CHAPTERONE

INTRODUCTION

Potato (*solanum tubersumL*) is one of the most important high nutritive values grown in the world. It comes in the forefront of tuber crops the fourth position after wheat, sorghum, andrice, as an edible and consumed crop in world. The majority of potato production comes from industrial countries; china, Russia,India, and united states of America with production72,63,23 and 20 million tons/annum,respectively(fao,2007). Egypt is the leading Arab countries in terms of potato production producing about 3.16 million tons/annum followed bay Algeria (2.18million tons) and Morocco (1.6million tons).Sudan occupies the seventh position with annual production of 0.4 million tons (Ombadadi, 2015).

InSudan, they are around Khartoum the capital of the Sudan, benefits from rich water resources (including the Nile and tributaries) and the fertile cultivable land along the Riverbanks is available natural resources, the land suitable for cultivation accounts for about750.000 of which 11 percent is allocated to urban and sericulture. In Jubal Mara, in the western part of the country, is reported to be the second most important potato production is Sudan. The gash delta area in Kassala province is often mentioned a zone of high potential for potato production, though figures on actual production in the area lacking (Elsir,2005).The potato plays a strong role in developing countries with its ability to provide nutrition food for the poor and hunger. The demand for potato is growing as both a fresh and processed food. The decreasing availability of land for area explosion means that yields well have to be improved. Critical to achieving improved tuber yields well be access to an adequate water supple, including more efficient used of scarce water and costly fertilizerinputs. Potato is grown in about 100 countries under temperate subtropical and tropical condition. (AOAD, 2006) the potato is a crop of temperate climates. Yield is affected significantly by temperature and optimum mean daily temperatures are 18 to 20^0C. In general a night temperature of below 15^0C is required for tuber initiation. Optimum soil temperature for normal tuber growth is 15 to 18C. Tuber growth is sharply inhibited when below 10C and above 30^0C. Improved varieties include Russet Burbank, Desiree Yukon Gold and Nicola among others. Potato requires a well drained well aerated porous soil with PH of 5 to 6. Compacted soils affect root penetration, water and nutrient uptake and tuber enlargement. *Fusarium solani*emeriti can persist in the soil for several years. The spores and the mycelium are carried into the soil on tools and in bean straw manure. They may also be splashed by rain or carried by floods. The chlamydospores are the survive structure in the absence of a host plant (Mohammad, 2016).

Promising disease management approach with following objectives:

- To isolate and identify the causal agents of wilt disease (*Fusarium solani*) in potato.
- To assess the effect of *Trichoderma harzanium*in on the growth of *Fusarium solani* in potato.

CHAPTER TWO
LITERATURE REVIEW

2.1.1 Potato Plant:

Potato (*Solanum Tuberosum L*) is a starchy, tuberous crop from the perennial nightshade *S.tubersum*. The world potato may refer either to the plant itself or the edible tuber. In the Indies, where the species in indigenous, there are some other closely related cultivatedpotato species isindigenous, there are some other closely related potato species. Potatoes were introduced outside the Andes region approximately four centuries ago, and have since become an integral part of much of the world; s food supply .it is the world, s fourth largest food crop, following maize, wheat, and rice. Wild potato species occur throughout the Americas from the United States to southern Chile. The potato was originally believed to have been domesticated independently in multiple locations, but later genetic testing of the wide variety of cultivars and wild species proved a single origin for potato in the area of present day Southern Peru and extreme Northwestern Bolivia. (From a species in the Solanum brevicaule complex), where theywere domesticated approximately 7,000-10,000 years ago. Following centuries of selective, there are now over a thousand different types of potatoes. Over 99% of the presently cultivated potatoes worldwide descended from varieties that originated n the low lands of south _central Chile, which have displaced formerly popular varieties from the Andean of the 21 century included about 33kg (73Ib) of potato. However the local importance of potato is extremely variable and rapidly changing .It remains and essential crop in Europe (especially central Europe), where per capita production is still the highest in the world, but the most rapid expansion over the past few decades has occurred in southern and eastern Asia .chine now leads the world in potato production, andnearly a third of the world potatoes are harvested in Chine and India (Aida,2015).

Fusarium dry rot is a devastating post-harvest disease affecting both seed potatoes and potatoes for human consumption in fact Fusarium dry rot of potatoes is a worldwide economic problem. There are many species of Fusarium reported to cause dry rot of potato worldwide (Nielson, 1981).The disease may cause greater Losses of potato than any other-post harvest disease. Crop losses attributed to dry rotestimated to an average of 6 to 25% (Powelson *et al*., 1993). Fusarium species thatcause dry rots are also important to the consumer because some, Fusarium thatcause dry rots also product mycotoxins, one of such toxins Trichothecene that is an inhibitor of eukaryotic protein synthesis and can pose series health problem to man and animals (Barmaid*et al*., 1991).There are many species of Fusarium reported to cause dry rot of potato worldwide. *F. solani* reported as the most pathogenic Fusarium species causing dry rot(Sharifi*et al.,* 2009).Fusarium is a large genus of filamentous fungi widely distributed soil and in association with plants. Most species are harmless saprobes and are relatively abundant members of the soil microbial comanuitly. Some species produce mycrotoxins in cereal crops that can affect human and animals health toxins produced these Fusarium species are Famonisins and Trichothecenes (Howard, 2003).

2.1.2Classification:

Kingdom: planate

Phylum : Asterides

Order : Solanales

Family : Solanaceae

Genus : Solanum

Species : Tuberosum

Scientific Name:*Solanum Tuberosum*

2.1.3 Economic importance:

The potato is a starchy tuberous crop from the perennial (*Solanum Tuberosum)*of the Solanaceas family (also known as the nightshades), .The world potato may refer to the plant itself as well as the edible tuber. In the region of the Andes there are some other closely related cultivated potato species. Potatoes are the worlds, fourth largest food crop following rice, wheat, and maize. Long term storage of potato requires specialized care in cold warehouses and such warehouses are among the oldest and largest storage facilities for perishable goods in the world. Once established in Europe, the potato son becomes an importance food stable and field crop. The annual diet on of an average global citizen in the first decade of the twenty _first century in clouded about 33kg (or 73Ib) of potato. However the local importance of potato is extremely variable and rapidly changing. It remains an essential crop in Europe where per capita production is still the highest in the world but the most rapid expansion over the past few decades has occurred southern and eastern Asia.Chine is now the words potato producing country and nearly a third of the words potatoes are harvested in china in India. The terms of global production potato (*Solanum Tuberosum*) is the fourth most important food crop aftercorn, rice and wheat. This crop is grown throughout the world. Present world production is some 321 million tans fresh tubers from 19.5 million has Asia and Europe are the world major potato producing regions accounting for more than 80% of world production.

The potato plays a strong role in developing countries whit its ability to provide nutrition food for the poor and hungry. The demand for potato is growing as both fresh and processed food.

The potato is basically a crop of temperate , climates yields are affected significantly by temperature and optimum mean daily temperatures are 18 to 20C in general a night temperature of below 15C is required for tuber initiation. Optimum soil temperature for normal tuber growth is 15 to 18C.

Under turkey and Indian condition drip irrigated potato registered 50 and 42 tons tubers /ha with a net present value (NPV). For high yields, the seasonal crop water requirements for a 70 to 150_days crop were estimated to be 150 to 750mm under arrange of climatic conditions and varying (70_180 days) length of growing seasons with a daily evapotranspiration rate of 4 to 5mm/day.

Its root system is shallow and fibrous, hence fustigation is recommended for higher nutrient availability and use efficiency, the aim of the fustigation program is to caver the difference between crop demand and supply. Other best management practices include ear thing up, protection of crop from pests and diseases need based weed management harvesting and post harvesting operations to minimize losses (Amin, 2015).

2.1.4 Distribution and use:

The production area extends from the temperate zones to the sup_ tropics. Main countries of production are the ex climates are USSR, Poland, china, USA and India. Sandy /loamy soils in cool /temperate preferred. Food stuff cooked for consumption. –raw, material for select products (crisps, chips, and dumpling) production of starch and alcohol, animals feed vegetable products.10-15%starch, 1-5%sugar, 2%protien, 15mg vitamin C / 100g I the taper.

The native potato is South America and was transported t Europe by early Spanish explorers of America during the sixteenth century,And its cultivation remained confined (Google).

2.1.5.diseaese:

2.1.5.1 Fungal disease:

Early blight (*Alternaria solani*) Ell-and mart, Phoma leaf spots (*Phoma sp*) Doran and chest, Late Blight (*Phytophthora intestines*) Mont de Barry, Black scurf (*Rhizoctonia solani .k*), Charcoal rot(*Macrophomina phoseolina*) (Tassi), Black rot (*Colletotrichum coccdes*) (Wallr), Silver scurf(*Helmintosporium solani*) Dora and Mont and Fusarium wilt and dry rot (*Fusarium sp*).

2.1.5.2 Bacteria disease:

Bacterial soft Rot,Bacterial wilts Brown Rot andCommon scab of potato.

2.1.5.3 Viruses disease:

Alfalfa Mosaic Virus, Beet Curly Top Virus, Andean Potato Mottle Virus and Andean Potato Latent Virus.

2.1.6 Area and production:

Potato is growing among the major countries of the world. Chine ranks first in area, followed by Reusingfederation. Ukraine and Poland India ranks fourth in area in the world (FAO STAT 2015). The present area under potato in India about 1,4 million hectares. India produces a total of about 25-28 million tones of potatoes every year and ranks fifth in production also after chine, Russian, federation, Poland and Ukraine. From each hectare of land it produces about 16-19 tones of potatoes. In European and American countries the potato productivity is about 30-40tones per hectare (Mohammad, 2015).

2.1.7Soil:

Potatoes can be grown in alluvial, hill, black, red and lateritic soils having PH in the range of 5,5-8,0 Deep Alluvial soils of indo-Genetic plains with almost neutral soil reaction are the most suitable-maximum area under potato in is in alluvial soils are however. Not congenial for potato production. Soil should be fine, loose and without compacted layers that hinders root penetration and reshapes tuber. (Mohankumar, Nair, 2000). Compacted layers also restrict of water Clods and stones present reduce root contact with soil and also cause deformation of tubers. Well-drained coarse or sandy loam to loamy soils, rich in organic matter are ideal for potato cultivation. Such soils ensure availability of sufficient oxygen for the growth of roots stoles and tubers, retain moisture and are help full in drainage of excess water that allows production. (Mohammed,2016).

2.2.1Fusarium dry rot:

Fusarium is alarge genus of filamentous fungi widely distributed in soil and in association with plants. Most species are harmless saprobes and are relatively abundant members of the soil microbial community. Some species produce mycotoxins in cereal crops the effect human and animal's health if they enter the food chain. The main toxins produced by this Fusarium species are Fumonisins and Trichothesenes (Howard, 2003).

2.2.2 Classification

Kingdom: Fungi

Subkingdom: dikarya

phylum: Ascomycota

Subphylum: pezizomycotin

class: Sordaiomycetes

Order: Hypocrites

Family: Nectraceae

Genus: Fusarium

Species: solani

By (Desjardins, 2006)

2.2.3Biology:

In solid media culture, such as potato dextrose agar (PDA), the different special forms of *F. solani* can have varying appearances. In general, the aerial mycelium first appears white, and then may change to a variety of colors-ranging from violet to dark purple according to the strain (or special) of *F. solani*.If sporodochia are abundant, the culture may appear cream or orange in color (Zaccardelli, *et al***,** .2008).

2.2.4symptoms:

Generally produces symptoms such as wilting, chlorosis, necrosis, premature leaf drop, browning of the vascular system, stunting and damping-of the most important of these is vascular wilt . Fusarium wilt starts out looking like vein clearing in the younger leaves and drooping of the older lower leaves, followed by stunting of the plant. On older plants, symptoms are more distinct between the blossoming and fruit maturation stages (Mohammed, 2015).

2.2.5 Diseases cycle:

The fungus can persist in the soil for several years. The spores and the mycelium are carried into the soil on tools and in bean straw manure. They may also be splashed be rain or carried be floods. The chlamydospores are the survival structure in the absence of a host plant (Cho, ***et.al***2001).

2.2.6Enveronment:

F. solani produce asexual (micro conidia and macro conidia). It is sexual stets is Nectriaheamatococca (Ascomycete), and overwinters as mycelium or spores infected or dead tissues or seed. It can be spread by air, equipment, and water (Vincent and Jean1971).warmer climates are preferred (warton *et al.* 2013). However; different species of Fusarium may be more prevalent in different areas. (Rowe *et al* 2013).the fungus can persist in the soil for several years. The spores and mycelium are carried into the soil tools. They also be splashed by rain or carried by floods. The chlamydospore is the survival structure in the absence of a host plant (Vincent and Jean, 1971).

As previously stated *F. solani* is a common soil saprophyte that infects a wide host range of plant spies around the world. It has the ability to survive in most soil. Arctic, tropical, desert cultivated and nonecultivated. Though Fusarium spp. May be found in many place and environment, development of the diseases is favored by high temperature and worm moist soil. The optimum temperature for growth on artificial media of between 25-30C and the optimum soil temperature for root infection is 30C or above (Salma, 2016).

2.2.8 Importance:

F.solani is so widespread; it is a significant problem in many crops. It is economically damaging to the banana industry, and the threat of move virulent strains or mutation to damage previously resistant crops it of major concern. *F.solani* also causes damage to many crops from the solanaceaefamily, including potato, tomato. Other commercially importance plants affected include basil, beans, carnation and water melon chrysanthemum peas, and watermelon. Woody ornamentals are infected, but usually not killed by Fusarium wilt alone (Dresistadt, *et. al*, 2004).

2.2.9 Morphology:

On potato dextrose agar medium *F.solani* produces sparse to abundant white cream mycelium macro conidia have three to four septa on average, are slightly curved, are rather wide and thick walled and may have slightly blunted apical and micro conidia are abundant oval to kidney shaped and formed in false heads on very long monophialides, clammydopers are abundant (Ombadadi,2015).

2.2 10 Hosts Range:

The fungal pathogen *F. Solani*, emeriti affects a wide variety of hosts at any age. Potato, tobacco, legumes, cucurbits, sweet potatos and banana ate a few of the most susceptible (koenning, 2001)

.2.2.11Management:

There are many ways to manage *F.solani*. Application of thiabendazole also, known as metric was a common and efficacious method used from(1970-1985) Eventually however the pathogen developed resistance to the chemical treatment, and while some people still use thiabendazola it is no longer an effective treatment. Effective chemical control of *F.solani*can be achieved with chemicals like tops. These chemicals protect not only agents dry root but also against other potato diseases like Rhizoctonia, salver scurf, and black rot , these chemicals treatment can delay emergence of the young plants but this doesn't mean these chemicals shouldn't be used many fungicides cut into seed pieces (Schwartz,2015). One of the control methods is to improve soil condition because *Fusarium spp.* spreadfaster through soils that have high moisture and bad drainage. Other control methods include planting resistant varieties removing infected plant tissue to prevent over win (Smith, *et.al.* 1988).

2.2.11.1Cultural Practices:

Cultural practices can also limit the spread of dry root. Plant high quality seed free from Fusarium dry root pathogens into soils without a history of Fusarium dry rot. Varieties vary in their reaction to dry rot, and highly susceptible varieties should be avoided. Harvest tubers at least 14 day after vine kill to promote good skin set and reduce skinning injury that can increase storage dry rot Avoid harvesting cold tubers that are more susceptible to injure provide condition that promote rapid wound healing early in storage, including high humidity, good aeration, and temperatures of 55to 64;Ffor 14 to 21 days. Since Fusarium dry rot increase with length in storage, short-term storage is advisable for fields where severe infection is expected (Howard *et al.*, 2005).

2.2.11.2 Soil Solarization:

Soil disinfestations by soil solarization method at warm season was scattered out for the relative control of Fusarium pathogens, the main crops cultivated areas, in northwest Iran. In soil solarization method infested soil was thoroughly plowed to destroy all large clods and remove any existing materials. The soil was irrigated deeply since it was a very importance step in the process for increasing transmission of heat through the soil. Then, the moistened soil was covered with transparent polyethylene sheet to raise soil temperatures high enough more than 10^{0}c above air temperature (Kumar *et al.*, 2002).The method come out to be a successful practices to control soil borne fungi, as well as Fusarium species (Pinkas *et al.*, 1984).

2.2.11.3 Botanical control:

The antifungal effect of certain medicinal and aromatic plants extract have been investigated by many works (Singh and Dwevide, 1987; Handque and Singh 1990).Thus, the development of new and different antimicrobial agents more safe has been a very importantstep (Agrafotis, 2002).the uses of natural product for the control of fungal disease in plant are considered as in interesting alternative to synthetic fungicides due to their less negative impacts on the environment. Plant extracts or plant essential oils have been tested against *F.oxysporum* species for inhibitor effect and control efficacy under greenhouse condition (Bowers, and Locke, 2000).

2.2.11.4 Biological control:

Biological control of dry rot is an intriguing concept, but currently nothing is available commercially. Researchers at Michigan State University are investigating efficacy of *Bacillus Subtili s*and *Bacillus pumilis* and *Trichoderma harzianum* in controlling in Fusarium dry rot.(warton and phillip,2013).Scientists in Tunisia have found that several bacteria species of the genus Bacillus, commonly found in the salty soils of Tunisia can reduce the amount of rot seen due to *Fusarium Salbucinum. Bacillus thuringiesis*, can help control dry rot when applied to older cultures (Sadfi,2007).

2.2.11.5Chemical control:

Effective chemical control of dry rot can be achieved with chemicals like Tops MZ, Maxim Mz, and Monocot MZ. These chemicals protect not only against dry rot but also against other potato disease like Rhizoctonia, silver scurf and Black dot. This chemicals treatments can delay emergence of the young plants but this does not mean these chemicals should not be used Many fungicides, including Thiabendazole, work best when they are applied to tubers before they are cut into seed pieces.(Schwartz,*et. al***.,** 2005).

2.3.1 *Trichoderma harzianum*:

Trichoderm are the most prevalent fungi in soil and root ecosystems. They are easy to be cultured (Contreras *et al*, 2009), and also are considered to be a fast- growing species in soil and on media especially, when the temperature is ranging between 25 to 30 c^0 (Aneja, 2003). Trichoderm species can antagonize and control a wide range of economically- important plant pathogens including fungi (Herrera-Estrella and Chet, 1998). Bacteria (Yedidia *et al*,2003 ; Sivan and Chet(1992) and nematodes (Sharon *et al.*, 2011). Different bio control mechanisms suggested for Trichoderma activity, which includes competition for space and nutrients, secretion of chitinolytic enzymes, myco parasitism and production of inhibitory compounds (Haram *et al*., 1996; Zimand *et al*., 1996).

Biological control of soil borne plant pathogens is not only beneficial in reducing harmful pesticide use also can help in reducing environmental pollutions. The potential of trichoderma species as biocontrolagent in plant disease control was first recognized in the early 1930s (Weindling, 1932) and subsequently they were applied successfully against several plant disease in commercial agriculture (Howell, 2003).Several superior strains have been indentified and formulated into commercial biopesticides (Agrios, 1997). Control may achieved by competition, production of antibiotics or myco parasitism (Campbell 1989).In India (Mishra *et al.*,2011)screened several isolates of *Trichoderm aviride* against some fungal pathogens including *Fusarium solani* of potato under*in vitro* conditions and found

T.viride (tr-8) as the most effective isolate in inhibiting the fungal growth of all pathogens through dual culture and production of cell-free culture filtrate. Isolation of Trichoderm spp. from soil was done following the technique used by(Rifai, 1969). For this purpose, soil samples were collected from potato root. Twenty grams of each collected soil**.** Samples were gently mixed with 500 ml distilled water containing 0.2% citric acid. Then 5 ml of the prepared solution was added to the Petri plates containing 15 ml of water agar and kept at 508C, then shook well for proper mixing. After solidification, 5 mm plugs of these cultures were transferred into Petri plates containing selective medium (Davet, 1979) and were incubated at 25^0Cafter proper growth.

CHAPTER THREE

MATERISLS AND METHODS

This study was conducted at the laboratory of plant pathology. Department of plant protection, college Agricultural studies, Sudan University of Science and Technology during March 2020.The aim of this study is to investigate the antifungal activities of *Trichoderm harzianum* against the growth of *Fusarium solani* (Desjardins, 2006) on PDA media under laboratory conditions where temperature around 28^0C

3.2Preparation of fungal culture of *Fusarium solani:*

3.2.1Collection of Sample:

A potato tuber showing symptoms of infection was collected from Libya vegetable market.

3.2.2 Isolation Method:

Isolation method was conducted at the laboratory of the plant pathology following steps adapted Mamatha, (2004) Cleaning of potato tubers thoroughly with freshwater. Then Infected parts were cut in discs about 1-2 cm. After that, the potato discs were dipped into Clorox 10% (2min). Then rinsed in sterilized distilled water for 2min. The cleaned discs were transferred to Petri-dish containing filter paper to dry. Previously prepared PDA media were place in Petri-dishes (four Petri-dishes) and inoculated with the disease potato discs under laminar flow cabinet. Finally, the Petri-dishes were tightened with par film. Finally, incubated at $28C^0$ for seven days to allow fungal growth.

3.2.3 Purification of fungus:

The growing culture was examiner under the microscope at 1000 magnification. A serial of sub culturing was done to obtain culture of Fusarium, which was later used in this experiment.

3.3 Source of *Fusarium solani*:

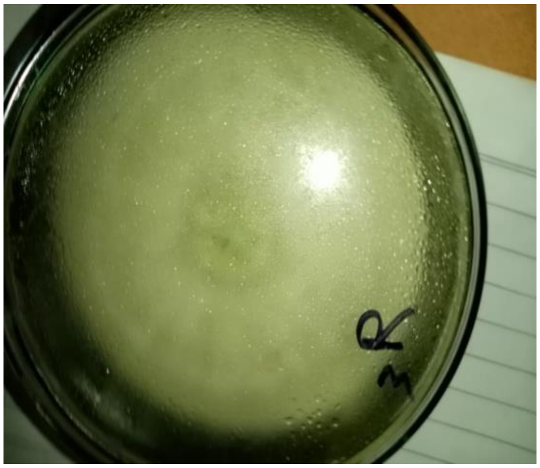
The fungus was obtained from fresh culture in the laboratory of plant pathology, Department of crop protection, Sudan University of Science Technology.

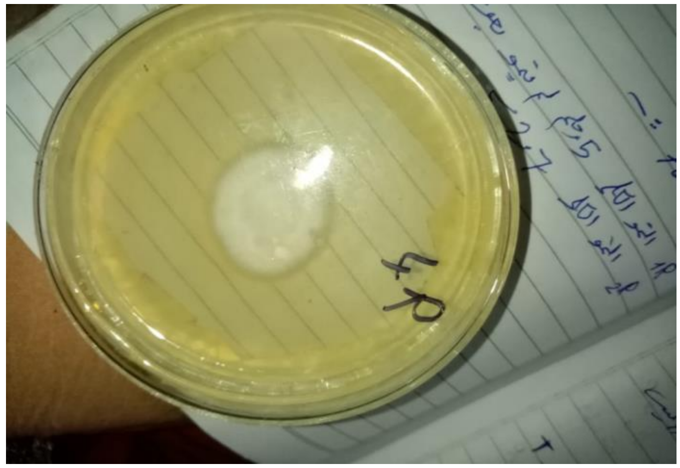
3.4. Test procedure:

Potato Dextrose Agar (PDA) 10gwere placed in250 ml flasks.). The antibacterial Chloromycetin capsules were used to suppress bacterial contamination.Half of the solidified medium was inoculated with a*F. solani*from 7 days old culture as in 5 mm discs. The second half was inoculated with a *T. harzianum*.Thus, both organisms would get equal opportunities for growth. One plate containing the test fungus only was included as control. The individual treatments were replicated four times. The Petridishes were incubated at 25°C. Then the fungal growth was estimated daily and percent growth inhibition was calculatedusing the formula developed byJagtap and Sontakke (2007):

$$I = \frac{C-T}{C} \times 100 \quad (1)$$

Where:I = Percent inhibition,C = Growth of test fungus in control medium in cm and. T = Growth of test fungus in the respective treatment in cm





A) B)

plate 1

A) The growth of *Trichoderm harzianum* in Petri plate

B) The growth of *Fusarium solani* in Petri plate

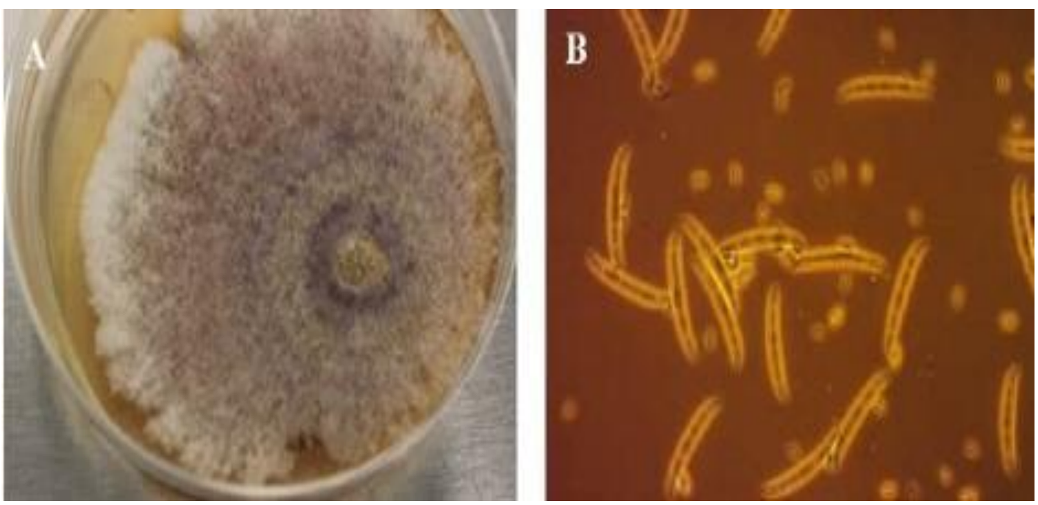


Plate2

a) The growth of *Fusarium solani* in Petri plate

b) The spores of *Fusarium solani*under Microscope

Plate3 Infected Tuber Showing the Symptoms of *Fusarium solani*

Plate4 Symptoms of *Fusarium solani* in leaf and stem in potato plant.

CHAPTERFOUR

RESULTS

4.1 Laboratory Experiments:

This study was conducted under the laboratory of plant pathology, Department of plant protection, College of Agricultural studies, Sudan University of Science and Technology during September and October 2020. The aim of this study is to investigate the antifungal activities of *Trichoderm harzianum* against the liner growth of *Fusarium solani***.**

4.1.1The inhibition zone of the growth of *Trichoderma harzianum* and *Fusarium solani in* Petri plate.

Result of this study showed that *Trichoderma harzianum* have inhibitory effects on the growth of the *Fusarium solani*. Growth of *F. solani* was inhibited by encroachment of Trichoderma growth from all sides of the pathogenic fungus (Fusarium).At 3days after incubation Fusarium, growth was similar in all plate. However, at 5and 7days the fungus growth was significantly inhibited by *Trichoderma* (Plates 2). The fungus on the control medium was 8.2cm in Petri dishes at 7 days after commencement of the experiment. *Trichoderma* inhibited the fungus mycelial growth by 1, 1.6 and 2.1%, respectively.

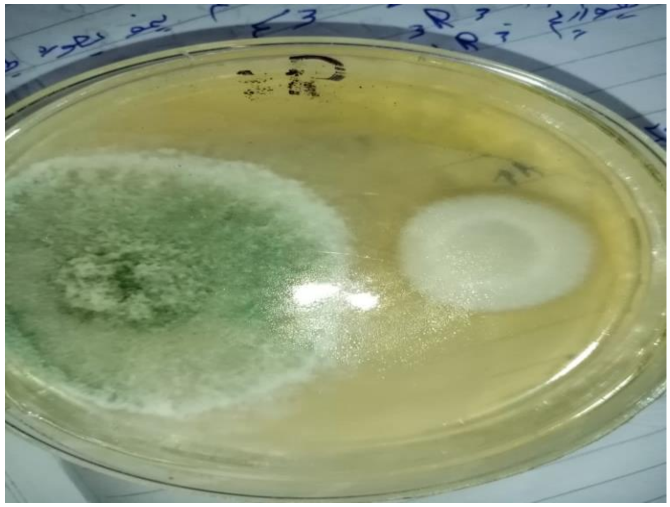


Plate5 Effect of *Trichoderma harzianum* against the liner growth of *Fusarium solani in vitro*

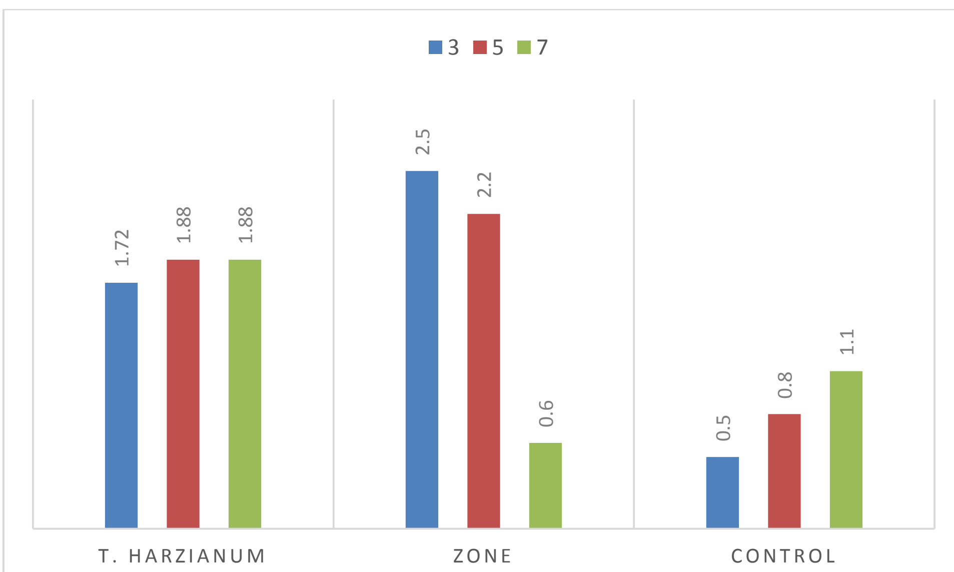


Fig.1The inhibition zone of the growth of *Trichoderm harzianum* and *Fusarium solani* in Petri plate.

CHAPTER FIVE

DISCUSSION

The well-established fact is that uses of synthetic pesticides have caused serious problem to human and animal health in addition to their negative impact on environment. These problems include contamination of the biosphere, toxicity to man, animals, beneficial insects and other non-target organisms. This have drawn the attention of the researchers and public to adopt new pest management strategies. In order to safe alternate products of low environmental persistence, highly specific, cheep, available and biodegradable(Agrios,, *et. al*., 1997).This was further highlighted by (Agrafotis, 2002) who reported that the development of new and different antimicrobial agents more safe and a very important stip. Fusarium dry rot of potatoes is a worldwide economic problem. There are many speciese of Fusarium reported to cause dry rot of potato worldwide (Nielson, 1981).

Biological control may be defined as the reduction in inoculum density or disease producing activity of pathogen in its active or dormant state, by one or more organisms naturally or through manipulation of environment and host of the antagonists (Baker and Cook, 1974). Biocontrol agents are widely regarded by the general public as “natural” and therefore non-threatening products, although risk assessments must clearly be carried out on their effects on non-target organisms. Moreover, knowledge concerning the behavior of such antagonists is essential for their effective use.

T. harzianum was tested against *F. solani* in laboratory experiments .The results indicated that *T. harzianum* significantly inhibited the growth of *F. solani*. (Table plate 2)

The results indicated that *F. solani* had slower growth than *T. harzianum.* The growth of *F. solani* was inhibited by encroachment of *T. harzianum.* Trichoderma grew on all possible sides of the pathogenic fungus (Fusarium) in the plates and suppressed further growth of the pathogen. The pathogens grew fully in the control plates after 7 days. Rapid growth of Trichoderma is an important advantage in competition with plant pathogenic fungi for space and nutrients.

Our data are supported by the study of Cook and Baker 1989).Generally, Trichoderma significantly inhibited the growth of *F .solani*. The antagonistic effect can be attributed to diffusible substances (antibiosis) secreted by the antagonists or due to their direct effect on the target pathogens. Concerning the antagonistic activity of Trichoderma isolates, our data are supported by and Deacon and Berry (1992) who found that *T. harzianum* was effective in inhibiting the growth of *Fusarium solani* in vitro.

CONCLUSION:

Trichoderma harzianum inhibited the growth of *F. solani* the causal agent of dry rot in potato significantly *in vitro*.

RECOMMENDATIONS:

Based on the foregoing the following studies were recommecded.

- To further, investigate the antimicrobial properties in a group of Trichoderma to determine their Potentials effect on *Fusarium solani* in potato
- To study different of *Trichoderma, spp* as a bio control agent in order to inhibit the growth of the fungus.

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APENDESES

3.1 Materials, tools, equipments used in the study:

Gloves

Slide

Aluminum fowl

Water Path

Medical Cotton

Laminar

Filter Papers

Potato Dextrose Agar(PDA)

Flame

Needle

Incubator

Camera

.Marker pen

Blender

Balance

Muzzle

Plate.6. Gloves

Plate7 Muzzle

Plate 8. Autoclave