Duration of Exposure		
		5 Days	21 Days	45 Days
1	Control	11.133±o.441	11.563±o.641	11.453±o.342
2	Lead Chloride ($PbCl_2$)	7.866±0.305	7.756±0.605	6.916±0.405
3	$PbCl_2$ +*S. nigrum*	11.733±0.455	12.645±0.755	13.122±0.302
4	$PbCl_2$ + Zn + Se + *S. nigrum*	10.123±0.526	10.733±0.554	11.853±0.326
5	$PbCl_2$ + Methionine + Cysteine + *S. nigrum*	11.345±0.565	13.567±0.315	13.688±0.445
6	$PbCl_2$ + antioxidants + Vitamins + *S. nigrum*	11.221±o.641	13.544±o.721	14.775±o.341

* Values are significantly different from control ($p < 0.05$)

After exposure of lead chloride the value of GSH in blood found reduced in comparison to control rats. It was significantly increased in *S. nigrum* extract treated rats and found high in long duration (0.851µg/ml). Further it was also increased gradually in all the groups and found highest (0.955 µg/ml) in last group treated with all the supplements and antioxidants. This value of GSH in blood erythrocytes showed significant elevation ($P< 0.05$) in comparison to control, *S. nigrum* alone dose and other group animals (Table -2).

Table - 2 : Effect of acute and chronic exposure of lead chloride and effective measures of *Solanum nigrum* and supplements on oxidative damage as GSHin erythrocytes of albino rats.

(Values are Mean ±S.E. and expressed as (µg/ml), N=6)

S. No.	Parameter/Group	Duration of Exposure		
		5 Days	21 Days	45 Days
1	Control	0.741 ±0.052	0.752±0.055	0.725±0.062
2	Lead Chloride ($PbCl_2$)	0.238±0.061	0.220±0.080	0.198±0.045
3	$PbCl_2$ +*S. nigrum*	0.765 ±0.042	0.831 ±0.072	0.851 ±0.031
4	$PbCl_2$ + Zn + Se + *S. nigrum*	0.445±0.060	0.470±0.058	0.495±0.075
5	$PbCl_2$ + Methionine + Cysteine + *S. nigrum*	0.565±0.040	0.570±0.048	0.695±0.085
6	$PbCl_2$ + antioxidants + Vitamins +*S. nigrum*	0.785 ±0.022	0.875 ±0.040	0.955 ±0.035

* Values are significantly different from control ($p < 0.05$)

The estimation of lipid peroxidation was done by its indicator Melondialdehyde (MDA) value. After exposure of lead chloride the value of MDA in blood found significantly increased in comparison to control rats. It was significantly decreased in *S. nigrum* extract treated rats and found low in long duration (0.085 n moles malon./mg protein) of 45 days exposure. Further it was also decreased gradually in all the groups and found lowest (0.045 n moles malon./mg protein) in last group treated with all the supplements and antioxidants at 45 days of exposure. This value of MDA in blood erythrocytes showed significant depletion ($P< 0.05$) in comparison to control, *S. nigrum* alone dose and other group animals (Table - 3).

Table - 3 : Effect of acute and chronic exposure of lead chloride and effective measures of *Solanum nigrum* and supplements on oxidative damage/lipid peroxidation as MDAin erythrocytes of albino rats.

(Values are Mean ±S.E. and expressed as (n moles malon./mg protein), N=6)

S. No.	Parameter/Group	Duration of Exposure		
		5 Days	21 Days	45 Days
1	Control	0.092±0.001	0.093±0.004	0.090±0.002
2	Lead Chloride ($PbCl_2$)	0.433±0.12	0.583±0.21	0.645±0.15
3	$PbCl_2$ +*S. nigrum*	0.072 ±0.01	0.080±0.021*	0.085±0.002*
4	$PbCl_2$ + Zn + Se + *S. nigrum*	0.31±0.09*	0.42±0.09	0.48±0.09*
5	$PbCl_2$ + Methionine + Cysteine + *S. nigrum*	0.070±0.01	0.068±0.04	0.062±0.03*
6	$PbCl_2$ + antioxidants + Vitamins + *S. nigrum*	0.065±0.016*	0.054±0.012	0.045±0.011*

* Values are significantly different from control ($p < 0.05$)

Oxidative stress represents an imbalance between the production of free radicals and the biological system's ability to readily detoxify the reactive intermediates or to repair the resulting damage (Flora, 2011). It has been reported as a major mechanism of lead induced toxicity. Under the influence of lead, onset of oxidative stress occurs on account of two different pathways operative simultaneously; first comes the generation of ROS, like hydroperoxides (HO_2), singlet oxygen and hydrogen peroxide (H_2O_2), and second, the antioxidant reserves become depleted (Flora *et al.,* 2002).

The antioxidant defenses of the body come into play to nullify the generated ROS. The most important antioxidant found in cells is glutathione (GSH). It is a tripeptide having sulfhydryl groups and is found in mammalian tissues in millimolar concentrations. It is an important antioxidant for quenching free radicals (Mates, 2000). Glutathione exists in both reduced (GSH) and oxidized form (GSSG). The reduced state of glutathione donates reducing equivalents ($H^+ + e^-$) from its thiol groups present in cysteine residues to ROS and makes them stable. After donating the electron, it readily combines with another molecule of glutathione and forms glutathione disulfide (GSSG) in the presence of the enzyme glutathione peroxidase (GP_x). GSH

can be regenerated from GSSG by the enzyme glutathione reductase (GR). Under normal conditions, 90% of the total glutathione content exists in reduced form (GSH) and around 10% is in the oxidized form (GSSG). Under conditions of oxidative stress, the concentration of GSSG is much higher than that of GSH.

Lead shows electron sharing capability that results in the formation of covalent attachments. These attachments are formed between the lead moiety and the sulfhydryl groups present in antioxidant enzymes, which are the most susceptible targets for lead and which eventually get inactivated. Lead inactivates glutathione by binding to sulfhydryl groups present in it. This results in synthesis of GSH from cysteine via the γ-glutamyl cycle, which is usually not effective in replenishing the supply of GSH (Hultberg *et al.,* 2001). Similarly, lead inactivates enzymes like δ-amino levulinic acid dehydratase (ALAD), glutathione reductase (GR), glutathione peroxidase (GP_x) and glutathione-S-transferase, which further depresses the glutathione levels (Ahamed& Siddiqui, 2007).

A few other notable antioxidant enzymes that are rendered inactive by lead include super oxide dismutase (SOD) and catalase (CAT). Decrease in SOD concentration reduces the disposal of superoxide radical, whereas reduction in CAT impairs scavenging of superoxide radical (O_2) Apart from targeting the sulfhydryl groups, lead can also replace the zinc ions that serve as important co-factors for these antioxidant enzymes and inactivates them (Flora *et al.,* 2007).

Lipid peroxidation is another biomarker of oxidative stress and is one of the most investigated consequences of ROS on lipid membranes. The generated free radical captures electrons from the lipids present inside the cell membranes and damages the cell. Apart from lipid peroxidation, lead also causes hemoglobin oxidation, which directly causes RBC hemolysis. This occurs due to inhibition of ALAD, which results in an increased concentration of substrate ALA in both blood and urine. These elevated ALA levels generate hydrogen peroxide and superoxide radical and also interact with oxyhemoglobin, resulting in the generation of hydroxyl radicals (Patrick, 2006). Progression of all the above mentioned mechanisms makes the cell extremely vulnerable to oxidative stress and may lead to cell death.

Vitamin B6 acts also as an antioxidant by stimulating the production of GSH and as a moderate chelator (Ahamed& Siddiqui, 2007). Senapati *et al.* (2004) reported the protective role of thiamine hydrochloride on lead-induced endogenous lipid peroxidation in rat hepatic and renal tissues.

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EFFECT OF SOIL APPLICATION OF CALCIUMSULPHATE ON GROWTH, YIELD AND QUALITY OF GUAVA CV. ALLAHABAD SAFEDA.

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ABSTRACT

A field study was carried out to determine the effect of soil application of Calcium sulphate on growth, yield and quality of guava cv. Allahabad Safeda during winter season. Different soil applications were applied i.e. T_1 : $CaSO_4$@ 0 g/plant (Control), T_2 : $CaSO_4$@ 60 g/plant, T_3 : $CaSO_4$@ 80 g/plant, T_4 : $CaSO_4$@ 100 g/plant, T_5 : $CaSO_4$@ 120g/plant and T_6 : $CaSO_4$@ 140 g/plant with three replications under randomized block design. The results of the study revealed significant increase in growth, yield and quality of guava fruit. However, application of $CaSO_4$@ 120 g/plant proved to be the best treatment in increasing the yield, fruit length & fruit breadth, fruit weight, TSS, Ascorbic acid and decreased acidity during winter season. Thus, it can be concluded that effect of soil application of Calcium sulphate increases the growth, yield and quality of guava fruits.

Keywords : *Allahabad safeda; soil application; yield.*

INTRODUCTION

Guava (*Psidiumguajava* L.), "Apple of the Tropics" and "Poor Man's Apple" is an important fruit crop of country, not because of large area and production, but due to its wider edaphoclimatic adaptability, various biotic and abiotic stresses hardiness, precocious and prolific bearing habit, quality fruit with high nutritive value and medicinal attribute. It is classified under genus Psidium covering about 150 species [1] but only *Psidiumguajava* L. has been commercially exploited. It was introduced in India in the 17th century by Portuguese and became a commercial crop. "It is very popular fruit crop and widely grown in tropical and sub-tropical regions up to 1500 m above mean sea-level. It is being cultivated throughout the American tropics, Asia, Africa and Pacific Islands. It is a more income generating crop without much care and input as it is sturdy in nature, prolific in bearing even on marginal lands. It is considered as a multipurpose tree due to its utility as a fruit, fuel, fodder, timber and it is highly remunerative crop. Although guava is native to Central America but now it is cultivated and naturalized throughout the tropics and due to increasing demand; it is also grown in some subtropical regions. Guava is a rich source of sugars, ascorbic acid and pectin. The content of ascorbic acid (Vitamin- C) ranges from 75-260 mg/100 g pulp which varies with cultivar, season, location and

stage of maturity. Guava fruits are good source of vitamin A (about 250 IU/100g) and contain appreciable quantities of thiamine, niacin and riboflavin" [2]. Secondary nutrients are required by the plants in small quantities and thus, can be applied more safely and easily through foliar application. Application of secondary nutrients through foliar fertilization has advantage of lower application rates, uniformity in distribution of fertilizer materials and quick response to applied nutrients" [3]. Among these nutrients, calcium is most important. Although soil application of calcium is potentially very efficacious but it is very unpopular. Calcium plays an important role in starch metabolism, acts as a cofactor for many enzymes and affects photosynthesis, nucleic acid metabolism and protein biosynthesis. Calcium deficiency can inhibit the growth of fruit trees by impeding photosynthesis, carbon metabolism and respiration, which reduces the yield and quality of fruit. Keeping in view, this experiment has been planned to study the "Effect of soil application of calcium sulphate on growth, yield and quality of guava cv. Allahabad Safeda.

MATERIALS AND METHODS

The present investigation was conducted at Experimental orchard of Department of Horticulture, Kulbhaskar Ashram Post Graduate College Prayagraj on 9 year old guava trees during the year 2016-20 for the winter season guava fruits. Allahabad Safeda variety was selected as an experimental material to examine the effect of soil application of calciumsulphate on growth, yield and quality of guava. The time of application was first fortnight of July. The experiment comprised of total 6 soil applications i.e. T_1 : $CaSO_4$ @ 0 g/plant (Control), T_2: $CaSO_4$@ 60 g/plant, T_3 : $CaSO_4$@ 80 g/plant, T_4 : $CaSO_4$@ 100 g/plant, T_5 : $CaSO_4$@ 120 g/plant and T_6 : $CaSO_4$ @ 140g/plant with three replications under randomized block design. After soil application, the fruits were analyzed for plant height (m), yield (kg/plant), TSS (°Brix), acidity (%), ascorbic acid (mg/100 g pulp) & fruit analysis for N, P, K, content).

Plant height (m) : The initial and final heights of the trees were measured with the help of measuring pole, upto maximum point of height. The increase in plant height was calculated by the following formula:

$$\text{Plant height (m)} = \frac{\text{Final height - initial height}}{\text{Initial height}} \text{x} 100$$

Yield (kg/plant): To calculate the total number of fruits per tree was multiplied with average fruit weight and the value was expressed in kilograms (kg/tree).

TSS (°Brix): The total soluble solids (TSS) was measured by hand refractometer.

Acidity (%): Acidity was estimated by using the method given in A.O.A.C. [4].

Ascorbic acid (mg/100g pulp): The ascorbic acid content was estimated by following the standard method suggested by A.O.A.C, [4].

RESULTS AND DISCUSSION

Soil application of Calcium was found effective in influencing the growth and yield of guava fruit. The plant height was not affected by the soil application of calciumsulphate. During winter season the maximum yield (29.88 kg/plant) of guava fruit was recorded in T5 i.e. $CaSO_4$ @ 120 g/plant and minimum yield was recorded under control. Increase in yield may be due to increase in fruit set per cent, number of fruits, weight of fruits and decrease in fruit drop. Similar findings were reported by Nijjar and Brar [5] in Kinnow, Khera et al. [6] in citrus and Meenaet al. [7], Yadavet al. [8], Jat and Kacha [9] &Sumanet al. [10] in guava.

The maximum TSS during winter season (11.89°Brix) was recorded under T_5 i.e. $CaSO_4$ @ 120 g/plant and the minimum TSS was noted in control. The acidity during winter season was found non-significant. Similarly, during winter season, the maximum ascorbic acid content (200.09 mg/100g pulp) was noted under T_5 i.e. $CaSO_4$ @ 120 g/plant and minimum ascorbic acid content was found under control (Table 2). As Ca is credited with definite role in the hydrolysis of complex polysaccharides into simple sugars, synthesis of metabolites and rapid translocation of photosynthetic products and minerals from other parts of the plant to the developing fruits ultimately leading to the increase in TSS and the higher ascorbic acid content may be attributed to adequate supply of hexose sugars via photosynthetic activity which increases on application of secondary nutrients. Similar results were observed byMeenaet al. [7], Yadavet al. [10], Jat and Kacha [9] in guava .

Table - 1 : Growth and yield of guava as influenced by Calcium sulphate.

$CaSO_4$ (g/plant)	Plant height(m)	Yield (kg/plant)
Control	4.66	20.69
60	4.66	23.55
80	4.69	24.70
100	4.68	27.09
120	4.89	29.88
140	4.87	27.11
CD(p=0.05)	NS	1.02

Table - 2 : Fruit quality of guava influenced by Calcium Sulphate application.

$CaSO_4$ (g/plant)	TSS%	Acidity %	Ascorbic acid (mg/100pulp)
Control	9.09	0.87	170.34
60	10.11	0.88	173.09
80	10.23	0.98	178.20
100	11.54	0.89	188.90
120	11.89	0.78	200.09
140	10.98	0.83	189.08
CD(p=0.05)	0.20	NS	2.60

Table - 3 : Nutrient content of guava fruit as influenced by calcium sulphate.

$ZnSO_4$ (g/plant)	N (%)	P (%)	K (%)
Control	3.09	0.24	0.57
60	3.11	0.30	0.70
80	3.23	0.32	0.71
100	3.41	0.32	0.73
120	3.87	0.33	0.77
140	3.56	0.28	0.73
CD (p=0.05)	0.22	N.S	N.S

The nutrient content of guava fruit was also influenced by soil application of calcium sulphate. The maximum N (3.87 %) content in guava fruit was recorded under T_5 i.e.

$CaSO_4$ @ 120 g/plant and minimum was recorded in control. The P and K content of guava fruit were found non-significant (Table 3). Similar findings was noted by Nijjar and Brar [5] in Kinnow,

CONCLUSION

Secondary nutrients like calcium play an important role in growth, fruit retention and development and cause efficient yield improvement. Results revealed that the maximum yield (29.88 kg/plant), TSS (11.89°Brix) and ascorbic acid (200.09 mg/100g pulp) winter seasons and N fruits of guava cv. Allahabad Safedawere recorded in 120 g $CaSO_4$. So, there is need to disseminate this soil application of calcium sulphate on guava among the farmers with extension methods like front line demonstration and others etc.

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ECO-FRIENDLY MANAGEMENT OF CERCOSPORA LEAF SPOT OF OKRA

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ABSTRACT

The present investigation was carried out in field. The cercospora leaf spot, caused by Cercospora abelmoschi is quite common in okra culture. The Symptoms of infected okra leaves firstly started as light brown spots then turned to purple and varying in size. The spots spread to cover large areas of infected leaves. In case of severe infection, spots joined together and formed patches. Later, leaves were dry and remained intact with stem of plant. Therefore, this study aimed to evaluate the efficiency of neem seed kernel extract (NSKE) @10%, neem leaf extract 10%, cow urine 10 %,Peach leaf extract @ 10%, and bio-agents viz,. Trichoderma spp@ 10%, Pseudomonas fluorescens @ 10% and Bacillus subtilis @10 % in the management of cercospora leaf spot on okra in field. Results revealed that minimum disease incidence (21.25%) was recorded in T7 followed by 22.33% in T1 and 24.25 % in T4. However, 25.88 % disease incidence in T2 followed by 26.33%, 27.33 and 27.88 % were recorded in T3, T5 and T6 respectively. While maximum disease incidence 28.33 % was recorded in case of control (T8) after first spray. On the basis of present investigation, it may be concluded that the used of Trichoderma spp. as a foliar application, may be recommended for the management cercospora abelmoschi in okra.

Keywords: *Cercospora abelmoschi, okra, ecofriendly*

INTRODUCTION

Vegetables are the most remunerative agricultural activity for small and marginal farmers, it is the main sources of farm income for small and limited resource farmers (5, 8). There is an increase in demand for the vegetable crop. Okra, (Abelmoschus esculentus (L). Moench belongs to the family Malvaceae, originated in Abyssinia than it was taken to North Africa, the eastern Mediterranean Arabia and India (Anon., 2008). Okra (Abelmoschus esculentus L.) is an annual vegetable crop propagated from seed in tropical and subtropical regions of the world. It is known by many local names in different parts of the world. It is alled "lady's finger" in England, "Gumbo" in United States and "Bhindi" in India (Chauhan, 1972). Okra is known to be originated from West Africa (Joshi et al., 1974). Major okra growing states in India are Uttar Pradesh, Odisha, Bihar and West Bengal. It is an annual vegetable crop grown from seed in

tropical and sub tropical parts of the world. Total area of vegetable in the world is 1115.931 thousand ha with fruit production 8710.210 thousand mt and productivity of the crop is 7.8 mt/ha (NHB, 2013). The area under okra cultivation in India is 530.8 thousand ha, with production 6350.3 thousand mt and productivity 12.0 mt/ha (NHB, 2013). In Uttar Pradesh total area under okra crop is about 12.44 thousand ha with production 159.30 thousand mt and productivity 12.8 mt /ha (NHB, 2013). It is one of the important vegetable, mainly grown for its tender fruits in many countries of the world. Okra seeds are good source of protein, vegetable oil and also rich in vitamin A and B, phosphorus and iodine, which play significant role in human diet (Baloch, 1994; Yadav & Dhankhar, 2001; Khushk et al., 2003). Okra is a power house of valuable nutrients, soluble and insoluble fiber, which helps to lower serum cholesterol, risk of heart disease, keeps the intestinal tract healthy and decrease colorectal cancer (Anon., 2007; Broek et al., 2007). Okra is specially valued for its tender and delicious fruits. To a limited extent it is canned, dehydrated to preserve it in a frozen form. Okra dry seeds contain 18-20 per cent oil and 20-23 per cent crude protein. Roasted and grinded seed find their use as a coffee substitute. It is good for people suffering from renal colic, leucorrhoea, chronic dysentery and general weakness (Singh, 2000). Fruit of okra is having high iodine content and useful for control of goitre. Bland mucilage of plants is used as clarifier in jaggery preparation. The leaves of okra are used in Turkey for preparation of medicine to reduce inflammation. The seed cake of okra is used as an animal feed. The dry fruit shell and stem containing crude fibre are uitable for manufacture of paper and card board.

Okra is found to suffer from a number of diseases caused by fungi, bacteria, viruses, mycoplasmas or phytoplasmas and nematodes. The most important diseases of okra are Damping Off (Pythium sp., Rhizoctonia sp.), Fusarium Wilt (Fusarium oxysporum f. sp. vasinfectum), Powdery Mildew (Erysiphe cichoracearum), Yellow Vein Mosaic Virus (YVMV) and Cercospora Leaf Spot (Cercospora abelmoschi and Cercospora malayensis). Among the fungal diseases Cercospora leaf spots of okra (Cercospora abelmoschi) is one of the most important in all states wherever okra is grown. (Jha & Dubey, 2000; Kochhar, 2005; Jiskani, 2006). The optimum temperature and pH for the growth of the fungus were found to be 28ºC and pH 6.5. Minimum growth of the fungus was recorded at the temperature of 5ºC and pH 10.5. Excellent sporulation was observed at 25ºC -30ºC and pH levels of 5.5 to 6.5. In India, two species of Cercospora viz., C. malayensis Stev. and Solh. And C. abelmoschi Ell. and Ev . were found to be the cause of leaf spots in okra. (Rangaswami, A and Chandrsekhran, S. 1962)

MATERIALS AND METHODS

Experimental site and location

In the present study, field experiments were conducted at Organic Research Farm, Karguaji, of the Bundelkhand University, Jhansi (U.P.). Field experiments were carried out in the premises of Institute of Agricultural Science, Department of Plant Pathology, situated in the main campus of the Bundelkhand University, Jhansi (U.P.) during 2023.

Collection of Disease Samples:

The diseased samples were collected from experimental site. The infected leaves, stems, sclerotia formed within stem were collected from infected plant in sterilized polybags. Thus collected typical symptomatic parts were kept in rough dry envelops and marked clearly mentioning location, infected parts, reaction types date of collection, etc. and brought to laboratory for isolation of pathogen and identification of the pathogen.

Cleaning and Sterilization of Glassware's:

All the glassware's under the present study were cleaned with washing powder and then cleaned in 0.1% mercuric chloride solution and finally washed thoroughly with tap water. This cleaned glassware's were sterilized in Hot Air Oven at 160 ˚Ċ. Metallic objects like blade, scissor, forceps, inoculation needle, cork borer etc. were sterilized by dipping in the spirit and heating on flame to red hot before inoculation. Laminar flow was sterilized with formalin and ultra violet lamp before use. Spirit was used as general disinfectant of hand. Dry glassware's were sterilized at 160 0C for 2 hours in hot air oven.

Isolation of fungi from diseased leaves

Fungal species were isolated from diseased leaves of okra showing characteristic symptoms of Cercospora leaf spot. The Cercospora leaf spot disease was characterized by necrotic lesions on leaves which were circular to angular spots or dots and vary in size from less than 1 mm to 10 mm in diameter. Margins of infected leaves (2 - 5 mm diameter) were cut to contain both diseased lesions and healthy uninfected tissues using flame-sterilized scissors and forceps. Cut out portions were surface-sterilized (1 % NaOCl for 5 min then rinsed in five changes of sterile distilled water) and blottered dry with tissue paper in the aminar flow. The dried diseased cut out were then inoculated on PDA. Inoculated Petri dishes were incubated at 28 ± 2 °C. Fungi grew from the plant parts were sub cultured until pure cultures were obtained. The fungi were identified with the aid of colony and hyphal characteristics and measurement of conidial shape was done using ocular micrometer (Barnett and Hunter, 1999).

Pathogenicity test:

The pathogenicity test was carried out by making a suspension of a fungus. One Petri dish of well developed pure culture of Cercospora abelmoschii was thoroughly mixed in 500ml sterilized water and mixed that suspension in knapsack spray machine in 4 liter water and sprayed on okra plant. The typical symptoms of leaf spot appeared after 15 days of spray.

Re-isolation of the fungus:

The fungus was re-isolated from artificially inoculated plants to confirm the cause of disease

Symptomatological study of the pathogen:

Symptoms of infected okra leaves firstly started as light brown spots then turned to purple and varying in size. The spots spread to cover large areas of infected leaves. In case of severe infection, spots joined together and formed patches. Later, leaves were dry and remained intact with stem of plant. Samples of diseased leaves were collected to isolate the causal organisms. Infection and lesion formation initially occur on older leaves before progressing entire lesions appear fuzzy due to the presence of numerous conidia. S.H. Eman and Farrag, (2011) the symptoms of disease are seen initially on lower and more matured leaves as small spots. Often the centers may turn white and dry up. As disease progress these spots joined together and formed patches. Later, the leaves are dry and remained intact with stem of plant.

Study on management of Cercospora abelmoschii of okra

Biocontrol agents viz., Trichoderma sp, Bacillus subtilis and Pseudomonas fluorescens obtained from the Culture Collection Section, the University. were used for the management study conducted under field conditions.

Culture medium and there preparation:

During case study, for growing fungi, bacteria etc. different culture media were used.

Composition :

Peeled Potato : 200 gm

Agar-agar	:	20 gm
Dextrose	:	20 gm
Distilled water	:	1000 ml
pH	:	6 - 6.5

PDA preparation procedure:-

The required quantity of peeled potatoes were cut into small pieces and boiled in 500 ml of distilled water till the pieces became soft. The potato extract was filtered through muslin cloth and the filtrate was collected in the beaker. Rest of the 500 ml water was made warm and 20 gm agar and 20 g ram dextrose was added properly by shaking through glass rod. Two hundred ml of this solution was dispensed in each conical flask of 250 ml capacity. Flasks were plugged with nonabsorbent cotton plugs. Flasks containing medium were sterilized at 1210C at 15lbs pressure/inch2 for 15 minutes in an autoclave. Transferred edium was allowed to cool up to 40-420c before pouring into petriplates. to newer ones. Lesions at maturity are 1/8 inch in diameter and appear light gray-colored to dark tan with a brown to purple border. Severely affected leaves wither and die from coalescing lesions. A diagnostic feature is the presence of tiny black dots (pseudostromata) that form in leaf substomatal cavities within the grayish-tan lesions. The pseudostromata produce conidiophores borne in clusters that serve as conidia-bearing structures. Pseudostromata are visible with a hand ens, and after exposure of leaves to high humidity,

Nutrient Agar Medium:

Composition :

Peptone	:	5 gm
Beef Extract	:	3 gm
Sodium Chloride	:	5gm
Agar Agar	:	15 gm
Distilled Water	:	1000 ml

Procedure for preparation of NAM medium

All the ingredients were mixed properly in 500 ml distilled water with the help of glass rod and volume was made up 1000 ml by adding required amount of distilled water. Two hundred ml of this solution was poured in each 250 ml capacity of conical flasks. Flasks were tightly plugged with nonabsorbent cotton plug and wrapped with silver foil and autoclaved at 121ºC temperature at 15lbs pressure/inch2 for 15 minutes. Sterilized medium was allowed to cool up to 40-420C before pouring into Petri plates.

Nutrient Broth:

Composition :

Peptone	:	5 gm
Beef Extract	:	3 gm
Sodium Chloride	:	5 gm
Distilled Water	:	1000 ml

Nutrient broth preparation procedure:-

Similar procedure was followed for the preparation of Nutrient Agar Medium except addition of Agar.

King's 'B' medium (Pseudomonas fluorescens selective medium):

For culturing the Pseudomonas fluorescens, King's 'B' medium was used during the investigation. Composition and preparation procedure is as following:-

Peptone	:	20 gm
Agar-agar	:	20 gm
(K2HPO4)	:	1.5 gm
(MgSo4)	:	1.5 gm
Glycerol	:	10 ml
Distilled water	:	1000 ml

King's 'B' medium preparation procedure:-

All the ingredients of King's 'B' medium were mixed properly in distilled water with the help

of glass rod and volume was made 1000 ml by adding required amount of distilled water. Two hundred ml of this solution was poured in each 250 ml capacity conical flasks. Flasks were tightly plugged with non-absorbent cotton plug and wrapped with silver foil and autoclaved at 121ºC temperature at 15lbs pressure/inch2 for 15 minutes. Sterilized medium was allowed to cool up to 40-420C before pouring into Petri plates.

King's 'B' broth preparation procedure:-

Similar procedure was followed for the preparation of King's 'B' medium except addition of Agar. In broth agar-agar powder was not added.

Preparation of plant extract:

Extracts of plant were prepared by crushing leaves of neem seed kernel (NSK), and neem (leaf) with sterilized distilled water. The material was dried at room temperature (23 0C) for 6 hours before extraction to remove the excess water. 100g plant leaves were crushed separately with 100 ml sterilized water and Neem seed kernels were collected and peeled is removed and crushed with mortar pestle and collected in muslin clothed fixed tightly and dipped in distilled water overnight. The extract were filtered through a muslin cloth and centrifuged for 5000 rpm at 30 min. The extracts were sterilized by passing them hrough a whatman filter paper (0.22 micron pore size).

Management of Cercospora abelmoschii of okra:

The present investigations were carried out during Rabi season at organic Research Farm of Bundelkhand University, Jhansi, Uttar Pradesh. The effectiveness of neem seed kernel extract (NSKE) @10%, neem leaf extract 10%, cow urine 10 %, tobacco leaf extract, and bio-agents viz,. Trichoderma spp@ 10%, Pseudomonas fluorescens @ 10% and Bacillus subtilis @10 % were taken. All the treatment viz., fungicides, botanicals and bioagents were applied as foliar spray. In control plot only water spray was given. Seven days after spraying, Plant Disease incidence was recorded in all the treatments and calculated the disease reduction in each treatment, per cent disease control. All recommended agronomical practices were followed. The details of experiments as follows-

Treatment Details:

Foliar application of Trichoderma spp @ 10 % concentration.

Foliar application of Pseudomonas @ 10 % concentration.

Foliar application of Bacillus subtilis @ 10 % concentration

Foliar application of Neem leaf extract @ 10 % concentration

Foliar application of cow urine @ 10 % concentration

Foliar application of Neem seed karnal extract @ 10 % concentration

Foliar application of tobacco leaf extract @ 10% concentration.

Control

Plant Disease incidence was recorded using following formula

$$PDI = \frac{\text{Number of diseased leaves/treatment}}{\text{Total number of leaves/treatment}} \times 100$$

Statistical analysis of data:

The data of the experiments conducted in the fields were subjected to statistical analysis. The data were transformed whenever required. The critical differences were worked out at 5.0 per cent probability level to find out the difference between the treatments.

RESULTS AND DISCUSSIONS

Isolation and identification of pathogen:

Fresh specimens infected with leaf spot disease of Abelmoschus esculentus L. Moench

(Bhendi or okra) were collected from the nearby farmer's field. The fungus was isolated from the diseased leaf and purified by single spore isolation method. The fungus initially grew on carrot leaf extract agar medium and the growth rate of the fungus was very low. The fungus produced white mycelium with oily droplets on the surface. The fungus produced only conidia on culture medium. Conidia were pale olivaceous in colour mostly obelavate though some clavate forms were also seen. The base was truncate, tip obtuse and wall distorted. The conidia were septate with one to eight septa and oil globules were invariably present. They measured 20.0 to 90.0 µm in length and 3.0 to 7.0 µm in width. The morphological characters of the C. abelmoschi reported on A. esculentus with those under the present study were mentioned in. This pathogen was found to be Cercospora abelmoschi Ellis and Everhart. This was identified based on cultural and morphological characters and pathogenicity of okra.

Pathogenicity:

Two week old sporulating culture of C. abelmoschi maintained on carrot leaf extract agar slants were inoculated on leaves of okra variety KPS 188 Rudra employing various methods yielded the following results. Okra variety KPS 188 Rudra which was used in inoculation studies showed 76 per cent infection and developed typical symptoms with all the inoculation methods tested. Of the two methods used for proving pathogenicity, atomization of spore and mycelial suspension proved to be the best inoculation technique with 100 per cent efficiency.

Study of symptoms:

To study the symptoms produced by C. abelmoschi on okra, the susceptible variety KPS 188 Rudra was inoculated by atomization of spore and mycelial suspension technique. Development of symptoms started 10 days after the inoculation. The disease first appeared in the form of a minute light olivaceous speck, which enlarged to form angular sooty spots bounded by the veins on the leaves . The margins of the spots were neither clearly marked nor surrounded by any halo. When the infection distributed through out the leaf blade, on both the surfaces, a mosaic like symptoms were observed. Though in the early stage the spots were isolated measuring about 1 to 8 mm in diameter soon they spread to coalesce to form large patches. Due to severe infection, defoliation of plant, stunted growth and poor yield resulted.

Management of the disease:

The present investigations were carried out during Rabi season at organic Research Farm of Bundelkhand University, Jhansi, Uttar Pradesh. The effectiveness of neem seed kernel extract (NSKE) @10%, neem leaf extract 10%, cow urine 10 %, tobacco leaf extract @ 10%,and bio-agents viz,. Trichoderma spp @ 10%, Pseudomonas fluorescens @ 10% and Bacillus subtilis @10 % were taken. All the treatment viz., botanicals and bioagents were applied as foliar spray. In control plot only water spray was given. The treatments were given at fortnight intervals for three times i.e., up to completion of the crop. The post treatment observations were taken after 10 days interval. The results of the experiment were presented here under

All the tested bioagents, botanicals and cow urine significantly reduced the disease ncidence and increase the crop yield as compare the control. Data given in Table no. 1 and fig. no. 1 that, treatment T7 recorded the highest per cent disease incidence 26.7 per cent before spraying; it was followed by T5 (25.1%). The minimum disease incidence was noticed in T6 (18.8%). However, all these (treatments) were statistically insignificant with respect to per cent disease incidence.

Data presented in the table No. 1 and fig. no. 1 the results reveled that minimum disease incidence (21.25%) was recorded in T7 followed by 22.33% in T1 and 24.25 % in T4. However, 25.88 % disease incidence in T2 followed by 26.33%, 27.33 and 27.88 % were recorded in T3, T5 and T6 respectively. While maximum disease incidence 28.33 % was recorded in case of control (T8) after first spray. The results reveled that minimum disease incidence (15.66 %) was recorded in T7 followed by 18.50 % in T1, 19.00 % in T3 and 20.25 % in T2. In case of T4 (21.50%) disease incidence was recorded. Whereas maximum 24.75% incidence in was recorded in T6 While in case of control (T8) 30.55% disease incidence was recorded after 2nd spray.

Table - 1 : Effect of different treatments on C. abelmoschi after 1st spray

Treatments	Treatments details	Doses	PDI before spray	After1st spray	% control	After2nd Spray	% control	Yield/ plot (kg)
T1	*Foliarapplicationof Trichoderma spp*	10%	19.80	22.33	21.17	18.50	39.44	8.00
T2	*Foliarapplicationof Pseudomonas*	10%	24.80	25.88	8.64	20.25	*33.71*	7.00
T3	*Foliar application of Bacillus subtilis*	10%	24.80	26.33	7.05	19.00	*37.80*	7.50
T4	*FoliarapplicationofNeem leaf extract*	10%	22.90	24.25	14.40	21.50	*29.62*	7.25
T5	*FoliarapplicationofNeem seed karnalextract*	10%	25.10	27.33	3.52	22.25	*27.16*	6.75
T6	*FoliarapplicationofCow urine*	10%	18.80	27.80	1.87	24.75	*18.98*	6.33
T7	*FoliarapplicationofTobacco leaf extract*	10%	26.70	21.25	24.99	15.66	*48.73*	8.50
T8	*Control*	-	22.70	28.33		30.55		6.00
CD@5% level		-	-	2.490			2.169	-

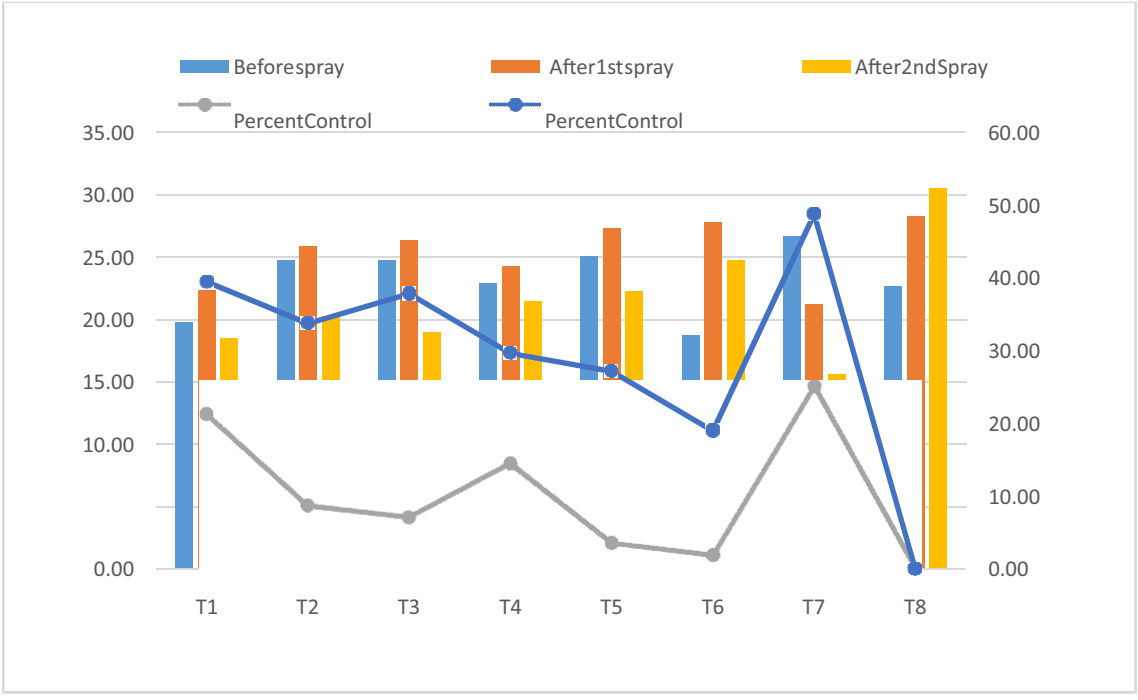

Fig. No. - 1 : Effect of different treatments on C. abelmoschi

Effect of different treatments on crop yield

Data presented in the table No. 1 the results reveled that the maximum yield 8kg/plot was recorded in T7 followed by 8kg/plot in T1, 7.50 in T3 and 7.25 kg/plot in T4. In case of T2 (7.00 kg/plot) was recorded. In case of T5 (6.75 kg/plot) yield was recorded followed by 6.33 kg/plot in T6. While in case of control (T8) 6.00 kg/plot was recorded.

CONCLUSION

Among all the various tested treatments tested against the management of the disease, minimum disease incidence was found in foliar application of Trichoderma spp @ 10 % concentration and tobacco leaf extract @ 10%, concentration, found most effective followed by foliar application of Bacillus subtilis. On the basis of present investigation, it may be concluded that the used these treatments as a foliar application, may be recommended for the management cercospora abelmoschi.

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IMPROVE HEALTH AND PRODUCTIVE EFFICIENCY OF ANIMALS BY USE OF INFORMATION AND COM MUNICATION TECHNOLOGIES BY FARMERS IN AMBEDKAR NAGAR DISTRICT OF UTTAR PRADESH

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ABSTRACT

Livestock sector is the one of the main component of earning source for farmers which ensures food and nutritional security on one hand and provides income and employment opportunities District Ambedkar Nagar is agriculture based district. Vast of majority of its population (80%) were engaged in agriculture and allied activities for their livelihood. About 85% farmers came under small and marginal category. The average land holding below 1.0 ha. and productivity of crops grown in district is below the average productivity of state. Nearly two third of farm family in district are associated with livestock farming and 80% of them are small landholders. In livestock, especially dairy is a supplementary enterprise to crop farming. An exploratory study was conducted in Ambedkar Nagar district of Uttar Pradesh to find out the constraints perceived by livestock farmers in use of Information and Communication Technology (ICTs) in advances and their possible solutions to overcome these constraints for management livestock in relation to improve the health and productive performance. A total of 120 respondents were randomly selected for the study. Data were collected through structured interview schedule and analyzed through different statistical tools. The study revealed the farmers are agree with importance of ICTs in improve productivity of livestock but majority of the livestock farmers showed the some constraints in use of ICTs tolls that high cost of repairing ICTs (60.83%), lack of training and practical exposure towards ICTs (53.33%) and low ICT literacy (58.33%) were found to be 'most serious constraints' while lack of awareness of benefits of ICTs (56.67%), lack of skills in handling ICTs (50.83%), poor finance (36.66%) and erratic power supply (44.17%) perceived as 'serious constraints'. Low network connectivity (20.83%), unavailability of different ICT tools (32.50%) considered as 'less serious constraints' and Negative attitude towards ICTs was perceived as 'not a constraint' by most of the livestock farmers. Study on possible solutions shows that a great majority of the livestock farmers were in agreement with the possible solutions like subsidy in the procurement of ICT equipments (93.33%), provision of finance facilities (88.33%), setting up of low cost repairing centers in villages (90.83%) and confidence build up through trainings and practical exposure to ICTs (81.66%). Livestock farmers were in agreement with the possible solutions like subsidy in the procurement of ICT equipments, Government should provide finance facilities, setting up of low cost repairing centers at village level and Krishi Vigyan Kendra should provide trainings to build up confidence and practical exposure on Information and Commutation Technologies.

Keywords : *Animals health, productivity, Information communication technologies*

INTRODUCTION

Livestock make largely under estimated contribution to rural development. They produce food, enhance soil health and crop production and provide additional income goods and services as well as case income (Borah and Halim, 2014). However, low productivity of animals owing to low knowledge level of the livestock owners remains an unresolved issue and a major challenge for the future. Farmer to farmer informal exchanges remains the main channel for accessing information and new technologies in India (Anonymous, 2005). The traditional methods of extension approaches have less accountability and effectiveness in terms of time management, larger audience coverage and greater impression on people. The delivery of information and knowledge to the farmers on the right time and in right way leads to more productivity and more profitability and these goals can be achieve through use of modern tools viz. ICTs. Use of different ICT tools has potential to change the economy of livestock, agriculture and rural artisans in India (Rajorial *et. al*., 2017). ICT refers to all information and communication systems and technologies including not only the digital formats such as the internet or the World Wide Web (www), but also interfaces with radio, cable and wireless television, video, cellular phones and print media (Rajorial *et. al*., 2017). ICT tools are the common denominator that links people, irrespective of caste, class, sex, religion, race or political alignments. Information delivered through ICT can be timelier and can reach a greater number of farmers directly (Richardson, 1996). Access to ICTs could reduce transaction costs related to information searching and reduce knowledge and information asymmetries, particularly related to market price information.

Information, rewarded with success stories, can motivate human to adopt healthy livestock technologies. For instance, information on immunization, calf mortality, maternal mortality, sanitation, nutritional awareness and causes, prevention and treatment of disease can be disseminated far and wide via ICTs. The enhanced and smooth communication results in the overall development of the livestock sector (Saravanan, 2010). However, it was indicated that due to lack of knowledge and information about these technologies, farmers are not getting benefit from these technologies in their working places. Furthermore, farmers directly could not communicate with buyers and their customers for selling their production in good prices and track medical expenditure on their livestock as well as expenditure on farm chemicals to receive information from other stakeholders. ICT offers great hope for improving access, quality and efficiency of information dissemination in livestock sector, but there is a need to understand the key issues underlying the problems and to formulate sensible strategies. Here, an attempt has been made to analyze the constraints and their possible solutions towards use of ICTs as a source of reliable and timely information delivery in livestock sector for potential to change the economy of livestock owners.

MATERIALS AND METHODS

Study design for Research on Constraints perceived by Livestock Farmers in Use of ICTs in Ambedkar Nagar District of Uttar Pradesh. Study was undertaken in 6 blocks of district viz. Akbarpur, Tanda, Baskhari, Bhiti. Katehari and Jalalpur. For study 2 villages were selected from each selected blocks and 10 livestock farmers were selected from each village. Thus, total 120 livestock farmers were selected for the study of ICT tools for accessing information on different aspects of livestock

farming. Data were collected from selected farmers through a common questionnaire from farmers viz. confidence in operating ICTs, availability of different ICT tools, cost of ICT tools, power supply, Network connectivity, awareness of benefits of ICTs, skill in handling ICTs, repairing facilities and centers in villages, need of training and practical exposure towards ICTs, finance facility and possible solutions of constraints. The identified possible solutions were measured on a three point continuum i.e. agree, neutral and disagree with a scoring system of 3, 2 and 1 respectively. Statistical tools like frequency and percentage were used to draw the inferences.

Perceived constraints by livestock farmers in use of ICTs

Constraints for the present study have been operationalised as obstacles or hurdles encountered by the livestock farmers in access and usage of ICTs. Fourteen possible constraints were enumerated after reviewing related literature, consultation with subject matter specialists and ICT experts. The constraints were also listed by direct questioning with the livestock farmers. The identified constraints were measured on a four point continuum i.e. most serious constraint, serious constraint, less serious constraint and not a constraint with a scoring system.

Possible solutions of the constraints

Information and Communication Technology (ICTs) offers great hope for improving access, quality and efficiency of information dissemination in livestock sector, but there is a need to understand the key issues underlying the problems and to formulate sensible strategies. Eleven possible solutions were enumerated after reviewing related literature, consultation with subject matter specialists and ICT experts. The identified possible solutions were measured on a three point continuum i.e. agree, neutral and disagree with a scoring system of 3, 2 and 1 respectively. These possible solutions were also listed by direct questioning with the livestock farmers.

RESULTS AND DISCUSSION

Perceived constraints by livestock farmers in use of ICTs

The constraint analysis is important to reach out the voice of the livestock farmers and the problems faced by them in order to enable planners, administrators, development workers and policy makers to implement developmental programmes and interventions which could cater to the needs of the farmers and benefit them in an improved manner. The constraints in the use of ICTs by livestock farmers were measured using four point continuum scales. The results are presented in Table 1 which is discussed below: High cost of repairing ICTs, lack of training and practical exposure towards ICTs and low ICT literacy were perceived as 'most serious constraints' by 60.83, 53.33 and 58.33 per cent livestock farmers, respectively while 'serious constraints' by 25.00, 25.83 and 30.00 per cent respondents, respectively. This might be due the poor economic conditions and low level of educational status of livestock farmers. These findings are in agreement with the finding of Mooventhan and Philip (2012), Shankaraiah and Swamy (2012) and Karunakaran (2004). Lack of awareness of benefits of ICTs, lack of skills in handling ICTs, poor finance, erratic power supply, lack of confidence in operating ICTs, lack of repairing facilities & centres in village and high cost of ICT tools were perceived as 'serious constraint' by 68.00.50.83, 36.66, 44.17, 42.50 and 36.67. per cent livestock farmers, respectively. These findings might be due to lack of knowledge abouts different ICT tools and its benefits in information delivery

and unavailability of uninterrupted power supply among livestock farmers of study area. These findings are similar with findings of Rebekka and Saravanan, 2015. Among the 'less serious constraints' were low network connectivity (20.83%), insufficient regional specific language (26.66%) and unavailability of different ICT tools (22.50%). Negative attitude towards ICTs was perceived as 'not a constraint' by 10.83 per cent of livestock owners.

Table - 1 : Constraints in the use of ICTs among livestock farmers (n=120)

S. No.	Constraints	MC		C		LC		NC	
		f	%	*f*	%	*f*	%	*f*	%
1.	Lack of confidence in operating ICTs	42	35	51	42.50	21	30.83	6	17.50
2.	Unavailability of different ICT tools	23	19.17	34	28.33	39	32.50	24	20.83
3.	High cost of ICT tools	47	39.16	44	36.67	33	27.50	2	1.67
4.	Erratic power supply	43	35.83	53	44.17	26	21.67	32	26.67
5.	Low Network connectivity	48	40.00	16	13.33	25	20.83	31	25.83
6.	Lack of awareness of benefits of ICTs	13	10.83	68	56.67	29	24.17	10	8.33
7.	Lack of skill in handling ICTs	31	25.83	61	50.83	21	17.50	7	5.83
8.	Low ICT literacy	70	58.33	36	30.00	9	7.50	5	4.17
9.	Lack of repairing facilities and centers in villages	41	34.17	51	42.50	18	15.00	10	8.33
10.	Negative attitude towards ICTs	6	5.00	11	9.17	13	10.83	90	75.00
11.	Lack of training and practical exposure towards ICTs	64	53.33	31	25.83	15	12.5	10	8.33
12.	High cost of repairing ICTs	73	60.83	30	25.00	10	8.33	7	5.83
13.	Insufficient regional specific language	25	20.83	38	31.67	32	26.66	25	20.83
14.	Poor finance	32	26.66	44	36.66	38	31.67	6	5.00

Note: MC: Most serious constraint, C: Serious constraint, LC: Less serious constraint, NC: Not a constraint.

Table - 2 : Possible solution of constraints in the use of ICTs (n=120)

S. No.	Possible Solutions	Agree		Neutral		Disagree	
		f	%	*f*	%	*f*	%
1.	Facility of different ICT tools and services	85	70.83	13	10.83	22	18.33
2.	Confidence build up through trainings and practical exposure to ICTs	98	81.66	12	10.00	10	8.33
3.	Provision of continuous power supply or power backup	82	68.33	16	13.33	22	18.33
4.	Enhancement in network connectivity	83	69.17	14	11.67	23	19.17
5.	Creation of awareness regarding benefits of ICTs	102	85.00	6	5.00	12	10.00
6.	Improvement in ICT literacy	97	80.83	13	10.83	10	8.33
7.	Setting up of low cost repairing centers in villages	100	90.83	6	2.50	12	6.67
8.	Counteracting negative attitude towards ICTs through proper motivation	26	21.66	13	10.83	81	67.50
9.	Provision of finance facilities	106	88.33	9	7.5	5	4.16
10.	Subsidy in the procurement of ICT equipments	112	93.33	2	1.67	6	5.00
11.	Development of different ICT tools with regional specific languages	105	87.5	7	5.83	8	6.67

Possible solution of constraints in use of ICTs

Table 2 shows that a great majority of the livestock farmers were in agreement with the possible solutions like subsidy in the procurement of ICT equipments (93.33%), provision of finance facilities (88.33%), setting up of low cost repairing centers in villages (90.83%) and confidence build up through trainings and practical exposure to ICTs (81.66%). Majority of the respondents were also in agreement with the possible solution like development of different ICT tools with regional specific languages (87.5%), creation of awareness regarding benefits of ICTs (85.0%), improvement in ICT literacy (80.83%), facility of different ICT tools and services (70.83%), provision of continuous power supply or power backup (68.33%) and enhancement in network connectivity (69.17%). This table further reveals that majority of the respondents disagreed with the statement counteracting negative attitude towards ICTs through proper motivation (Rajorial *et al.,* 2017). The livestock farmers were facing lots of constraints in using different ICT tools. Most important among them were high cost of repairing ICTs, lack of training and practical exposure towards ICTs, low ICT literacy, high cost of ICT tools and lack of repairing facilities and centers in villages.

CONCLUSION

This research study revealed that Information delivered through ICT can be timelier and can reach a greater number of farmers directly (Richardson, 1996). Access to ICTs could reduce transaction costs related to information searching particularly related to market price information. Information, rewarded with success stories, can motivate human to adopt healthy livestock technologies. ICT offers great hope for improving access, quality and efficiency of information dissemination in livestock sector has potential to change the economy of livestock owners with agriculture and rural artisans. In constraints to these solutions that great majority of the livestock farmers were in agreement with the possible solutions like subsidy in the procurement of ICT equipments, Government should provide finance facilities, setting up of low cost repairing centers at village level and Krishi Vigyan Kendra provide trainings to build up confidence and practical exposure on use of ICTs in livestock production. This will contribute to much more turn out from livestock sector in term of production, yield and returns etc to boost up the income of farmers.

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DISEASE MANAGEMENT OF WHITE RUST OF MUSTARD BY USING PLANT EXTRACT AND BIO AGENTS

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ABSTRACT

The present investigation was carried out in field. The white rust caused by *Albugo candida* is quite common in mustard. The Symptoms of infected plant was formation of raised creamy white pustules on the undersurface of leaves and often coalesced. Pustules developed on the upper surface of the leaves. The affected tissue turned necrotic and died. The pathogen stimulated hypertrophy and hyperplasia resulting in abnormal swelling and malformation of the affected organs. Therefore, this study aimed to evaluate the efficiency of bioagents and botanicals against white rust. In the present investigation, minimum 24.25 % severity and maximum 7.77 Q/ ha grain yield was recorded in *Trichoderma viride* @ 2x108/ml (T1) followed by 25.25 % severity and 7.22 q/ ha grain yield in *Trichoderma* isolate @ 2x108/ml (T3). While maximum, 28.75 % severity was recorded in Onion bulb extract @ 10% (T7) and minimum 5.3 q/ha gain yield Garlic bulb extract @ 10% (T8). In case of control 32.25 % severity and 4.5q/ha grain yield was recorded after the third spray and grain yield after harvesting. On the basis of present investigation, it may be concluded that the used of *Trichoderma* spp. as a foliar application, may be recommended for the management of this disease.

Keywords : *Disease, mustard, white rust*

INTRODUCTION

Mustard (*Brassica juncea* L.) is important oilseed crop. It is also called "rai', 'raya ' or 'laha'. Rapeseed-mustard is an inevitable component of India's traditional culinary system that can be used as a source of edible oil, raw material for industrial products and as a spice. It is the third major oil seed crop of the world, after soybean and oil palm (Abhishek *et al.,* 2017). Oilseed crops play a vital role in national economy. The mustard seed contains proteins (25.39%), fats (38.45%), ash (4.25%), carbohydrates (21.19%), fibres (6.36%), moisture (4.36%) etc. (Fahad and Mohammed, 2012).

Several factors are responsible for the decline in production of Rapeseed-Mustard in Punjab. Among them, diseases caused by fungi constitute one of the most important factors which are responsible for low yield in this crop (Saharan, 1991). Several important diseases like Alternaria blight (*Alternaria brassicae*), White rust (*Albugo candida*), Downy mildew (*Peronospora parasitica*) and Sclerotinia rot (*Sclerotinia sclerotiorum*) created a serious threat to the successful cultivation of Rapeseed-Mustard in past few years. Among these diseases, White rust (*Albugo candida)* is one of the most important diseases which affect the crop

severely (Saharan and Verma, 1992). White rust is the major and widely prevalent disease of rapeseed and mustard, in India. It is caused by an oomycotic fungi *Albugo candida,* which appears in an epiphytotic form, inducing serious damage to the cruciferous crops (Kolte, 1985). he pathogen causes symptoms on all aboveground parts of the plant, producing characteristic white blisters (Singh *et al.,* 1999) and the floral malformation caused by this pathogen is called as stag head (Verma and Petrie, 1980). The floral parts like stamens and pistils are converted into green fleshy structures without any seed set. It has a wide host range (Kaur et al., 2011) and causes yield loss ranging from 23 to 54.5% (Saharan *et al.,* 1984; Saharan and Lakra, 1988; Saharan, 1991). Godika *et al.,* (2001) reported that the white rust has the potential to cause up to 89.9% yield loss due to foliar and floral infection. Chemical compounds should not only be safe to human beings and other mammals, but also to environment including beneficial microorganisms. With the growing awareness of harmful effects of pesticides, use of bioagents and plant extracts (botanicals) with less toxicity and ecological effects as anti-fungal spray is gaining importance in recent years (Mehta *et al.,* 2005). The concept of integrated disease management seeks to minimize the advantages in the use of fungicide. In the present study different Organic amendments, Botanicals, Bio-control agents and chemical fungicides are used as foliar spray and soil amendments in mustard crop to find out its efficiency in effective and economical control against White rust.

MATERIALS AND METHODS

Experimental Site And Location

In the present study, field experiments were conducted at Organic Research Farm, Karguaji, of the Bundelkhand University, Jhansi (U.P.). Lab experiments were carried out in the premises of Institute of Agricultural Science, Department of Plant Pathology, situated in the main campus of the Bundelkhand University, Jhansi (U.P.) during 2023.

Evaluate the bio agents and plant extract for the management of white rust of mustard.

Collection of the Bioagents:

The following bioagents with their recommended doses were used in present study. The bioagents required for the experimental work were obtained from the Culture Collection Section, of the University.

Table - 1.1 : Details of Bioagent Used and Their Respective Concentration.

Sr. No.	Bioagents	Con. used for spraying
1	*Trichoderma viride*	**$2x10^8$/ml**
2	*Trichoderma asperellum*	**$2x10^8$/ml**
3	*Trichoderma* Isolate 1	**$2x10^8$/ml**
4	*Pseudomonas fluorescens*	**$2x10^8$/ml**

Culture medium and their preparation:

PDA and PDB media used for the growth and multiplication of fungal bioagents *viz*. *Trichoderma viride, Trichoderma asperellum and Trichoderma* Isolate 1. PDA and POB were prepared as per prescribed procedure and the test tubes and bottles containing PDA and PDB were steri lized in autoclave at 151bs pressure at 121 °C for 15 min. After sterilization the PDA slants were prepared by keeping them in slanting position and were allowed to solidify. The composition of PDA and PDB are as follows:

Composition PDA:

Peeled Potato	:	200 gm
Agar-agar	:	20 gm
Dextrose	:	20 gm
Distilled water	:	1000 ml
pH	:	6 - 6.5

Composition PDB :

Peeled Potato	:	200 gm
Dextrose	:	20 gm
Distilled water	:	1000 ml
pH	:	6 - 6.5

Nutrient Agar Medium for bacterial bioagents :

Composition

Peptone	:	5 gm
Beef Extract	:	3 gm
Sodium Chloride	:	5gm
Agar Agar	:	15 gm
Distilled Water	:	1000 ml

Procedure for preparation of NAM medium

All the ingredients were mixed properly in 500 ml distilled water with the help of glass rod and volume was made up 1000 ml by adding required amount of distilled water. Two hundred ml of this solution was poured in each 250 ml capacity of conical flasks. Flasks were tightly plugged with nonabsorbent cotton plug and wrapped with silver foil and autoclaved at 121ºC temperature at 15lbs pressure/inch^2 for 15 minutes. Sterilized medium was allowed to cool up to 40-42^{0}C before pouring into Petri plates.

Nutrient Broth :

Composition

Peptone	5 gm
Beef Extract	3 gm
Sodium Chloride	5 gm
Distilled Water	1000 ml

Nutrient broth preparation procedure :-

Similar procedure was followed for the preparation of Nutrient Agar Medium except addition of Agar.

Collection of the botanicals :

The following botanicals reported to be exhibited antifungal properties against fungal pathogen were collected from the Culture Collection Section, of the University.

Table - 1.2 : Details of bioagents and their spraying concentration.

Sr. No.	Bioagents	Con. used treatment and spraying
1	Eucalyptus leaf extract	**10%**
2	Neem leaf extract	**10%**
3	Onion bulb extract	**10%**
4	Garlic Bulb extract	**10%**

Preparation of Plant Extract :

Extracts of botanicals were prepared by crushing of Eucalyptus leaf, Neem leaf, Onion bulb and *Garlic Bulb* with sterilized distilled water. The material was dried at room temperature (23 ^{0}C) for 6 hours before extraction to remove the excess water. 100g plant leaves and bulbs were crushed separately with 100 ml sterilized water and collected in muslin clothed fixed tightly and dipped in distilled water overnight. The extract were filtered through a muslin cloth and centrifuged for 5000 rpm at 30 min. The extracts were sterilized by passing them through a Whattman filter paper (0.22 micron pore size).

Experimental Site :

The experiment was conducted during Rabi-2022 on the experimental farm of the Department of Plant Pathology Organic Research Farm, Karguaji, of the Bundelkhand University, Jhansi (U.P.). The field experiment was laid out by applying randomized block design with 9 treatments and three replications. The mustard variety, Vardan, susceptible to white rust (*Albugo candida*) was used in the present experiment. Recommended dose of fertilizers was applied and irrigated lightly for better seed germination. Then, ten days after sowing, thinning and gap filling operations were done to

maintain uniform plant population. Experimental plots were frequently visited and keenly observed for recording observations of the disease symptoms. Intercultural operations were performed as and when required. The details of field layout and treatments are as follows.

Table - 1.3 : Experiment details

Crop Season	2022-23
Design	RBD
Replication	03
Treatment	09
Variety	Vardan
Plot size	2.5 x 2.1 m^2
Field size	30 x 10 m2
Spacing	60 x 10 cm
Date of sowing	21st November, 2022

Table - 1.4 : Treatment details:

S. No.	Treatment
T0	Control
T1	*Trichoderma viride* @ $2x10^8$/ml
T2	*Trichoderma asperellum* @ $2x10^8$/ml
T3	*Trichoderma* isolate @ $2x10^8$/ml
T4	*Pseudomonas fluorescens* @ $2x10^8$/ml
T5	Eucalyptus leaf extract @ 10%
T6	Neem leaf extract @ 10%
T7	Onion bulb extract @ 10%
T8	Garlic bulb extract @ 10%

Three sprayings of bioagents and botanicals were given at ten days interval. First spraying was done after disease initiation and subsequent second sprayings were given after each 10 days interval.

Observations :

Observations on white rust disease severity were recorded on five randomly selected plants on each bottom, middle and top leaves. The first observation was taken after disease appearance and subsequent three observations were taken 2 days after each spraying. The white rust disease was graded on the basis of disease severity observed on leaves by applying 0-9 disease rating scale given by **Mayee and Datar (1986)**

Grade/ Scale Description

0 = No symptoms on leaf

1 = Small, raised blisters covering 1% of the leaf area

3 = Small, raised blisters covering 1-10% of the leaf area

5 = Blister, raised covering 14-25% of the leaf area

7 = Raised, shiny, white blisters covering 26-50% of the leaf area

9 = Raised, shiny blisters, coalescing to form large patches, over 51% or more of the leaf area

The statistical analysis

The data of various experiments obtained was statistically analyzed using standard method described by Panse and Sukhatme (1976). The standard error (SE) for disease severity, disease incidence and grain yield were calculated and critical difference (C. D.) at 5% level of significance was worked out. The per cent data was transformed to arc sine values before subjecting to statistical analysis.

RESULT S AND DISCUSSION

Effect of bioagents and botanicals on severity of white rust disease in mustard

After first spray, minimum 17.68 % severity was recorded in *Trichoderma viride* @ $2x10^8$/ml (T1) followed by 17.75% severity in *Trichoderma* isolate @ $2x10^8$/ml (T3), 17.78 in *Trichoderma asperellum* @ 2x108/ml (T2) when spraying foliar application of the treatment whereas,18.68 % severity was recorded in foliar application of *Pseudomonas fluorescens* @ $2x10^8$/ml (T4). While

maximum, 20.25 % severity was recorded in Onion bulb extract @ 10% (T7). After second spraying, minimum 22.25% severity was recorded in *Trichoderma viride* @ 2x108/ml (T1) followed by 22.75% in *Trichoderma* isolate @ $2x10^8$/ml (T3), 23.25 % severity in *Trichoderma asperellum* @ $2x10^8$/ml (T2) when spraying foliar application of the treatment whereas, in case of *Pseudomonas fluorescens* @ $2x10^8$/ml (T4) 23.65 % severity was noticed. While maximum, 25.85% severity was recorded in Onion bulb extract @ 10% (T7), followed by 25.75 % severity in neem leaf extract @ 10% (T6) and 24.78 % severity in Garlic bulb extract @ 10% (T8). In case of control 28.00 % severity was recorded after the second spray of the treatments similar trend of results was observed after third spray. In case grain yield maximum 7.77 Q/ ha was recorded in *Trichoderma viride* @ $2x10^8$/ml (T1) followed by 7.22 q/ ha in *Trichoderma* isolate @ $2x10^8$/ml (T3), 6.9 q/ ha in *Trichoderma asperellum* @ 2x108/ml (T2) when spraying foliar application of the treatment whereas, in case of *Pseudomonas fluorescens* @ $2x10^8$/ml (T4) 6.7 q/ ha was recorded. Average 5.9 Q/ha yield was recorded in Onion bulb extract @ 10% (T7), followed by 5.78 in Eucalyptus leaf extract @ 10% (T5), 5.4 q/ha in neem leaf extract @ 10% (T6) 5.3 q/ha and in Garlic bulb extract @ 10% (T8). In case of control 4.5q/ha yield was recorded. Similar results was recorded by Singh *et al.,* (2017) reported Garlic extract followed by Neem extract @15% as the best plant extract for the management of White rust of Mustard. Earlier experiments has also highlighted the importance of Biocontrol agents like *Trichoderma* and *Pseudomonas* in effectively controlling foliar pathogens in Mustard crop. Meena et al., (2014) also reported that, treatments garlic bulb extract, *Trichoderma harzianum* as seed treatment alone or in combination with foliar spray by garlic aqueous extract. T. *harzianum* and *Pseudomonas fluorescens* did not differed significantly among themselves. Foliar sprays with chemical fungicides did significantly better than the non-chemical fungicides against Alternaria blight. Similar, results were observed by garlic bulb extract, *T. harzianum* as a seed treatment in combination with *Pseudomonas fluorescens* spraying was significantly superior for white rust on leaves foliar sprays by garlic bulb extract increased the seed yield significantly as compared to control.

Table - 2.1 : Effect of bioagents and botanicals on white rust disease severity in mustard

Sr. No.	Treatment	Disease severity (%)				
		Before spraying	After first spraying	% disease control	After second spraying	% disease control
T1	*Trichoderma viride* @ $2x10^8$/ml	12.65	17.68	21.42	22.25	25.55
T2	*Trichoderma asperellum* @ $2x10^8$/	15.67	17.78	20.97	23.25	16.96
T3	*Trichoderma* isolate @ $2x10^8$/ml	14.75	17.75	21.11	22.75	18.75
T4	*Pseudomonas fluorescens* @$2x10^8$/ml	15.67	18.68	16.97	23.65	15.53
T5	Eucalyptus leaf extract @ 10%	13.75	19.76	12.17	26.68	4.71
T6	Neem leaf extract @ 10%	14.33	19.75	12.22	25.75	8.08
T7	Onion bulb extract @ 10%	12.78	20.25	10	25.85	7.67
T8	Garlic bulb extract @ 10%	13.75	19.25	14.44	24.78	11.50
T0	Control	14.78	22.50	-	28.00	-
	CD @ 5%	**-**	**1.979**	**-**	**2.509**	**-**
	SE(m)	**-**	**0.654**	**-**	**0.830**	**-**

Table - 2.2 : Effect of bioagents and botanicals on white rust disease severity and growth parameter in mustard

Sr. No.	Treatment	Disease severity (%)		Seed weight	Yield q/ha
		After third Spraying	% disease control		
T1	*Trichoderma viride* @2x10^8/ml	24.25	24.80	5.43	7.77
T2	*Trichoderma asperellum*@ 2x10^8/ml	26.75	17.05	5.63	6.9
T3	*Trichoderma* isolate @2x10^8/ml	25.25	20.15	5.55	7.22
T4	*Pseudomonas fluorencens* @ 2x10^8/ml	27.78	13.86	5.30	6.7
T5	Eucalyptus leaf extract @ 10%	29.75	7.75	5.60	5.78
T6	Neem leaf extract @ 10%	28.25	12.40	5.46	5.4
T7	Onion bulb extract @ 10%	28.75	10.85	5.30	5.3
T8	Garlic bulb extract @ 10%	28.00	13.17	5.50	5.9
T0	Control	32.25	-	5.25	4.5
	CD @ 5%	**2.855**		**3.286**	**0.646**
	SE(m)	**0.944**		**0.182**	**0.237**

CONCLUSION

Thus, from the results obtained on various aspects during present investigation on white rust (*Albugo candida*) of mustard (*Brassica juncea*) can be concluded that:

- Among all the tested bioagents, minimum disease severity was found in *Trichoderma viride* and *Trichoderma* isolate @ 2x10^8/ml concentration, these two bioagents found most effective for the manage disease as well as increase the grain yield.
- Among all the tested botanicals, minimum disease severity was found in Garlic bulb extract @ 10% followed by Onion bulb extract.

On the basis of present investigation, we can say that, the used these treatments as a foliar application, may be recommended for the management white rust (*Albugo candida*) of mustard (*Brassica juncea*).

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Short Communication

RECORD OF NEW INDIAN ADDITION LYGAEUS KALMI STAL, 1874 (HEMIPTERA: HETEROPTERA: LYGAEIDAE) FIRST TIME FROM ORIENTAL REGION

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Chamoli region of Uttarakhand comes under the West Himalayan region (2B: Biotic province) comprises with moist deciduous tropical and subtropical pine forest cover; with the unique ecosystem of Indian Himalayas this region is a hot spot of rich biodiversity. It is habitat of many unique diversity of India (Chandra *et al*, 2018).

Lygaeus kalmi Stal, 1874 small milk weed bug first was described in 1874 by Stal; after that Ashlock, and Slater 1988 reported from United state of America; Baranowski and Slater 2005 described from West Indies; after more than 3 decades now this taxa was found in Himalayan region state Uttarakhand in the year 2017. It had been recorded first time form Oriental region. Earlier work on Hemiptera of Indian Himalayas was done by Chandra and Kushwaha, 2013; Chandra and Kushwaha, 2017 and Chandra *et al*., 2018)

This is a new addition to Indian fauna and True Bugs of India. The new distribution record from Neo-tropical to Oriental region shows the long range extension of the species.

SYSTEMATIC ACCOUNT

Order HEMIPTERA Linnaeus, 1758

Suborder HETEROPTERA Latreille, 1810

Superfamily LYGAEOIDEA Schilling, 1829

Family LYGAEIDAE Schilling, 1829

***Lygaeus kalmi* Stal, 1874**

1874. *Lygaeus kalmi* Stal *Enumeratio Hemipterorum* pt. 12(1):1-186

1893. *Lygaeus kalmii melanodermus* Montandon, *Ann. Soc. Ent. Belg*

Material examined: Uttarakhand, Chamoli (Lat. 30.70375 Long. 79.59657 Elev. 3510 m), 1ex. 9.vi.2017, Coll. S.K. Sajan & Party.

Diagnosis: Body argentine to black body with a broad orange or red band on the forewing that forms an "X" shape that does not meet in the middle; pronotum with a red transverse band framed anteriorly by two black semi-circular lobes and antecedently by two black spots; membranous portion of the forewing in eastern samples all black, antenna black, legs, trochentor and coxa blackin colour; membrane brownish black

Distribution*:* India: Uttarakhand. Elsewhere: North America, and West Indies.

Acknowledgements

The authors are grateful to the Director, Zoological Survey of India, Kolkata, for providing the necessary facilities for the study. Thanks are also due to officer in charge, Zoological Survey of India, Central zone regional center, Jabalpur, Madhya Pradesh.

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***Lygaeus kalmi* Stal, 1874**

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Short Communication

TARNISHED PLANT BUG (TPB) Lygus lineolaris (Palisot de Beauvois, 1818) (HEMIPTERA: HETEROPTERA: LYGAEIDAE) FIRST TIME FROM INDIA

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Having the unique and most diverse ecosystem of Indian Himalayas western Himalayan region is a mega hot spot of rich insect biodiversity, due to high elevation and specific habitat this region comprises unique mega biodiversity of India (Chandra *et al*, 2018), Chamoli district of Uttarakhand state formally Uttar Pradesh comes under the West Himalayan region (2B: Biotic province) comprises with moist deciduous tropical and subtropical pine forest cover.

Nomenclature and The taxonomic history of TPB are very unpredictable. Palisot de Beauvois,1818 described TPB as *Capsus lineolaris* in 1818, after that Say in 1832 redescribed as *Lygus oblineatus*. TPB was determined like a major pest by Harris in 1841, he named it *Phytocoris lineolaris*; *Lygus lineolaris* first valid name was given by Uhler, 1872. Provancher in 1872 and Walker, 1873 named TPB as *Capsus flavonatus*. In 1886 it was synonymies by Uhler as *Lygus lineolaris* and *Lygus oblineatus* in association of pest of European plant; Knight in 1917 divided *Lygus lineolaris* in two subspecies from Northern America *L. pratensis* and *L. pratensis*. Slater and Davis in 1952 renamed TPB present accepted name *Lygus lineolaris*.

This is a new addition to Indian fauna and True Bugs of India. The new distribution record from Neo-tropical to Oriental region shows the long range extension of the species.Earlier work on Hemiptera of Indian Himalayas was done by Chandra and Kushwaha, 2013; Chandra and Kushwaha, 2017 and Chandra *et al*., 2018)

SYSTEMATIC ACCOUNT

Order HEMIPTERA Linnaeus, 1758

Suborder HETEROPTERA Latreille, 1810

Superfamily LYGAEOIDEA Schilling, 1829

Family LYGAEIDAE Schilling, 1829

***Lygus lineolaris* (Palisot de Beauvois, 1818)**

1818. *Capsus lineolaris* Palisot de Beauvois, 187.

1959. *Lygus lineolaris* Carvalho, *Cat*, : 150.

Material examined: Uttarakhand, Chamoli (Lat. 30.70375 Long. 79.59657 Elev. 3510 m), 1ex. 9.vi.2017, Coll. S.K. Sajan & Party.

Diagnosis: Body argentine to black body with a broad orange or red band on the forewing that forms an "X" shape that does not meet in the middle; pronotum with a red transverse band framed

anteriorly by two black semi-circular lobes and antecedently by two black spots; membranous portion of the forewing in eastern samples all black, antenna black, legs, trochentor and coxa blackin colour; membrane brownish black

Distribution*:* India: India: Uttarakhand. Elsewhere: Canada, and USA.

Acknowledgements

The authors are grateful to the Director, Zoological Survey of India, Kolkata, for providing the necessary facilities for the study. Thanks are also due to officer in charge, Zoological Survey of India, Central zone regional center, Jabalpur, Madhya Pradesh.

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Lygus lineolaris **(Palisot de Beauvois, 1818)**

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Short Communication

FIRST RECORD OF ODONTOPUS SCUTELLARIS WALKER, 1872 (INSECTA:HEMIPTERA: PYRRHOCORIDAE) FROM CENTRAL INDIA

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Ken Ghariyal WLS is situated in Chhatarpur district of Madhya Pradesh of central India. A survey was done in the above protected area by the team of the Zoological Survey of India, Jabalpur under the programe of Panna biosphere reserve. A colony of *Odontopus* Laporte 1832 collected.

Odontopus Laporte 1832 members of the family Pyrrhocoridae are very common pests to the plants of the family Malvaceae and Sterculiaceae. In 1904, Kirkaldy Probergrothius name replaced *Odontopus* Laporte 1832, due to this name resembling the genus Coleoptera described by Siebermann. priority of this genus described by (Alluaud, 1889). (Kirkaldy, 1905, and Distant, 1919) recognized that the name *Odontopus* was not a question of law. Hesse was the only taxonomist (1925) who accepted the new name (Robertson, 2004).

Odontopus scutellaris Walker, 1872 a high altitude genera, recorded first time from the central India, it was collected from the Chhatarpur district (Bundelkhand region), it is first record to the state of Madhya Pradesh.

Genus *Odontopus* Laporte 1832

1832. *Odontopus* Laporte, *Ess. Jlem*.,: 37.

Type species: *Odontopus sexpunctatus* Laporte 1832.

Country of origin of type species: Senegal

Type depository: Not known

Synonyms: *Probergrothius* Kirkaldy 1904

***Odontopus scutellaris* Walker, 1872**

1872. *Odontopus scutellaris* Walker., *Cat het*. V: 178.

Material examined: ex 20, Ken Ghariyal Wildlife sanctuary, District: Chhatarpur, Date: 06.11.2022; Coll. Sanjay Paunikar and Party.

Diagnosis Character: The bug was oval and had a bloody red color. The prothorax contains a transverse dip in center and a concave black narrow depression, and its scutellum is black except for the apex. Its corium and membrane both are black. Antennal first segment is dark red, however, the subsequent three segments are black. All segmental lines and the mesosternum disc are ventrally sanguineous. Head: rectangular, with a noticeable and prominent central lobe greater than the lateral lobes, and robust antennae bearing tubercles positioned laterally in ahead of the eyes. Rostrum reaching up-to the beyond bottom of the coxae.

Thorax: broad base, narrowed anteriorly, gently sinuating lateral margin; an insufficiently long longitudinal sulcus separating the anterior and posterior lobes from the edge; The curving sulcus of the collar likewise terminates before reaching the lateral margin, leaving a small, cyclical depression behind and without any holes in the pronotum or skull. Scutellum black, with a slightly convex centre and a deep horizontal groove at its base. All tibiae have bristle-like black setae, the front femora has many sub-apical teeth, and all legs are sanguineous. It has two black spots in the corium without punctures in the hemelytra, clavus, and corium, one in front of the inner angle and the other in front of the outer angle. Large cells at the base and numerous transverse lines in the distal half characterize this black membrane.

Distribution: India: North Bengal, and Madhya Pradesh.

***Odontopus scutellaris* Walker, 1872**

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The authors are grateful to the Director, Zoological Survey of India, Kolkata, for providing the necessary facilities for the study. Thanks are also due to officer in charge, Zoological Survey of India, Central zone regional center, Jabalpur, Madhya Pradesh.

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