بسم الله الرحمن الرحيم

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Effect of Mesquite aqueous extract on fungal growth of: *Fusarium solani*

تأثير المستخلص المائي لأوراق المسكيت علي نمو فطر (فيوزيريم سولانى)

B.Sc (Honours) Graduation Research Project in Plant Protection

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الآية

(وَهُوَ الَّذِي أَنشَأَ جَنَّاتٍ مَّعْرُوشَاتٍ وَغَيْرَ مَعْرُوشَاتٍ وَالنَّخْلَ وَالزَّرْعَ

مُخْتَلِفًا أُكُلُهُ وَالزَّيْتُونَ وَالرُّمَّانَ مُتَشَابِهًا وَغَيْرَ مُتَشَابِهٍ كُلُواْ مِن ثَمَرِهِ

إِذَا أَثْمَرَ وَآتُواْ حَقَّهُ يَوْمَ حَصَادِهِ وَلاَ تُسْرِفُواْ إِنَّهُ لاَ يُحِبُّ الْمُسْرِفِينَ)

سورة الانعام الاية(141)

DEDICATION

To my mother

To my father

To my brothers and sisters

To all my family, my teachers, colleagues and friends with love and respect.

Huda

Acknowledgements

All thanks are due to Almighty Allah who gave me health and strength, and helped me tremendously to produce this work.

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ABSTRACT

This study was carried out in the laboratory of plant pathology, plant protection department, college of Agricultural studies, Sudan University of science and Technology in 2017. The objective of this study is to evaluate the effect of Mesquite leaves aqueous extracts and Fulldazin fungicides against *Fusarium solani*in potato tuber.

The aqueous extract prepared of Mesquite leaves,used three concentrations (25%, 50%, and 100%).

Results that have been obtained show that the effect of the aqueous extracts of the leaves Mesquite in all concentrations was of significant effect in inhibiting the growth of fungus compared to the control.

As a result, this study shows that the Mesquite leaves containing materials with the effect of an anti-fungal growth.

ملخص البحث

اجريت هذه الدراسه في مختبر علم امراض النبات , قسم وقاية النبات , كلية الدراسات الزراعية , جامعة السودان للعلوم و التكنولوجيا 2017 لتقييم تأثير المستخلص المائي لأوراق نبات المسكيت علي فطر الفيوزريم سولاني في بيئة بطاطس دكستروز أجار مقارنه بمبيد فيلدازين تحت ظروف المعمل . تم تحضير المستخلص المائي من أوراق المسكيت .استخدمت ثلاثة تركيزات من المستخلص المائي لأوراق المسكيت(25%,50%,100%)النتائج التي تم الحصول عليها في اليوم الثاني والثالث والرابع توضح أنتأثير المستخلصات المائية في أوراق المسكيت في كل التركيزات خلال ثلاث أيام كانت ذات تأثير معنوي في تثبيط نمو الفطر مقارنه بالكنترول.

نتيجة لذلك توضح الدراسةأن نبات المسكيت يحتوي علي مواد ذات تأثير مضاد لنمو الفطر.

CHAPTER ONE

1-1: Introduction:

Mesquite plant, Prosopis juliflora Swartz, of the sub-family, Mimosoideae is an invasive, evergreen and multi-purpose leguminous, tree or shrub (Babiker, 2006). The plant is considered native to semi-arid areas of the West Indies Mexico, Central America a northern South America (Felker et al., 2003).

At its entries of origins the mesquite has played an important social role. In addition to its role in combating desertification and supply of high-value mechanical wood product’s fire wood and charcoal mesquite provides shelters, animal feed and food for humans in areas where protein intake is very low and Ander adverse condition of drought and famines (Ibrahim, 1989).

In Sudan, mesquite was introduced in 1917 from South Africa and Egypt (Vbroun and Massey, 1929), and unfortunately, due to its deliberate distribution within Sudan, the plant became a threat to agriculture and biodiversity. (Babiker, 2006).

1-2:Objectives:

- To investigate the effect of the aqueous extracts of leaves Mesquite plant on growth of *Fusarium solani.*
- To study the inhibitory effect of leaves Mesquite plant extracts on early growth of *Fusarium solani*

CHAPTER TWO

2-1: Mesquite:

The name Prosopis was selected by Linnaeus to describe the only species he was aware of, p.spicigera, in 1767 (felker, et.al. 2001). Felkeret. Al., (2001) stated that genus prosopislinnaeus emends Burk art is in the family leguminosae (Fabaceae), sub-family Mimosoideae. The placing of Prosopis in the wider taxonomic classification system is given below, based on Elias (1981) and Lewis and alias (1981):

2-1-1: Classification

Family: Leguminosae 650 genera, 18,000 species

Sub-family: Mimosoideae 50-60 genera, 650-725 species

Tribe: Mimosa 5 tribes

Group: Prosopis 9 groups

Genus: Prosopis 4 genera

2-1-2: Description:

Common mesquite *(Prosopis juliflora*) a Fabaceae, is an evergreen multi-purpose tree or shrub. Depending on water availability the plant grows up to 12m high or into a shrub. Mesquite growth is not limited by soil type, pH, salinity and/or soil fertility. The tree is a nitrogen fixer, endowed with an extensive root system. Its tap root grows down to 53m and its lateral roots may extend beyond the crown (Choge and Chikamai, 2003). The tree is competitive and allopathic. It is also a prolific seed producer. The seeds, mainly distributed by animals and water, are persistent and a high seed bank often builds up in soil (fowler, 1998).

2-1-3: Economic and other uses:

Various Prosopis species have been introduced to Africa over the past 190 years for their beneficial qualities which include erosion control, shade, fuel wood, building materials, and pods for animal and human consumption in arid and semi-arid regions. The fact that there is clear economic use to this species but severe negative consequences of P. juliflora invasion makes this conflict of interesting species sacrificed (Elsiddig, 2004)..

2-1-4: Mesquite as an alien Plant:

Mesquite was introduced into several countries with the primary objective of curbing desertification and providing fire wood and thus preserving indigenous trees (Babiker, 2006; Chog and Chikamai’ 2006). However, in most of the countries, where it was introduced, mesquite has spread outside where it was originally planted and has become a serious weed (El Houri, 1986; Babiker, 1976). Ease of spread of mesquite is consistent with its invasive nature, ease of adaptations to novel environments, lack of natural enemies, underutilization and mismanagements (Ali and Labrada, 2006; Babiker, 2006; Chog and Ngujiri, 2006; Kathiresan, 2006). Exploitation of mesquite in Argentina between 1500 and 1975 reduced the natural coverage of Prosopis to between 25 and 50% (Choge and Chikamai, 2003). P. juliflora, which is of rampant spread in Yemen, has been reported to constitute a threat to agriculture, pastures and biodiversity when underutilized and mismanaged (Elsiddig, 2004). However, utilization of wood and non-wood products of mesquite in Yemen, Sayun and Tarim areas, in addition to the benefits realized by the community, curtailed spread of the tree and lessened its importance as a weed (Ali and labrada, 2006). However, blockage of natural ephemeral water courses by mesquite often causes serious flood problems in Yemen (Elsidig, 2004).

2-1-5: Mesquite in Sudan:

Sudan, the third largest country in Africa with an area of 1.752.187 Km2, lies between longitudes 21^{0} 49 E-38^{0}-34 E and latitudes 8^{0} 45 N-23^{0} 8 N (Fig. 2). The River Nile and its Mesquite (Juliflora) was introduced into Sudan from Egypt and South Africa in 1917 and established in a limited area in Shabbat arboretum in Khartoum North (Broun and Massy, 1929, Babiker, 2006). In 1918 it was planted in a plot near where is to-day stands Khartoum airport (Babiker, 2006). In 1937 the plant was introduced into the grazing area in the White Nile province as a trial for evaluation of efficacy as a shelterbelt for curtailment of sand encroachment. A mesquite plantation was established at Elshagera, Kilo5, in 1938 and subsequently mesquite was planted on eroded slopes near Sonar, Elfoung, and Elgalabat and on sandy soils with high salt contents near Port Sudan with good results (Abdel Bari, 1986). However, plantations at Fewer, in the Gezira scheme, and on the sandy soils in Cordovan and Darfur were not successful. Mesquite was planted in Taker in 1945, Kassala in 1947, Elghaba in 1958. In 1962-1964 mesquite was further planted in the greenbelt on the suburbs of Khartoum. In 1966 mesquite was introduced into New Halfa to fence the experimental farm. As a result of these experimental plantations P. juliflorawas proclaimed a hope of a forestation in the arid areas of the Sudan (Abdel Bari, 1986).

The drought which struck the Sudan -Shelia countries in the 1960s to the early 1970s together with associated desert encroachment rejuvenated interest in mesquite and provided the impetus for further introductions of the plant to protect residential and cultivated areas (Babiker, 2006). In Sudan dry zones variations of rainfall (50-250 mm/annum), high evaporation, associated with high temperature and high wind, increasing animal population, shortage of fodder and firewood, desert encroachment (5 kilometer yr-1) and land degradation together with the associated decrease in productivity provided the impetus for further introductions of mesquite (Laxen, 2007). Mesquite was introduced into the then River Nile province as shelterbelts to protect the agricultural schemes at Kelly, Gandato and Elzeidab by the Sudanese Council of Churches. In 1980 the plant was re-introduced through the Finland forest programmer and was planted in central (Tendelti) and northern Sudan (Lati basin) (Musnad, 1971). In 1986 the plant was introduced and distributed in several locations into the then Kassala province.

In the 1980s the International Research Centre of Canada (IDRC) and the Faculty of Veterinary Sciences University of Khartoum evaluated about 30 mesquite ecotypes for fodder production in Northern Cordovan in the premises of El-Obeid. Under the same project several species of mesquite including P. valutina, P. chilensis, and P. glandulosa var. torreyana were evaluated at El Obeid and further west for establishment, fuel wood and fodder production (Abdel Bari, 1986). Furthermore, mesquite was planted at two sites (Hama rat el-wiz and el Bashir oasis) in a zone where rainfall was 200-320 mm/anuum (Elsiddig, 2004). A report made by Abdel Bari in 1986 indicated that mesquite had established satellite foci along the highway from Port Sudan to Khartoum and by 2007 mesquite has spread and established itself in most of the Sudanese States (Laxen, 2007).

The identity of the mesquite species introduced into Sudan, as in elsewhere, has been a source of controversy. The species when introduced was claimed to be P. juliflora (Broun and Massy, 1929, Jackson, 1960). However, it was later identified as P. Chilensis (Molino) Stuntz (Wunder, 1966). The latter identity was confirmed by Abdel Bari, 1986), but refuted by ElFadl (1997), and Mohamed (2001) who ascertained the species as Juliflora. The considerable taxonomic confusion, often encountered in mesquite, may be due to the renowned genetic and phenotypic variations and hybridization within and between species (Babiker, 2006; Hamza, 2010).

Mesquite was originally appreciated for its plasticity and qualities of survival, sand fixing potential (Plate 2) and not least for the take-off, comprising of fuel wood, charcoal, construction timber and livestock feed, availed to local community.

However, the plant has spread into various ecological niches and was recognized as a potential problem late in the1970s. Mesquite has invaded natural and managed habitats, including highways, railway lines; floodplains, watercourses, irrigation canals and degraded abandoned land and irrigated areas (Plates 13-18) (Abdel Bari, 1986, Babiker, 2006). Mesquite is a problem within Central, Northern and Eastern Sudan in the sandy soils of Western Sudan, apart from localized foci; no problems of weedy invasions were reported (ElFadl and Luukanen, 2003).

Mesquite tends to establish successfully on clay and alluvial soils which have good water retention (Luukanen et al., 1983). The bulk of mesquite infestation (>90%) is in Eastern Sudan, where livestock keeping and subsistent agriculture, constitute the main sources of income (Babiker, 2006). In most of the infected sites mesquite forms impenetrable thickets that smothered and excludes native vegetation and substantially changes community structure and several indigenous trees were replaced by mesquite (Elsiddig, 1998).

A workshop held on the 26th of November 2007 in the Martyr's hall, Sudan University of Science and Technology, attended by participants and representatives of 7 states, known to be mesquite infested or at risk, and the private sector including contractors engaged in Prosopis control, revealed that six States, namely Khartoum, Gezira and the White Nile (central Sudan), River Nile, the Northern State (Northern Sudan), Kassala, and the Red sea States (Eastern Sudan) are infested by Prosopis, while 2 States (Gadarief and Sennar) are at risk (Babiker, 2007). The Red sea State was the most infested, while Khartoum State was the least. Infested areas in thousand hectares were 424.2, 224.8, 22.433, 12.036 and 4.569 in Red sea State, Kassala State, White Nile State, the Gezira State and Khartoum State, respectively. The infested areas in Gadarief, Sennar and the Northern States were not reported. It deserves mentioning that the weed was first introduced into Khartoum in 1917, Kassala in 1947, the Red sea in 1938, Northern state in 1977, the White Nile in 1937, and the Gezira in 1937. In the Gadarief, renowned for rainfed agriculture, mesquite was planted around the refugee's camps in the 1970s to provide shade, shelter and animal feed. In Sennar State, a part from the early introductions made in the 1930s, no data on more recent introductions were available. The discussions revealed localized infestations in Sennar and Gadarief and numerous scattered foci in Darfur and Kordofan (Western Sudan) States. Legislations invoking eradication of the weed were made in some of the States, but were never in place (Appendix 1andThe main methods of control are hand cutting, using hand tools, and mechanical and manual uprooting. Both methods are costly and very slow and regeneration from seeds or through coppicing was the norm (Plates 19-20). A simple hand equipment for uprooting mesquite was displayed. Chemical control, employing 2, 4-D in diesel, to cut stumps, was reported in limited areas. Research on biological control was limited. Some observations were made on efficacy of the bruchid Algarobius Prosopis, which was involuntary, introduced with the weed seeds

Wood and charcoal making. The biomass resulting from mechanical removal of the weed is usually burned.

The workshop was informed that land abandonment, failure to replace mesquite or use the land after hand pulling, encourages re-infestation and that mesquite spread and distribution is linked with heavy animal stocking, water courses, irrigation canals and the water table. The banks of the Atbara River, in eastern Sudan, the White Nile, south of Khartoum and north of El Dawium, and the Nile, in the Northern state, are infested to different levels

A part from New Halfa scheme, where a rigorous follow up and strict regulations comprising livestock movement and early detection and quick response are in vogue, most of the Prosopis cleared areas were re-invaded. The re-invasion was attributed to improper planning of the control campaign, improper use of the cleared land and lack of follow up (Babiker, 2006). The role of the seed bank, in regeneration, is yet to be ascertained. Ahmed (2009) in his studies on effects of soil burial on mesquite emergence and establishment reported no seedling emergence from seed buried at or below 2 cm soil depth.

In eastern Sudan, where mesquite infestation is the highest, the plant showed low spreading rate in 1962-1978. An increase in rate of spread was observed in the 1980s and the plant was recognized as a plausible serious weed (El Houri, 1986). In 1987-1992 the rate of spread was substantial (389.5 ha per annum). A further increase in rate of spread (483.2 ha per annum) was reported in the period 1992-1996 (Elsiddig et al., 1998). An investigation undertaken at Tokar Delta on socio-economic impact of mesquite on local communities showed clearly that invasion by mesquite decreased the cultivated area, increased crop production cost and food prices, decreased job opportunities, led to migration of productive people and concomitantly led to the decline of the social well-being of local communities. Furthermore, a drop in the water table from 10 m to 14 m was reported (Sid Ahmed, 2005).

In Eastern Sudan the plant is spreading very fast (> 1 ha /day) accordingly cheap, versatile and effective methods of control have to be developed. Research undertaken at the Gezira Research Station showed that glyphosate and 2, 4-D applied to 1-4 months seedlings resulted in initial growth suppression, however complete recovery of the seedlings occurred (Ahmed, 2009). Clopyrlid, triclopyr and their tank mixtures applied to cut stumps, and as basal or foliar treatments effected excellent and lasting suppression of the plant. Furthermore treatments made in June-September were more effective than those made in January to May and that triclopyr performance was less affected by timing of application (Ahmed, 2009). A collaborative research on chemical control undertaken in Khartoum, Gezira, River Nile and In Eastern Sudan the plant is spreading very fast (> 1 ha /day) accordingly cheap, versatile and effective methods of control have to be developed. Research undertaken at the Gezira Research Station showed that glyphosate and 2, 4-D applied to 1-4 months seedlings resulted in initial growth suppression, however complete recovery of the seedlings occurred (Ahmed, 2009). Clopyrlid, triclopyr and their tank mixtures applied to cut stumps, and as basal or foliar treatments effected excellent and lasting suppression of the plant.

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Kassala States revealed that triclopyr 48EC as Trillian at 2%, in diesel and aqueous carriers, respectively, applied as basal or foliar treatments effected excellent and lasting control of mesquite (Ahmed, Mubark, Sayeed and Babiker, 2014). Ongoing research also showed that triclopyr

at 0.5-1.0%, in 30% diesel, applied to cut stumps, affected excellent and persistent control of mesquite (Ahmed, E. A. Personal communication).

2-1-6: Prevention and control:

2-1-6-1: Cultural control:

High value, such as for agriculture or where labor is relatively cheap. Hand clearing can also be used in conjunction with some mechanical or chemical methods, such as chemical stump treatment (khan, 1961). Grubbing was is more cost effective in lighter infestations. Fire, probably one of the original management tools used in American grassland, has undergone limited assessment for controlling Mesquite.

Young seedlings are sensitive to fire but older trees become hand clearance is the first but method used to deal with Prosopis as awed. Work teams are sent into invaded pasture to fell the trees and uproot all stumps. Although very effective, fire can be used successfully as management tool for preventing the re-establishment of young Prosopis seedling while also improving forage production. Fire has been used in conjunction with other methods in the development of integrated eradication programmers.

Studies on succession suggest the possibility of ecological control, by leaving succession to take its natural course. The invasion of Prosopis species into rangeland has been observed and studied for over century in the USA (Archer, 1995) and for long periods in South America (Antoni and solbring, 1977) and India (chinnimani, 1998).

2-1-6-2: Mechanical control:

Mechanical site cleanse involves tractor operations developed for removing trees in which the roots are severed below ground level to ensure tree kill. These operations include root plunging and changing which are often the most effective mechanical means, using moldboard plough pulled behind a caterpillar tractor or a heavy chain pulled between tow machines. For root ploughing, large trees must first be felled by hand, but this treatment has been used to remove stumps up to 50cm in diameter without difficulty and has treatment life of 20 years or more (Jacoby and Ansley, 1991). Other advantages are that only a single pass is required, and whole site cultivation is effected leading to improved soil water conservation, and there is a chance to reseed with improved forage species. However, this method is one of the most expensive control treatments and is recommended only on deep soils that have a high potential for subsequent increased forage production (Jacoby and Ansley, 1991).

2-1-6-3: Chemical control:

Chemical treatments involve the use of herbicide to kill trees, with the most effective being stem or aerial applications of systemic herbicides. Effectiveness is dependent upon chemical uptake, which in Prosopis is limited by the thick bark, woody stems and small leaves with a protective waxy outer layer difficult. Many herbicides and herbicide mixtures have been tested, mostly on P. Glandulosa until the banning of its use in the 1980s, 2, 4, 5-T was the herbicide of choice in the USA (Jacoby and Ansley, 1991). And Australia (Csurhes, 1996).Although 2, 4-D provided excellent suppression of top growth, few trees were actually killed and such chemical treatments had to apply periodically to ensure that forage yields were maintained.

Infested sites often needed spraying ever 5-7 years. The most effective chemical for high tree kill in the USA is clopralid, but dicamba, picloram and triclopyr have also been successfully used, either alone or in combination (Jacoby and Ansley, 1991). In India, ammonium sulfa mate was successful in killing P.juliflora trees and as a stump treatment (paschal and Shetty, 1977).

2-1-6-4: Biological control:

Several biological control programmers using species of seed-feeding brushed beetles have been developed and implemented. The Advantages With brushed is their observed host specificity with many species found to feed only on Prosopis, and some only on a single species. Other insect species known to have deleterious effect on native and exotic Prosopis in The Americas, mainly twig girdlers and psyllids, have also been suggested as possible biological control agents.

The same tow brushed species were also introduced to Ascension Island in an attempt to control P._juliflora which is present on 80% of the island, often in dance thickets. Two other species, one a psyllids and the other amirid, were identified as attaching Juliflora on Ascension Island and were thought to have been introduced accidentally from the car bean. The mired Rhizocloa sp. Causes widespread damage and is thought to lead to substantial mortality of trees (fowler, 1998). In Australia, Prosopis infestation are at a relatively early stage and extreme care is being employed in the selection of suitable biological control agents, following the long history of problems caused there by plant and animal introduction. Insect species continue to be tested for their efficacy and host specificity as possible biological control agents of Prosopis species in Australia (e.g. Van klinken, 1999, .van klinken et al., 2009).

Prosopis_species continue to spread widely imparts of their native ranges where many insect species including brushed, spilled and other injurious pests are common components of the ecology. These regularly attack Prosopis but the trees have adapted to infestation by these pests and are still able to become invasive weeds over large tracts of land.

2-1-6-5: Integrated control:

Fire has been used in conjunction with other methods in the development of integrated eradication programmers. For example spraying with herbicides produces dead wood that will ignite and support a sustained fire with more likelihood of killing the remaining trees.

Control could also include the use of animals, other than insect, to eat and kill Prosopis seed. The factor common to most Prosopis invasions is over –grazing with spreads Prosopis seed widely. Prosopis seed found in cattle faces have much improved germination compared with undigested seed (peinetti et al., 1993; Danthu et. 1996). In contrast, the percentage of P.juliflora seed excreted after ingestion by sheep and goats was much lower (10-15) (Harding, 1991; Danthu et al., 1996). Marked difference were noted in the germination of seed following passage through different animals (Moony et al., 1977); germination was 82% with horses, 69% with cattle, but only 25% with sheep .p.flexuosa seed were killed completely followed ingestion by pigs (peinetti et al., 1993). Replacing free-ranging cattle with other livestock, particular sheep and pigs, possibly in conjunction with other control method, Could drastically reduce the spread of Prosopis species weedy invasion of Prosopis can be successfully Adapted to agroforestry systems by a conversion process developed by felker et al. (1999) and adapted.

This conversion requires three main management interventions: thinning, pruning and treatment of understory .weedy thickets with 100-2500 trees/ha and dense infestation with over 2500 trees/ha. This thinning operation is the most problematic and costly aspect of conversion and limits the uptake of such system. The use of a tractor-mounted flail-mower to cut rows through the stand is the most economical means of initial thinning. The harvested biomass is sold to offset some of the cost of the operation.

2-2: *Fusarium dry rot:*

Fusarium dry rot of potato 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 potatoes than any other-post harvest disease. Crop losses attributed to dry grot have been estimated to an average of 6 to 25 %(Powel son et al, 1993).

Fusarium species which cause dry rot are also important to the consumer because some, Fusarium which cause dry rots also produce mycotoxin, one of such toxins is trichothecene which is an inhibitor of eukaryotic protein synthesis and can pose serious health problem to man and animal (Beremaid et al, 1991).

This fungus which prefers warmer climates causes a variety of colored rots in potatoes (Rowe et al, 2013). There are many species of Fusarium reported to cause dry rot of potato worldwide of which Fusarium solani has been reported as the most pathogenic Fusarium species causing potato dry rot (Sharifi et al, 2009).

2-2-1: Classification:

Kingdom: Fungi

Phylum: Ascomycota

Class: Sordariomycetes

Subclass: Hypocreomycetidae

Order: Hypocreales

Family: Nectriaceae

Genus: Fusarium

Species: solani

2-2-2: Host range and distribution:

The predominant hosts for Fusarium solani are potato, pea, bean, and members of the cucurbitFamily such melon, cucumber, and pumpkin. Some strains may cause infections in human.

Fusarium damping-off, corn rot, fruit root, root rot and surface rot are caused by F. solani f.sp.eumartii (Aoki et al., 2003).

Mart, Sacccand found in most states in the United States. The fungus has a worldwide distribution, but its frequency as an important plant pathogen is well known and hence remains the most common disease-causing fungus in its genus (Aoki et al., 2003).

2-2-3: Phylogeny:

The phylogeny of isolates from potato and tomato was determined based on sequences of two DNA fragments: rDNA internal transcribed spacer regions and partial sequences of elongation factor 1- anal isolates of Solani .f.sp.eumartii from tomato and potato formed a single monophyletic clade distinct from other formal specials and mating population of F.solani f.sp.eumartii, the results of this study demonstrates that Emeriti wilt and tomato foot rot in California both are caused by F.solani .f. spp .emeriti, (Romberg and Davis, 2007).

2-2-4: Description:

Fusarium solani is a filamentous fungus in the genus fusarium, and the anamorphic of haematonectria aematococca. Fusarium solani (mart.) Sacc. (2008). is a name that has been applied broadly to what is now known as the F. solani species complex (FSSC; O Donnell 2000). Members of the FSSC, which includes several additional named species and currently corresponds to approximately 50 phylogenetic species (Zhang et al., 2006; O'Donnell etal., 2008), are ubiquitous in soil, plant debris and in other plant and animal substrata and can be serious plant and human pathogens (Booth, 1971). The FCCS contains both heterothallic and homothallic strains and species, as well as strains that have no known sexual stage. The fungus produces three types of asexual spores, micro conidia and Chlamydia spores. The macro conidiophores by division. They are important in secondary infection (Agrios, 2005) .

The chhlamydospore are globes and have thick walls. It is formed from hyphae or alternatively by the modification of micro cells. Conidia considered as endurance organs in primary infection.

The teleomorph or sexual reproductive stage of F. oxysporum is unknown. (Booth, (1977) stated that the chromosome number of the fungus is (12) and the perithecial state is Gibberella but not confirmed (Agrios, 2005).

2-2-5 Causal organism:

Several fusarium app., including F.sambucinum, .Fsolani var .coeruleumand, F.avvenaceum, can cause dry rot. These fungi survive on refuse and live in soil. Infections can originate from infected seed tubers. Tuber rot usually does occur unless the tuber is injured during harvest. Wound provide a way for the fundus associated with soil to enter the tuber. Dry rot is one of the common storage diseases in Idaho. Fusarium dry rot lead to secondry infections by soft rot bacteria (Ocamb et al., 2006).

2-2-6: Symptoms:

The fungus can be soil borne, airborne or carried in plant residue and can be recovered from any part of the plant from the deepest root to the highest flower (Summeral et al., 2003).

Fusarium dry rot of potato is a devastating post-harvest losses disease affecting both seed potatoes and for human consumption (Loria and Rosemary, 1993). Dry rot causes the skin of the tuber to wrinkle. The rotted areas of the potato may be brown, grey, or black and the rot creates depressions in the surface of the tuber. Seed pieces may not completely before they have the chance to be planted. Singns of a pathogenic Fusarium species can be seen on an infected potato, and include white or pink mycelia(masses of vegetative fungal tissue) and very colorful spores that can be blue, black, purple, grey, white, yellow, or pink (Loria and Rosemary, 1993).

2-2-7: Disease Cycle:

Fusarium dry rot is caused by several fungal species in genus Fusarium. F. sambucinum (teleomorph Giberella pulicaris) is the most common causing dry rot of stored tubers in North America, but other Fusarium species are also known to cause dry rot , particularly . Solani var. coeruleum, and F. avenaceum. (Philip and William, 2008).

2-2-8: Environment (Ecology):

Fusarium solani produces asexual spores (micro conidia and macro conidia). It is sexual state is Nectriahaematococca (Ascomycete), and overwinters as mycelium or spores in infected or dead tissues or seed. It can be spread by air, equipment, and water. (Vincent and Jean, 1971) Warmer climates are preferred. (Warton at 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 may also be splashed by rain or carried by floods. The chhlamydospore is the survival structure in the absence of a host plant. (Vincent and Jean, 1971).

2-2-9: Importance:

Dry rot is not just a cosmetic problem like many other pathogens. It destroy tubers and leaves them completely inedible or unusable as seed in the future. Long-term storage losses have been reported to be as high as 60% while annual dry rot losses can range from 6 to 25% (Gachango and Hanson, (2012)). In Michigan, over 50% of seed lots have reported having variable levels of dry rot. (Gachango and Hanson, (2012)). Fusarium spp ., are among the most important plant pathogens in the world and are highly variable because of their genetic makeup and changes in environment in which they grow causing morphological changes (Nelson, 1983).

2-2-10: Management:

There are many ways to manage dry rot. This includes application of fungicides, cultural practices, sanitation, biological control and botanical pesticides. However, most techniques for managing dry rot are aimed at preventing injury to the tubers, either seed or the harvested crop. Preventing bruises will greatly aid in avoiding infection (Warton et al. 2007).

2-2-11: Cultural practices:

Cultural practices can also limit the spread of dry rot. Plant high quality seed free from Fusarium dry rot 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 days 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 injury. Provide conditions that promote rapid wound healing early in storage, including high humidity, good aeration, and temperatures of 55 to 64, F for 14to 21 days. Since Fusarium dry rot increases with length in storage, short-term storage is advisable for fields where severe infection is expected (Howard et al., 2005).

2-2-12: Botanical controls:

The antifungal effect of certain medicinal and aromatic plants extracts have been investigated by many workers (Singh and Dwivedi, 1987, Handique and Singh 1990). Thus, the development of new and different antimicrobial agents more safe has been a very important step (Agrafotis, 2002). However, the step of validation of traditional uses of antimicrobial compound in higher plants was studied by a number of researchers. Accordingly, the effect of different plants extracts on the germination and growth of many fungal pathogens have been reported (Agrafotis, 2002).

The use of plant extracts for controlling Fusariumwilt, cultural practices and the use of other methods are the most common strategies. However, they are either not available or effective. The uses of natural products for the control of fungal diseases in plant are considered as an interesting alternative to synthetic fungicides due to their less negative impacts on the environment. Plantextracts or plant essential oils have been tested against F.oxysporum species for inhibitor effect and control efficacy under greenhouse condition (Bowers, and Locke, 2000). If natural plant products can reduce populations of soil borne pathogens and control disease development, that these plant extracts have potential as environmentally safe alternatives and as component in integrated pest management programs.

2-2-13: Biological control:

Biological control of dry rot is an intriguing concept, but currently nothing is available commercially. Researchers at Michigan State University are investigating the efficacy of Bacillus subtilis andBacillus pumilis and Trichoderma harzianum in controlling Fusarium dry rot. (Warton and Phillip, 2013).

2-2-14: Chemical control:

Effective chemical control of dry rot can be achieved with chemicals like Tops MZ, Maxim MZ, and Mon coat MZ. These chemicals protect not only against dry rot, but also against other potato diseases like rhizoctonia, silver scurf, and black dot. These chemical treatment can delay emergence of the young plant, but this doesn’t mean these chemicals shouldn't be used. Many fungicides, including thiabendazole, work best when they are applied to tuber8s they are cut into seed pieces. (Schwartz, et al, 2005).

2-3: Potato plant:

2-3-1: Scientific classification:

Kingdom: Plantae (unranked):

Order: Solanales

Family: Solanaceae

Genus: Solanum

Species: tuberosum

(Binomial name: Solanum tuberosum L.)

2-3-2: Economic importance:

The potato is a starchy tuberous crop from the perennial Solanum tuberosum of the solanaceae family (also known as the nightshades).

The word potato may refer to the plant itself as the edible tuber. In the region of the Andes, there are some other closely related cultivated potato species. Potatoes are the world’s fourth largest food crop, following rice, wheat, and maize. Longs –term storage of potatoes 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 soon became an important food staple and field crop. The annual diet on of an average global citizen in the first decade of the twenty-first century included about 33Kg (or 73 IB) 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 in southern and eastern Asia. China is now the world’s largest potato-producing country, and nearly a third of the world’s potatoes are harvested in China and India (Thompson and Morgan, 1855).

CHAPTER THREE

MATERIALS AND METHODS

3-1: Experimental site:

Experiments were carried out in the laboratory of plant pathology, department of plant protection, college of Agricultural Studies, Sudan University of Science and Technology during August 2017.

3-2: Collection of mesquite plant:

The leaves of mesquite were collected from trees growing in the premises of the college of Agricultural Studies, Shambat. The parts collected were cleaned from dust and material by hand, washed with distilled water, surface sterilized with 5% ethanol Alcohol, thoroughly washed in sterilized water and dried shade at ambient temperature, ground and powdered separately to obtain fine powder for extraction and kept till use.

3-3: Preparation of aqueous extract of mesquite leaves plant part:

Aqueous extracts of each of the mesquite parts were prepared as recommended by Okigbo (2006). The obtained fine powder form different parts of mesquite was weighted (500gm) and added to it 1000 ml sterilized distilled water and then placed in shaker for 24 hrs. The extracts were filtered using what man No.1 filter paper and in the refrigerator to serve as stock solution (plate 1).

3-4: Isolation of *Fusarium solani* from plant material:

The Infected potato tubers showing symptom of green mold disease were collected from local market in Khartoum and cut into small pieces (0.5, 1.0 cm), washed thoroughly with tap water, sterilized with Clorox (NaOCI) (1%) for 1 minute, rinsed three time in sterilized distilled water and dried on sterilized filter papers. The sterilized section were then seeded at potato dextrose agar medium (PDA) in petri dishes' (9cm), 6 pieces/ per plate.

The inoculated petri dishes were incubated at $25C^0$ for 7 days. After incubation, growing fungi were sub cultured on PDA medium for further purification of the fungus. Furthermore, Compound microscopic examinations were carried out for Mycelia and Conidia structure based on the method of booth, (1977) to confirm that the fungus is *Fusarium solani.*

Identification of the fungus was supplemented by already prepared slides of *F.solani* at the pathology laboratory. Standard books and research papers were also consulted during the examination of this fungus (Aneja, 2004). The purified isolates were maintained on PDA medium for further studies.

3-5: Data analysis:

All the data were determined by Analysis of Variance (ANOVA) using a completely randomized design. The significance of differences between treatments were determined, using the Duncan's Multiple (DMR) test of statistical.

Plate (1): The aqueous extracts of mesquite leaves.

Plate (2): Laboratory Equipment's:

Plate (A): Autoclave

plate (B): Sensitive balance

Plate(C): cylinder

plate (D): Flask

plate (E): Petri dish

Plate (F): Aluminum foil

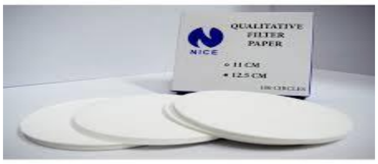

Plate (G):Filterpeper

Plate(H): Gloves

Plate (I): Forceps

CHAPTER FOUR

Results

4-1: Laboratory Experiments

This study was conducted at the laboratory of plant pathology, Department of plant protection, college of Agricultural studies, Sudan University of science and Technology during September 2017.

The aim of this study is to investigate the antifungal activities of (*Prosopisjuliflora*), Mesquite leaves aqueous extract on the liner growth of *Fusarium solani* in cultural media under laboratory conditions where temperature around 27c.

4-2: Effect of Mesquite Leaves

Aqueous extract on the liner growth of *Fusarium solani*, the effect of Mesquite leaves aqueous extracts on the liner growth of *the Fusarium solani* compared to control. The three concentrations from the extract showed spectrum of fungicide activity. The results (table 1) showed that extracts of Mesquite plant tested had negative effects on fungal growth. In general the antifungal activity increased with extract concentration. Among all doses the dose 100% extracts tested caused % reduction in growth, the dose 50% extracts tested caused % redaction, followed in descending order by the dose 25% extracts tested caused % redaction.

Table (1): Effect of aqueous extract of mesquite leaves, (*Prosopis spp*) on the linear growth of *Fusarium solani* after (two, three and four days) post incolation

Mesquite extract concentration		Linear growth(cm)	
	2days	3days	4days
25%	(7.4)a	(7.8)e	(7.9)e
50%	(3.8)ab	(5.4)f	(7.4) ab
100%	(6.7)c	(7.9)ab	8abc
Control	(9.2)a	(9.6)ab	(9.8)a
Fungicides	(0.0)a	(0.0)a	(0.0)d
C.V	28.6%	19.1%	22.3%
L.S.D	4.442	1.714	3.788

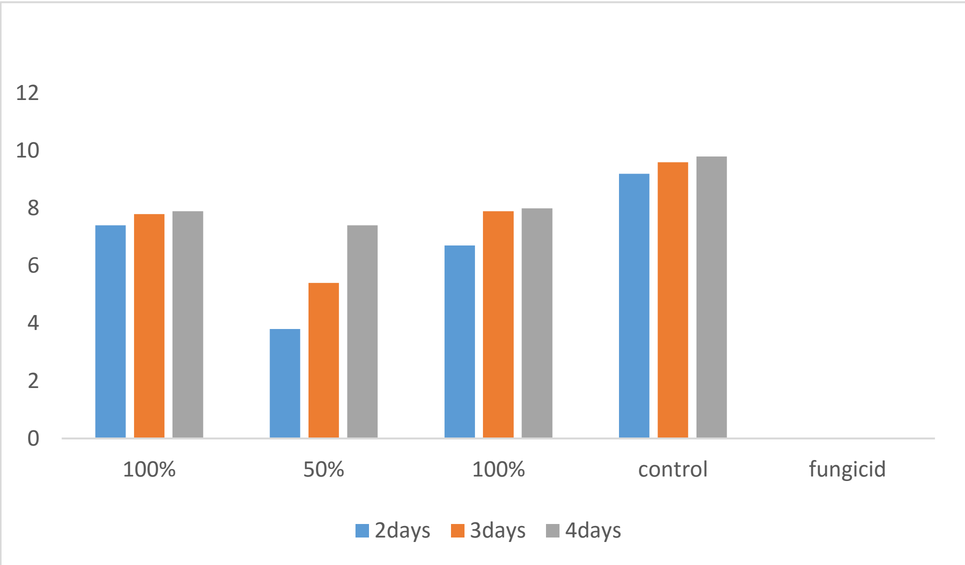

Figure1: Effect of aqueous extract of mesquite leaves, (*Prosopis spp*) on the linear growth of *Penicillium digitatum* after (two, three and four days) post incolation.

CHAPTER FIVE

5-1: DISCUSSION:

The antifungal effects of crude medicinal plant extracts Mesquite leaves was determined by in vitro study using water as solvents three concentration of Mesquite plants extracts were used (25,50and 100%) as antifungal activity against *Fusariumsolani* . The results of the experiment revealed that the mesquite extract was more effective .This finding corroborates the notion plants are one of the most important sources of medicine. Plants-derived compounds (Phytochemicals) have been attracting much interest as natural alternatives to synthetic compounds.

The present investigations revealed that in vitro growth of *F.solani* was significantly checked by aqueous extracts of Mesquite at all concentration results showed that , mesquite had the highest antifungal activity against F.*solani* as it inhibited % the radial fungus growth (100%).

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