Arts & Commerce College, Warwat Bakal
Tq. Sangrampur Dist. Buldana

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POST-HARVEST LOSS IN MAIZE DUE TO HEAVY RAIN

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Abstract

Maize is one of major crop in India. India rank at 7th position across the globe in maize production. It is utilize in various packaging food preparation, major source of cattle feed. In India maize is primarily used in poultry farms, as a source of feed. In rural parts of the country it is directly consume by the people as food. In India cereal grains get infected by the attack of various pathogens which reduce the vigor of the seeds. This is happen due to improper handling, storage, packaging and transport. During a post-harvest period, seeds were not stored in proper aerated chambers. In certain cases moisture content were not reduced which leads to the attack of various fungal infestation. In the present study, field survey of rain affected area from Bhokardan tehsil was carried out and infected samples were collected and analyze by inoculating the samples on artificial medium. A total number of 16 fungal species were isolated from the infected samples. Fungal genus like Aspergillus, Penicillium, Fusarium, Cladosporium, Curvularia and Rhizopus were predominantly found on the maize infected samples.

Keywords: - Maize, Fungi, Post-harvest, Loss

Introduction:

Maize (Zea mays) is very much versatile crop produced in the world; because of its cultivation, adaptability and uses, it is cultivated all over the world. It is second most widely grown crop in the world. Most of the part it is cultivated as a staple food. Animal feed and as a raw material for variety of industrial products. The major significance lies in its adaptability to diverse climates, high yield potential and nutritional value. Because of its cold-intolerant in the temperate zone it must be planted in the spring. Despite of its tremendous uses as a staple food animal feed and as a raw material for various industrial products, its yield was hampering by the attack of various diseases.

Fungal diseases and fungal invasion on maize is a severe constraint in maize production. It is susceptible to a large number of fungal, bacterial and viral plant diseases. That economic importance includes corn smut, ear rot, corn leaf blight, sheath blight and stock rot. Some fungal attack leads to produce potentially dangerous mycotoxins such as aflatoxin. Post harvested practices are very much important in maize because many mouldy fungi attack on maize grains at the time of harvesting and post harvesting. Swal et al, 2019 reported almost half of the produced maize grain loss in post-harvest in sub-saharan Africa due to infestation of pests, microbes and different filamentous fungi. Drying and proper aeration is very much important to prevent or reduce the attack of these mould fungi which contaminate the grain with mycotoxins. *Aspergillus* species *Penicillium* and *Fusarium* species are the most common mycotoxin sources. In an improper post harvesting conditions fungi like *Fusarium, Aspergillus*, *Rhizoctonia, Penicillium* and *Cathartus* were reported from maize grain (Lamboni and Hell, 2009). *Fusarium* and *Aspergillus* species is a primary source of mycotoxins. Silages are an effective technique to prevent the attack of these filamentous fungi. After the attack of this fungi the feed may get degraded which constitutes a loss in dry matter and can reduces palatability of the feed; which may be endanger the health of livestock (Storm, I.M.L.D., 2009). Poor pre-harvest practices and post harvested storage practices are a major cause of the contamination of maize by *Fusarium verticilliodes* and fumonisins. The proliferation of this field fungal pathogens and accumulation of its mycotoxins in post-harvested maize, caused by such improper practices (Tran et al, 2021).

Materials and methods:

Field Study:-

In the present study local area of Bhokardan tehsil of Jalna district were studied. During the September- October 2022, many villages from Bhokardan tehsil face a heavy rain. Most of the maize crop is at harvesting stage in that area. Field survey of rain affected area was done in the month of September- October 2022.

Collection of Sample:-

Infected samples of maize were collected in the polythene zip lock bags. Samples were collected from different fields and from different localities and brought into the laboratory for further study.

Isolation of Fungi:-

The infected samples were inoculated on PDA (Potato Dextrose Agar) medium and CZA (Czepekdox Agar medium) in aseptic condition. Inoculated plates were kept for incubation at 25+_ 2^0C for 4-5 days.

Preparation of Potato Dextrose Agar Medium:-

Potato	-	100 gm
Dextrose	-	20 gm
Agar agar	-	20 gm
Distilled Water	-	1000 ml

Pure culture:-

The individual fungal members were subculture on fresh petriplate containing PDA as a nutrient medium from the primary isolates. The Pure culture is also transfer on slants, to keep the cultures.

Identification of Fungi:-

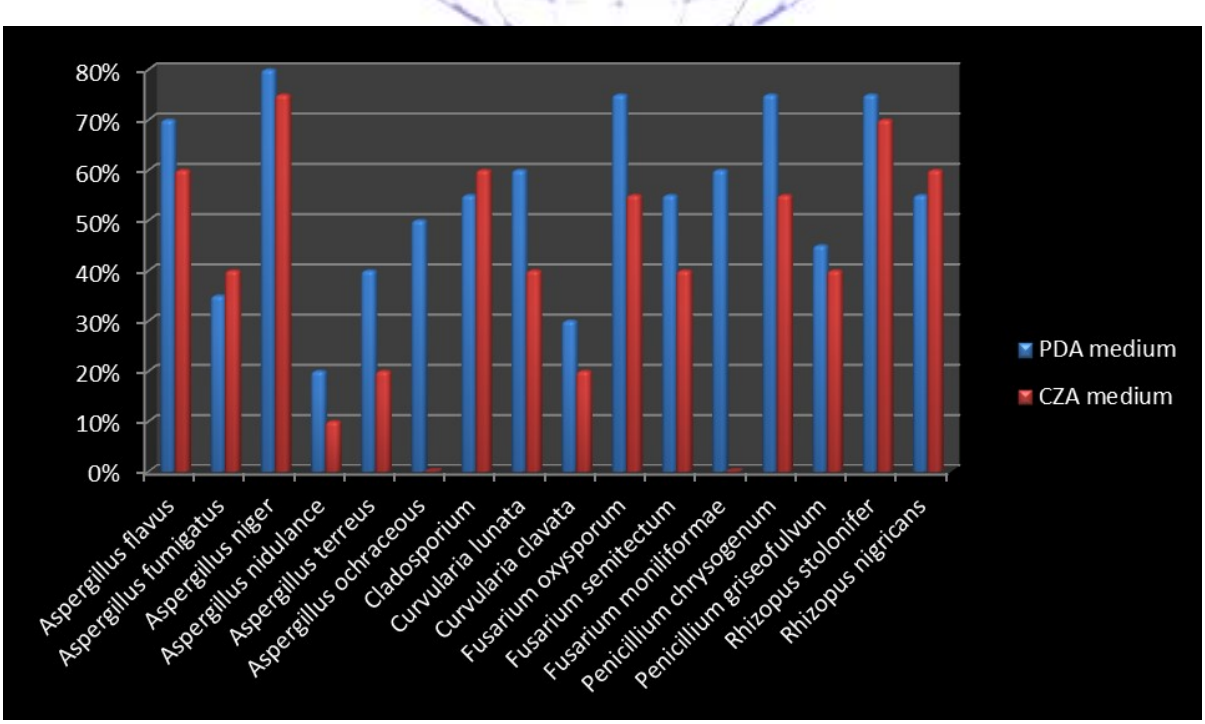
Fungi were identified by using microscopic observations of the fungi under microscope. By using standard manuals, literature, monographs individual fungi were identified in the Botany laboratory of Arts, Commerce College, Warwat Bakal.

Result and Discussion:

Infected samples were inoculated on PDA (Potato dextrose agar) and CZA (Czepekdox agar) medium, various fungi shows their presence on both the medium (Table 01). *Aspergillus niger* (80 %) shows highest percentage of incidence on PDA medium followed by *Fusarium oxysporum* (75 %) and *Penicillium chrysogenum* (75 %). While *Aspegillus niger* (75%) shows highest percentage of incidence on CZA medium followed by *Rhizopus stolonifer* (70%), *Rhizopus nigricans* (60%) and *Aspergillus flavus* (60%). *Aspergillus niger* shows their dominancy on both the medium as compare to other fungi. Lamboni and Hell (2009) reported the dominance of *Fusarium* (36.05%) on maize grain followed by *Penicillium* (23.50%) and *Rhizoctonia* (5.65%). *Penicillium roqueforti, Aspergillus fumigatus, Geotrichum candidum* and *Fusarium* species were reported by (Storm IMLD, 2009) from stored maize grains. Fungal species like *Fusarium, Penicillium* and *Aspergillus* were predominantly reported from post harvested maize seed by (Garbaba et al, 2018). PDA medium prove to be a good medium for the isolation of maximum number of fungal isolates from maize. Attack of fungal species on maize not only reduces the yield, it also reduces the vigor of maize. Infected samples of maize smell pungent, which indicate the quality of material. It is due to accumulation of mycotoxins in infected parts and biodeterioration of the seeds due to the infestations of several fungal members. Proliferation of *Fusarium verticilliodes* and deposition of Fumonisins in post harvested maize seed were observed by (Tran et al, 2021). Texture of the maize seeds turns black, whitish to bluish in color instead on yellow orange.

Table 01: Percent incidence of fungi on infected samples of maize

Sr. No.	Name of Fungi	Percent incidence of fungi	
		PDA medium	CZA medium
1	*Aspergillus flavus*	70%	60%
2	*Aspergillus fumigatus*	35%	40%
3	*Aspergillus niger*	80%	75%
4	*Aspergillus nidulance*	20%	10%
5	*Aspergillus terreus*	40%	20%
6	*Aspergillus ochraceous*	50%	-
7	*Cladosporium*	55%	60%
8	*Curvularia lunata*	60%	40%
9	*Curvularia clavata*	30%	20%
10	*Fusarium oxysporum*	75%	55%
11	*Fusarium semitectum*	55%	40%
12	*Fusarium moniliformae*	60%	-
13	*Penicillium chrysogenum*	75%	55%
14	*Penicillium griseofulvum*	45%	40%
15	*Rhizopus stolonifer*	75%	70%
16	*Rhizopus nigricans*	55%	60%



Conclusion:

From the results it is concluded that, Maize crop is severely hampered by heavy rain during the monsoon season. Most of the crop got destroyed by the attack of various fungal pathogens. Disease intensity was quite high due to which accumulation of mycotoxin may be possible in the infected samples. Such samples were not safe for the consumption as well as cattle feed and also not used in poultry farms.

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Discoloration Of Head In Sorghum Due To Curvularia Lunata

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FULL PAPER

Introduction:

Sorghum is an important staple food crop of Vidarbha region; it is cultivated on very large area in Vidarbha region as a cereal as well as forage crop. Sorghum is rich in carbohydrate content, as it required less amount of irrigation and other artificial nutrients; it prove to be an good alternative for wheat and rice. At the time of flowering to physiological maturity when it get a higher moisture content in the field, various fungi start to attack and grow on the head of sorghum. Due to attack of such fungi on sorghum head, it gets infected. As compare to other pathogens associated with the head of sorghum *Curvularia* species shows their dominance. More than 19 different species of *Curvularia* were reported on infected head of sorghum (Girish et al, 2011). *C. clavata, C. cymbopogonis, C. eragrostidis, C. geniculata, C. inaequalis, C. intermedia, C. ischami, C. lunata, C. oryzae, C. ovoidea, C. pallescens, C. penniseti, C. robusta, C. senegalensis, C. siddiquii, C. sorghina, C. trifolii, C. tuberculata* and *C. verruculosa* were associated with the sorghum head. Out of which *Curvularia lunata* was most dominating. Along with the Curvularia lunata, genus like *Aspergillus, Fusarium, Cladosporium, Epicoccum, ALternaria, Phoma* and *Cylindricarpons* species also reported from grain mold complex of sorghum (Kebede et al, 2023).

Sorghum seeds infected from *Curvularia lunata* shows blackish mycelial mat present on the surface of seeds, which is loosely attached to the surface. Due to such blackish mat associated with seed surface it lead to discoloration of the seeds (Rastogi et al, 1990). This reduces the quality of seeds. Histopathological study reveals that *Curvularia lunata* infects the pericarp and aleurone layer of seeds. Due to the infection of *Curvularia lunata* to sorghum seeds reduces the germination percentage and also increases the grain mold severity (Prom et al, 2003). Seed germination was hampered

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due to the infection of *Curvularia lunata*. Grain mold disease formation and its occurrence is totally depends on the differential developmental stages of sorghum plant. Wetness duration is also responsible for the attack of pathogens. Different pathogens attack on sorghum at various developmental stages. *Curvularia lunata* shows their first appearance at the stage of flowering and it shows their maximum incidence at the time of physiological maturity of sorghum (Navi et al, 2005). Sporulation in the *Curvularia lunata* and grain mold severity due to *Curvularia lunata* drastically get increased due to increase in the relative humidity and increase in the temperature (Tonapi et al, 2007). Temperature ranges from 25^0C to 28^0C increases the sporulation in *Curvularia lunata*.

Materials and Methods:-

Collection of samples:-

Samples of sorghum head were collected from different localities of Buldana district of Maharashtra. Infected samples were collected from flowering to physiological maturity stage. Collected samples were packed in zip lock bags and bringing to laboratories for further analysis.

Isolation of Pathogens:-

Pathogens associated with the sorghum head was isolated by Agar plate method (APM) and standard blotter method (SBM).

Standard Blotter paper method:-

A pair of white blotter paper was taken and jointly soaked in sterile distilled water. Pair of soaked blotter paper were placed on sterile petri dishes, and make a chamber. 5 seeds in each plate were placed in aseptic conditions. Inoculated plates were allowed to incubate for 4-5 days at room temperature.

Agar plate method:-

Potato dextrose agar (PDA) medium were prepared and poured in sterilized petri plates, allowed to solidify. 5 seeds of infected head were inoculated on each plate and plates were incubated for 4-5 days at room temperature.

Composition of PDA (Potato dextrose agar) medium:-

Peeled potato – 100gm, Dextrose 20g, Agar 20 gm and distilled water 1000ml, pH 5.6. 100 gram of potato were taken and peeled; boiled until get soft and squeeze through muslin cloth. Then dextrose was added in it and final volume of solution was made up to 1000ml. In this solution agar was added, pH was adjusted to 5.6.

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Identification of Pathogens:-

Microscopic observations were taken by preparing microscopic slides for each isolates. Pathogens were identified with the help of standard literature and monographs.

Experimental results:-

Head samples of sorghum were collected from tehsil of Buldana district. All the infected samples were subjected to visual analysis. On the basis of visual symptoms appeared on the surface of seeds, seeds were categorized in different grades. All such seeds were used for the isolation of pathogens. Isolation of pathogens was done by standard blotter method and agar plate method. Out of 80 samples collected from different localities of Buldana district, 73 samples were infected by the attack of *Curvularia lunata*. As compare to other pathogens associated with this moldy samples *Curvularia lunata* prove to be dominating. Similar type of results was reported by (Girish et al, 2011). They reported more than 19 different *Curvularia* species associated with infected sorghum head. Out of which *Curvularia lunata* were more dominating, having 39% of incidence as compare to other species.

Table: - Incidence of Curvularia lunata on sorghum seeds at various developmental stages

Sr. No.	Name of Tehsil	Percent Incidence of *Curvularia lunata*	
		Flowering stage	Physiological maturity
1	Motala	20%	86%
2	Buldana	23%	94%
3	Malkapur	20%	91.5%
4	Nandura	18%	92%
5	Jalgaon Jamod	24%	89%
6	Sangrampur	21%	93%
7	Chikhali	24%	85.5%
8	Shegaon	23%	92.5%
9	Khamgaon	20%	90.5%

Samples collected at the time of flowering shows 22% incidence of *Curvularia lunata*. While samples collected at the time of physiological maturity shows 91.25 % of incidence of *Curvularia lunata*. Maximum incidence was recorded at the time of physiological maturity of plant. Samples collected from Jalgaon Jamod at the time of

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flowering stage shows highest incidence of *Curvularia lunata* (24%). While sample collected from Buldana at the time of physiological maturity shows highest incidence of *Curvularia lunata* (94%). Similar type of reports was given by (Navi et al, 2005). They show the maximum incidence of *Curvularia lunata* were observed at the physiological maturity stage. Out of all the samples collected from different localities, seed samples having black net like structure associated with them have maximum incidence of *Curvularia lunata* as compare to other pathogens. Blackish discoloration of sorghum seeds due to the attack of *Curvularia lunata* were reported by (Rastogi et al, 1990). They reported a black coloured macelial net like structure were loosely attached with the sorghum seeds. At the time of physiological maturity of sorghum plant, whenever it get a higher moisture content, *Curvularia lunata* attack on such sorghum head and causes disease. Due to its accumulation at the time of physiological maturity to harvesting, it may secrete certain toxic metabolites in seeds. Which may be reduces the quality and quantity of sorghum seeds.

Conclusions:-

From the results and observations it is concluded that *Curvularia lunata* is a serious constraint of sorghum. It attack on sorghum and responsible for the loss in yield. From visual observations, it reduces the quality and vigor of sorghum. As sorghum grains contain blackish mat along with them it is not good for human consumption. Due to continuous accumulation of *Curvularia lunata* on sorghum grain may lead to the deposition of certain harmful toxic metabolites in sorghum grain. For this reason it is recommended that such infected sorghum seeds were not good for the dietary purposes.

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ISOLATION OF CURVULARIA LUNATA FROM SORGHUM AND EVALUTION OF ANTAGONISTIC POTENTIAL AGAINST TRICHODERMA HARZIANUM

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Abstract :-

Curvularialunata is one of the fungal pathogens who cause diseases to crop plants. It is responsible for the qualitative and quantitative reduction in the yield of crop. It also reduces the vigour and texture of the grains. Due to its infection and continuous accumulation over a crop plant it may secrete certain mycotoxins in the seeds.Curvularialunata were one of the members of fungi who are responsible for cause of grain mold disease in sorghum. It attack on the sorghum head and destroy its vigour and quality of grains.Present investigation concern with the control of harmful pathogenic fungi Curvularialunatafrom destroying the crops. In this study fungiTrichodermaherzianum were tested against the plant pathogenic fungi Curvularialunata. Trichodermaherzianumshows the antagonistic activity against Curvularialunata and retards its growth. After some days of infection Trichodermaherzianum completely digest the mycelium and spores of Curvularialunata. Minimizes its impact on crop plant and help in the retention of crop yield. This study shows significant reduction in the growth of Curvularialunata due to the activity of Trichodermaharzianum.

Keywords: -*Trichodermaharzianum, Curvularialunata*, antagonistic activity, plant pathogen

Introduction:-

Curvularialunata is a member of grain mold associated fungi. It is responsible for the qualitative and quantitative reduction in the yield of Sorghum. Total yield of sorghum is reducing by grain mold associated fungi as compare to other infections. *Curvularia* majorly responsible for the loss in seed viability and seed vigour. On infected seed samples ofsorghum, more than 19 different species of *Curvularia* were reported in Marathwada region of Maharashtra (Girish et al, 2011). Out of which *Curvularialunata* shows their dominance over other species; in all the infected samples collected from different localities. Hybrid sorghum varieties were more susceptible to grain mold infection as compare to other species. While in Rajasthan,*Curvularialunata* were reported on 151 samples out of 161 samples collected and isolated. Total percent if incidence of *Curvularialunata* were 93.78% as compared to other fungal incidence(Rastogi et al, 1990). Visual symptoms were observed on sorghum seeds in the form of

black discoloration and mycelial net present over seed.

Seed germination and seed viability also reduced due the impact of *Curvularialunata* in sorghum. In artificial infestation of *Curvularialunata* on different sorghumcultivers reduces the germination percentage (Prom et al, 2003).Colonies on grain appears as gray, brown or black hairy, cottony cushion like loosely attached mat present on the periphery of seeds. It is primary identification on the basis of visual appearance (Navi et al, 1999).While hybrid sorghum cultivers also shows the infection of *Curvularialunata* in Marathwada region of Maharashtra (Panchal and Dhale, 2011). Infection of *Curvularialunata* to sorghum was prominent at physiological maturity as compare to other developmental stages. At the flowering and milky stage the intensity of *Curvularial* infection was quite low (Navi et al, 2005). At the time of Physiological maturity when the moist conditions were appeared maximum infection were recorded in grain sorghum.

Different techniques were implemented for the control of fungal pathogens from attacking the crop. Integrated pest management, Leaf extract of various plants, Chemical pesticides, fungicides and use of antagonistic individuals are the major once. Use of Antagonistic organism is one of the best methods used for the control of fungal attacks. Because it is biocontrol method and have no any adverse impact on crop health. As well as it is cost effective, any sorghum cultivar can use it.*Trichoderma* reduces the growth of *Curvularialunata*, They showed the greatest inhibition in mycelial growth of *Curvularialunata*. 74.11–95.78% of inhibition against the *Curvularialunata* was recorded in dual culture technique (Klaram et al, 2022). The fungal invagination of *Curvularialunata* was control by the application of *Trichodermaharzianum* were also reported from United States of America. *Trichodermaharzianum* proved to be a good biological control agent against *Curvularialunata* (Alfiky and Weisskopf, 2021).*Trichodermal*application for the control of *Curvularialunata* is well known. It hampers the growth of mycelium of *Curvularialunata* and shows 45 % of inhibition (Sen et al, 2023).

Materials and methods:-

Collection of samples: -

Infected samples of sorghum panicles were collected from local fields of Sangrampur tehsil of Buldana district (Maharashtra) with the help of cutters and packed in ziplock bags. Samples were collected from different localities of Sangrampur tehsil and at different time interval. Collected samples were bringing into laboratory for further studies.

Preparation of media: -

For the isolation of pathogen PDA (potato dextrose media) were used. 100 gm potato was peeled out and weigh accurately with the help of weighing balance. Latter on potatoes were chopped into small pieces and boiled into distilled water. Boiled potatoes were squeezed with the help of muscling cloth and extract were taken into a conical flask. 20 gm dextrose was dissolved into distilled water in aseparate beaker. Simultaneously in another beaker 20 gm of agar agar were

dissolved in warm distilled water. Mix all the ingredients in one beaker pH were adjusted with the help of pH meter and final volume were made upto 1000 ml by adding distilled water. Sterilize the media and glassware; sterile media were poured in the petridishes.

Composition of media:-

Potato - 100 gm
Dextrose - 20 gm
Agar -agar - 20 gm
Antibiotics - pinch
D/W - 1000 ml

Isolation of *Curvularialunata*:-

Curvularialunata were isolated from the infected samples of sorghum panicles. Infected grains were taken from the head of sorghum, and inoculated on pre-sterilized petriplates containing agar medium in aseptic conditions. Incubate the plates for one week at 25 + 2^0C. Individual colonies were subculture on another petriplate and pure culture was obtained.

Identification of Pathogens:-

Identification of pathogens associated with infected grains of sorghum were carried out with the help of colony characters, growth pattern of fungi, texture of colonies, pigmentation pattern and microscopic examinations of the fungal culture with the help of binocular microscope. Confirmation of the pathogens was done by using scientific literature and manuals.

Isolation of *Trichodermaharzianum*:-

Trichodermaharzianum were isolated from the soil samples of crop fields. Soil samples were collected and brought to laboratories; Weigh 1 gram of soil sample and serial dilutions were made with the help of saline solution. Soil samples were inoculated on petriplates containing agar medium in aseptic conditions by spread plate technique. Plates were incubated at room temperature for 4-5 days; individual colonies were separate out by subculture technique. Identification of *Trichodermaharzianum*was done with the help of colony characters, microscopic observations and using monographs.

Antagonistic activity of *Trichodermaharzianum* against *Curvularialunata*:-

Antagonistic assay was performed by dual culture technique. Fresh culture of *Curvularialunata* was inoculated on four corners of petriplates containing PDA (Potato dextrose Agar) medium. *Trichodermaharzianum* culture was inoculated at the center of plate and allows incubating at room temperature.

Experimental Results:-

Antagonistic potential of *Trichodermaharzianum* were tested against *Curvularialunata* by dual culture technique and the observations were taken. From the results it is observed that *Trichodermaharzianum* attack on the mycelium of *Curvularialunata* and restricts their growth.

Mycelium of *Trichodermaharzianum* enters into the mycelium of *Curvularialunata* and absorbs the sap including all the nutrient present in them through haustoria. As a result the growth of mycelial structure of *Curvularialunata* gets restricted and in certain cases gets illuminated. In the present investigation the growth of *Curvularialunata* were arrested by the activity of *Trichodermaharzianum*.It shows 55.5% of inhibition against *Curvularialunata*.The growth of *Curvularialunata* was arrested by the activity of *Trichodermaharzianum* were reported by (Klaram et al, 2022). They showed *Trichodermaharzianum* reduces the growth of mycelium of *Curvularialunata* and shows 95.78% of inhibition. While similar type of results was shown by (Sen et al. 2023). They reported 45% of inhibition by *Trichoderma* against the growth of *Curvularialunata.*

Table: -Antagonistic activity of *Trichodermaharzianum* against *Curvularialunata*

Name of fungi	Control	Treated	% of Inhibition
Curvularialunata	5.8	2.8	55.5 %

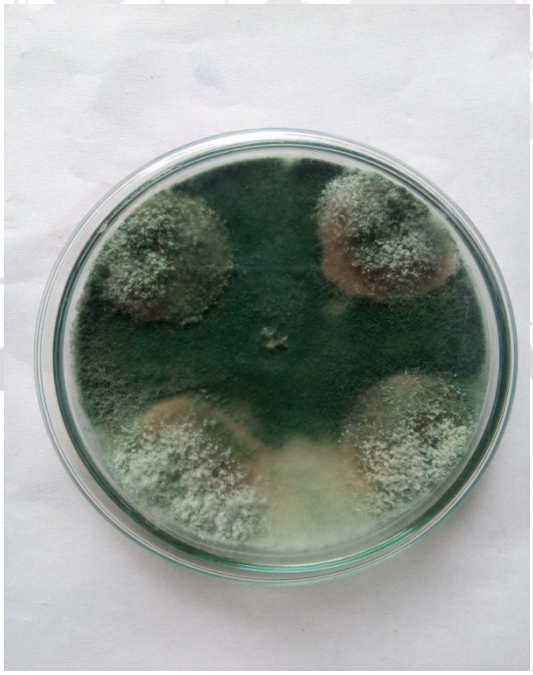

Fig: Antagonistic activity of *Trichodermaharzianum* against *Curvularialunata* by dual culture technique

Conclusions:-

From the results and observations it is concluded that, *Trichodermaharzianum* retards the growth of *Curvularialunata*. It helps the farmer to minimize the infection of pathogens on sorghum. *Trichodermaharzianum* shows such an antagonistic activity against *Curvularialunata* due to presence of certain diffusible substances present in them. It is then strongly recommended for the farmers to use them as a biocontrol agent. It is a cost effective as well as doesn't have any

adverse impact on the health of crop plant and human being.

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