The Efficacy Of The Fungicide Ridomil (Metalaxyl) On Control Of Early Blight Disease (*Alternaria solani* Ell. and Mart.) Jones And Grout In Tomato Crop (*Lycopersicon esculentum* Mill.)

By

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ΔΕΔΙΧΑΤΙΟΝ

To my family

Father, mother, brother and sisters.

To every one who gave me a smile to

encourage me

with

endless love.

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CHAPTER ONE

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most widely cultivated food crops. It belonging to the family: Solanaceae. This family contains many cultivated food crops such as Potato, Pepper, Eggplant, Tobacco, Petunia and Tomatille. The origin of Tomato is Central and South America especially Mexico, from where Tomato was transferred to Europe in the ١٦th century, then to the old world continents (Hedrik,١٩١٩ and Rick,١٩٧٦).

The Tomato plant is very versatile and the crop can be divided into two categories: fresh market Tomatoes and processed Tomatoes. In both cases, world production and consumption has grown quite rapidly over the past ٢٥years (Wener,٢٠٠٠). It is highly nutritive and the richest source for lycopene. In the last decade, Tomatoes were grown annually on a total area of about ٣٠٠,٠٠٠ hectare in open fields and about ٣٠٠٠ hectare under cover control farms (Acta-Horticulture,٢٠٠٣). The worldwide production of this crop in ٢٠٠٠ was approximately ٩٨ million metric tons (MMT)(Kemmitt,٢٠٠٢).

At the present time, Tomato is becoming increasingly important in The Sudan for local consumption and for export. Being an important cash crop, Tomato cultivation is now practiced almost through the year. Tomatoes are grown in almost every part of The Sudan successfully during the winter season. The yield is a very low during summer month (Ibrahim,١٩٩٢ and Abdlmageed *et al.*,١٩٩٣). The area under Tomato production has remarkably increased. In ١٩٩٩ the area located for Tomato production was estimated as ١٣٠٠٠ hectare and the amount produced about ٤١٧٠٠٠ MT. In ٢٠٠٠ the area allocated for Tomato production was ٢١٠٠٠ hectare and the amount of production was ٢٤٠٠٠٠ MT.(FAO,١٩٩٩،٢٠٠٠). The major areas of production in the Sudan are Khartoum State, Northern Gezira and many parts of the Northern and Eastern States (Ali,١٩٩٣).

The crop is subject to many pests and diseases starting from the cotyledon stage up to harvest (Kisha,١٩٨٤; Brader *et al.,*١٩٨٥). In the last decade Early Blight Disease was reported as one of the most important handicaps of Tomato production quantitatively and qualitatively (Mohamed,٢٠٠٢; Mohyeldin,٢٠٠٢). Yield loss amounting to ٣٠–٤٠% was reported by Eltayeb (١٩٨٩). All of the previous attempts to control Early Blight Disease through cultural practices and /on application of fungicides which are registered in The Sudan for the control of powdery mildew did not work (Abusin,١٩٩٤). Thus, it became vital to try the use of fungicides registered abroad for the control of Early Blight Disease in The Sudan.

The present study was conducted with the objective of controlling Early Blight Disease with use of one fungicide Ridomil (Metalaxyl) in Tomato crop.

The fungicide will be tested in three concentrations. The efficacy of this fungicide will be assessed by assessment of the following Pathometers:

١-Disease incidence.

٢-Disease severity.

٣-Yield.

CHAPTER TWO

LITERATURE REVIEW

٢,١ Occurrence And World Distribution Of Early Blight Disease:

Early Blight Disease incited by *Alternaria solani* (Ell. and Mart.) Jones and Grout is an old, serious and well-known disease of Tomato and Potato crops (Rich,١٩٨٣). It causes leaf spots and tuber blight on Potato and leaf spots, fruit rot and stem lesions on Tomato (Paulgrow,٢٠٠٠).

Walker (١٩٥٢) reported that the Early Blight Pathogen (*Alternaria solani*)was first described by Ellis and Martin in ١٨٨٢ from dying Potato leaves and was called *Macrosporim solani.* It was also found pathogenic on Tomato crop. *A. solani* is widely spread in the tropics, subtropics and temperate zone (Anon.,١٩٨٣). Hooker *et al*,.(١٩٨١). reported that the fungus has worldwide distribution and infects many types of Solanaceous plants, both cultivated and weeds.

Miller and Pollard (١٩٧٦) reported that the disease is known to occur in all countries of Africa, Asia, Australia, Europe, North America and Central America. In all the States of America, *A. solani* is more profound where the general level of soil fertility is low, especially with normal or excessive July rainfall (Lancashire and Counter,١٩٤٠). Tarr

(١٩٥٥) stated that early blight disease caused by *A. solani* on *Lycopersicon esculentum* (Tomato), in The Sudan is largely scattered in the Central and Southern Sudan and Red Sea Coast.

٢,٢ The Causal Organism:

The causal agent of Early Blight Disease is *Alternaria solani* (Ell. and Mart.) Johns and Grout. It belongs to class: Deuteromycetes (Fungi Imperfecti), order: Monilialales, family: Dematiaceae. It is a member of genus Alternaria that attacks members of family Solanaceae as well as other host plants (Alexopolous and Mims,١٩٧٩).

Alternaria conidia occur abundantly in house dust and have been found to be the chief fungal causes of hay fever and inhalant allergy (Alexopolous and Mims,١٩٧٩). Culture of *A. solani* vary widely in pathogencity. Some are saprophytic, while others are highly pathogenic (Rich,١٩٨٣). A'racy *et al*.,(٢٠٠١) reported that, the fungus is readily cultured on artificial media such as V-٨ juice agar where it produces a deeply pigment gray/black hairy colony. The mycelium is haploid and septate becoming darkly pigmented with age. Sporulation in culture can be stimulated by exposure to fluorescent light. The conidia are borne singly or in chains of two distinct conidiospores. The beaked conidium may possess ٩–١١ transverse septa as well as vertical septa.

Morphological and pathogenic variability among isolates of *A. solani* has given rise to claims of existence of races, although this remain unproven.

Anderson and Frago (٢٠٠٠) reported that *A. solani* produces large pear shaped conidia (١٥–١٩X١٥٠–٣٠ micrometer) with both transverse and longitudinal cross walls. They are detached easily and are carried by air current. Conidiospores occur singly or in small groups and are pale to olive–brown, erect and ٦–١٠ micrometers in diameter and up to ١٠٠ micrometers long. Colonies are gray–brown to black.

٢,٣ Etiology:

The source of the inoculum for the primary infections in an early crop is supposed to be either the over–wintered spores or new spores developed from mycelium that has persisted in the soil or in the plant remains from a former crop. Spores are produced abundantly, especially during heavy dews and frequent rains and are blown in from of mycelia growing on debris or on infected cultivated plants and weeds. Early infections may produce spores to be carried to latter maturing plants by wind and insects. Flea Beetle and Colorado Beetles are the principal agents of dissemination in addition to splashing rain (Heald,١٩٣٣; Agrios,١٩٩٧).

The fungus *A. solani* survive in infected leaf or stem tissues or in the soil. It can be carried on Tomato seeds and in Potato tubers. Air currents, wind blown soils, splashing rain and irrigation water, easily carry *A. solani* spores. Infection of susceptible leaf or stem tissues occur in warm, humid weather with heavy dews or rain. Early Blight can be developed quite rapidly in mid to late season and is more severe when stressed by poor nutrition, drought and pests (Dillard *et al.,*١٩٩٥). Warm temperatures and high relative humidity favour infection (Ohms and Fenwick,١٩٦١; Harrison *et al.,*١٩٦٥; Easton *et al.,*١٩٧٦). Tiny wounds caused by blowing sand favour disease development, especially if followed by dew, fog or rain (Rotem,١٩٥٩). The highest rate of spores dispersal of *A. solani* was observed on the final stage of Early Blight Disease and continued for more than weeks after the plant have died (Rotem,١٩٦٤). The mycelium of the fungus remains dormant in dry infected leaves for a year or more. Conidia have been found to retain viability for ١٧ months at room temperature (Rsmehrotra,١٩٨٠). Under dry conditions it can survive in infected plant debris in the soil for up to three years. It is also a seed-born pathogen (Anon.,١٩٨٣). High nitrogen and low phosphorous fertilizers resulted in the lowest incidence of *A. solani* infection (Barchay *et al.*,١٩٧٣; Soltanpour and Harrison,١٩٧٤).

٢,٤ Symptomatology:

Symptoms are initially observed on older, senescing leaves (Rands, ١٩١٧; Pscheidt,١٩٨٥). Walker (١٩٦١) reported that the disease appears first as spots on the leaflets of Tomato and Potato. Symptoms of the above ground parts according to Rowe *et al.*,(١٩٩٦) usually appear first on older leaves and consist of small, irregular, dark brown to black and dead spots ranging in size from a pin point to half an inch in diameter. As the spots enlarge, concentric rings may form as a result of irregular growth patterns by the organism in the leaf tissue. This gives the lesion a characteristic "target–spot" or "bull's eye" appearance. There is often a narrow, yellow halo around each spot and veins usually border lesions. When spots are numerous, they may grow together, causing the infected leaves to turn yellow and die. Usually the oldest leaves become infected first and they dry up and drop from the plants as the disease progresses up the main stem.

Fruit infection occurs while fruit is green. The infection of both green and ripe Tomato fruits normally lead to reduction in fruit size and the infected fruits may drop prematurely. Of the characteristics of this disease is the appearance of foliage blight usually coincides with time when the plant have begun formation of fruits (Walker,١٩٥٢). Tomato crop is susceptible to *A. solan*i at all growth stages but susceptibility increase as plants mature (Vloutaglou and Kalogerakis,٢٠٠٠).

Kemmitt (٢٠٠٠) reported that, Early Blight Lesions on Tomato stems are often sunken and lens–shaped on young Tomato seedlings. Lesions may completely girdle the stem. This phase of the disease is known as "collar rot" which may lead to reduction in plant vigor or death of the plant.

٢,٥ Economic Importance Of The Disease:

Early Blight Disease is one of the most common diseases of many kinds of plants throughout the world. It affects the leaves, stems and fruits in vegetables. Early Blight cause great losses in the total production (Agrios,١٩٧٨; Dorozhkin and Ivanyuk,١٩٧٩; Hafiz,١٩٨٦). Eltayeb (١٩٨٩) revealed that the occurrence of Early Blight disease was observed on four crops. These were Potato, Tomato, Eggplant and Pepper. Furthermore *A. solani* was recorded on two other perennial plant species namely, *Datura sp*. and *Ipomea sp.*

Losses in yield range from ٦ to ١٠٠٪ as reported by Haware (١٩٦٨). The disease causes direct losses by the infection of fruits and indirect losses by reducing plant vigor. Fruit from defoliated plants are also subject to sunscald (Watte,١٩٩٤). The severe epidemic of early blight may reduce potato and tomato yields by as much as ٢٠ to ٣٠٪ (Blackinski *et al.,*١٩٩٦). Foolad *et. al.,*(٢٠٠٢) found that the disease causes plant defoliation which reduces yield, fruit quality and contributes to significant crop loss.

٢,٦ Control Measures:

Early Blight Disease is generally one of the most severe Tomato problems facing vegetable growers each season. For top yield of high quality, early blight control is essential. Anderson and Frago (٢٠٠٠) reported that, the disease is controlled primary though the use of resistant cultivars, cultural practices and foliage fungicides.

٢,٦,١ Cultural Control Measures:

Anderson and Frago (٢٠٠٠) reported that cultural practices, such as ploughing, crop rotation, removal and burning of infected plant debris, eradication of weed hosts, help to reduce the inoculum level for subsequent plantings and susceptible crops. Other cultural measures include avoiding irrigation in cool, cloudy periods, harvesting fully mature fruits and avoiding bruising or other mechanical damage.

One of the most important components of Early Blight Disease management is selection of cultivars that have lower susceptibility to disease (Rowe *et al.,*١٩٩٦). Incorporation of cultivars resistance in a reduced spray strategy to suppress early and late blight of potato has been emphasized by Shtienberg *et al.,(*١٩٩٠). Kemmitt (٢٠٠٢) reported that, using wild lycopersicon species, which showed a high degree of resistance in breeding programs, has led to the release of a number of Tomato cultivars with a degree of resistance to Early Blight Disease.

High nitrogen and low phosphorous treatment significantly reduced the incidence of the disease. Maintenance of adequate soil fertility levels is critical for managing Early Blight. The disease is often associated with crops suffering from insufficient nitrogen (Kemmitt,٢٠٠٢).

٢,٦,٢ Chemical Control Measures:

The use of fungicides is still the primary tool for controlling most major diseases such as Early Blight. Early Blight Disease can cause economic losses, but sprays are not initiated until spotting occur (Nancy Pataky,١٩٩٩). Stevenson (١٩٩٤) reported ١٨–٣٩٪ increase in yield in well sprayed areas. Timely spraying with fungicides is the best method of protection against the disease (Singh,١٩٨٣). Ivanyuk (١٩٨٣) found that the effects of fungicides on Tomato and Potato crops inoculated with *A. solani* include: disturbance of the biology of the pathogen, reduction of the rate of infection and strengthening defense reaction of the plant. Kemmitt (٢٠٠٢) reported that, timing of fungicide sprays relative to environmental conditions and subsequent potentialities for disease development is critical if good control is to be attained.

Walker (١٩٥٢) and Mckay (١٩٥٥) reported that Bordeaux mixture and insoluble Copper are only moderately effective, Nabam plus Zinc sulfate, Zineb and Ziram are more effective. Ramakrishana and Kandasway (١٩٧٨) showed that the most effective and economic control measure of Early Blight on Tomato was achieved though the use of Dithane M-٤٥(Mancozeb) followed by Benlate (Benomyl) and Difolatan (Captafol). Guddewar *et al.*,(١٩٩٢) reported that the best control of Early Blight Disease and the highest yields were obtained with Mancozeb followed by Captan and Copper oxychloride. Fungicides were applied ٥٣ days after planting with ٣ more sprays at intervals of ٧ days.

According to Daman and staub (١٩٩٢), Difenoconazole was found to be very effective against Early Blight because of its protectant, curative and eradicant mode of action. Chemical control of Early Blight by foliar application of Antracol and Dithane M-٤٥(Mancozeb) has been reported by Shuja (١٩٩٥) and Siddiqui *et al.*,(١٩٩٥). Dithane (Mancozeb) M-٤٥ has been reported as very effective fungicide against Early Blight having protective and eradicative properties (Rizvi,١٩٩٥).

Anderson and Frago (٢٠٠٠) reported that protective fungicides (*i.e* Maneb, Mancozeb, Chlorothalonil and Triphenyl tin hydroxide) are effective against Early Blight when applied at approximately ٧–١٠ days intervals. Accordingly spraying should commence at the first sign of the disease or immediately after blooming. Acrobat MZ is newly introduced effective fungicide having protective, curative and antisporulent properties which provides long residual protection (Anon.,٢٠٠٢). Fadl *et al.*,(١٩٨٥) in laboratory tests with ٣ fungicides observed that Ridomil MZ(Metalaxyl) was most inhibitory to linear growth at low concentration.

Metalaxyl being a member of Acylalanine group and is characterized by its systemic activity (Cooke *et al.*,١٩٨١) provides control when applied as foliar spray, by reducing spore germination, intercellular growth of the fungus and sporulation. Ridomil Gold (Mancozeb + Metalaxyl) ٦٨ WP reduces both growth and sporulation of the fungus while Mancozeb only inhibits spores germination. Two sprays of these effective fungicides successfully controlled the disease.

CHPPTER THREE

MATERIALS AND METHODS

٣,١ Experimental Site:

The experiment was conducted during winter season of ٢٠٠٤/٢٠٠٥ in The Demonstration Farm Of The Department Of Horticulture Of The Faculty Of Agriculture–University Of Khartoum, Shambat (Latitude ١٥° ٤٠'N and Longitude ٣٢° ٣٢'E and Altitude ٢٨٠ meters above Sea level).

٣,٢ Climate:

The climate is semi arid, tropical with an average annul rainfall of ١٦٠mm. coming mostly during July–September. The mean maximum and mean minimum temperatures are as high as ٤٢° C in summer and around ١٢°C in winter, respectively (Adam,١٩٩٦).

٣,٣ Soil:

The soil is clay loamy type, slightly alkaline with pH ٧,٥–٧,٧ which suits tomato production (Elhassan,١٩٨٨)

٣,٤ Materials:

The materials used in this experiment were Tomato seed var. Peto ٨٦. This variety was chosen because it is popular among Tomato growers. The fungicide used was Ridomil (Metalaxyl), Urea (٤٦٪N) and Knapsack sprayer five liters capacity (١٥ Ib./inch).

٣,٥ The Experiment:

٣,٥,١ Land Preparation:

The experimental field site chosen was a sick plot heavy infected with debris to Tomato plots previously infected with Early Blight disease incited by *Alternaria solani*. The land was ploughed, harrowed, leveled and divided into ٢٠ plots. The plot size was ٣x٣ meters. Each plot comprises two mastaba of ٢,٥x١ meters each. Mastaba run east–west.

٣,٥,٢ Sowing:

The seeds were sown in the last week of December ٢٠٠٤, in the northern side of the mastaba by direct seeding, at the rate of ٦–٨ seeds per hole at spacing of ٢٠ cm. between holes.

٣,٥,٣ Thinning:

Thinning was done seven weeks after sowing. Four plants were left in each hole. Two weeks after first thinning the second thinning was performed leaving two plants per hole.

٣,٥,٤ Watering:

Land was irrigated immediately after sowing and then at frequency of ٤–٧ days.

٣,٥,٥ Weeding:

Hand weeding was performed ٧, ١٠ and ١٤ weeks after sowing .

٣,٥,٦ Fertilization:

Urea fertilizer (٤٦٪N) in a granular form was applied manually in two splitted doses ٧ and ١١ weeks after sowing at the rate of ٥٠Kg/fed.

Foliar fertilizer, special liquid fertilizer (Amainos) was added at ١٢, ١٣, ١٤, ١٥ weeks after sowing at the rate of (٥،٦ ml/L) using a Knapsack sprayer.

٣,٥,٧ The Treatments:

The experiment comprised one fungicide, Ridomil* which was applied at three different concentrations, together with the control treatment (No Chemical).

The doses were chosen according to the recommendation of the manufacturing company. These were proposed dose, ٢٥٪ more and

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* Donated by Nilan Company< Khartoum. Not registered yet for control of Early Blight Diseases.

٢٥٪ less than the proposed dose (Table No.١). Each treatment was replicated four times. The statistical design adopted was the Completely Randomized Block Design (CRBD).

٣,٥,٨ Spraying:

The fungicide was applied at the appearance of Early Blight symptoms at the three concentrations chosen at ٨, ١٠ and ١٢ weeks after sowing using Knapsack sprayer five liters capacity (١٥ Ib./ inch).

٣,٥,٩ Harvesting:

Harvesting of fully mature fruits started ١٤ weeks after sowing and continued for four weeks. Picking of Tomato fruits at the ripening stage was performed every ٢ to٣ days.

٣,٥,١٠ Weighing:

The harvested fruits were weighed using a sensitive ordinary balance called MFD BY A and D CO., LTD< JAPAN.

٣,٦ Data Collection:

٣,٦,١ Sampling:

The plants in the first two holes in each mastaba were left as guards. From each replicate of each treatment eight plants were checked for the disease incidence, disease severity and yield.

Table No.(١): The Treatments Of Applied

Fungicide	Symbol	Designation	Dose (kg/fed.)
Ridomil	A	٢٥ % more	١,٢٥
	B	Proposed dose	١,٠٠
	C	٢٥ % less	٠,٧٥
Control	D	No chemical	٠,٠٠

٣,٦,٢ Disease Incidence:

Only the plants displaying the typical symptoms of Early Blight disease were considered diseased. Disease incidence was assessed three times during the season, before: the first spray, second spray and third spray. The first count was when the plants were ٨ weeks–old. And then every ١٤ days. The percentage of disease incidence was calculated as follows:

Percentage Of Disease Incidence =

$$\frac{\text{No. Of Diseased Plants}}{\text{Total No. Of The Plants}} \text{ X ١٠٠}$$

٣,٦,٣ Disease Severity:

Disease severity was assessed one time when the plants were ١٢ weeks–old. The percentage of disease severity was assessed from the leaves of the whole infected plants, it was calculated as follows:

Percentage Of Disease Severity =

$$\frac{\text{No. Of Infected Leaves Of ٨ Plants}}{\text{Total No. Of The Leaves Of ٨ Plants}} \text{ X ١٠٠}$$

٣,٦,٤ Yield:

٣,٦,٤,١ Number Of Fruits Per Plant:

It was calculated as follows:

$$\text{Number Of Fruits/Plant} = \frac{\text{Total No. Of Fruits}}{\text{Total No. Of Plants}}$$

٣,٦,٤,٢ Discarded Fruits:

The discarded fruits were calculated by counting the number of unmarketable fruits by using the following formula:

$$\text{Percentage Of Discarded Fruits} = \frac{\text{No. Of Discarded Fruits}}{\text{Total No. Of Fruits}} \text{ X ١٠٠}$$

٣,٦,٤,٣ Yield Per Unit Area:

Total yield of fruits for each treatment in each replicate was calculated as follows:

Percentage Of Yield in kg/ha. =

$$\frac{\text{Yield in kg/Mastaba}}{\text{Area Of Mastaba}} \text{ X } \frac{\text{١٠٠٠٠}}{\text{١٠٠٠}} \text{ X ١٠٠}$$

٣,٧ Statistical Analysis:

The obtained data were subject to analysis for variance appropriate for the Completely Randomized Block Design, according to the procedure described by Gomez and Gomez (١٩٨٤).

CHAPTER FOUR

RESULTS

٤,١ Disease Symptoms:

The symptoms showed up as leaf spots which are dark–brown to black in colour. The spot range size varies from a pin point up to about four mm.(Plate No.١). Lower leaves are usually attacked first and then, as the disease progresses upwards the young leaves became infected and makes affected leaves fall–off. There is often a narrow chloratic zone around spots.

Dark–target like sunken spots develop on branches and stems. In severe infection spots showed upon fruits which became malformed and rottened (Plate No.٢).

٤,٢ The Disease:

٤,٢,١ Disease Incidence:

At the time of the first spray there was no disease symptoms on the Tomato plants in the field experiment as shown in AppendixTable No.(١). Before the second spray the symptoms of the disease became obvious (AppendixTable No.٢).

Plate No.(١): Right: Healthy Leaf   Left: Infected Leaf

(a) (b) (c)

Plate No.(٢): Healthy fruit(a) Discarded fruits(b) and (c)

The results presented in Figure No.(١) and AppendixTable No.(٣) clearly showed that the use of Ridomil (Metalaxyl) at the three concentrations resulted in variable reductions in the disease incidence (mean of ٤٥,٠٠–٥٦,٣١%) in comparison with the control treatment (٦١,٦٣%). The highest percentage of disease incidence of ٦١,٦٣٪ was reported for treatment D(control) and the lowest percentage of ٤٥٪ was reported for concentration A(١,٢٥kg/fed).

The statistical analysis revealed significant differences among the four treatments.

٤,٢,٢ Disease Severity:

The results presented in Figure No.(٢) and AppendixTable No.(٤) clearly showed that the use of Ridomil at the three concentrations resulted in variable reductions in the disease severity (mean of ٤,٥٦–٧,٠٧٪) in comparison with the control treatment (٨,٩٦%). The highest percentage of disease severity of ٨,٩٦% was recorded for treatment D(control) and the lowest percentage of ٤,٥٦% was reported for concentration A(١,٢٥kg/fed.).

The statistical analysis revealed significant differences among the four treatments.

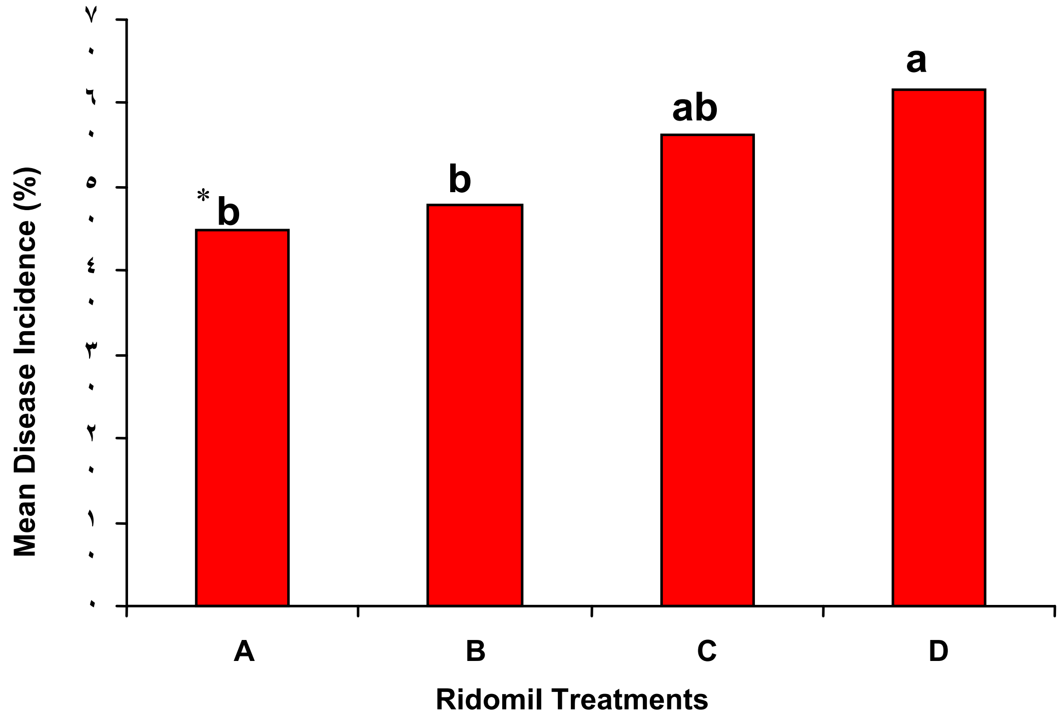

Figure No.(١): Effect Of Ridomil Treatments On Early Blight Disease Incidence In Tomato Crop

* Columns With The Same Letters Were Not significantly Different From Each Other According To LSD Test At ٥٪

Legend:

A= ١,٢٥ kg/fed.

B= ١,٠٠ kg/fed.

C= ٠,٧٥ kg/fed

D= ٠,٠٠ kg/fed

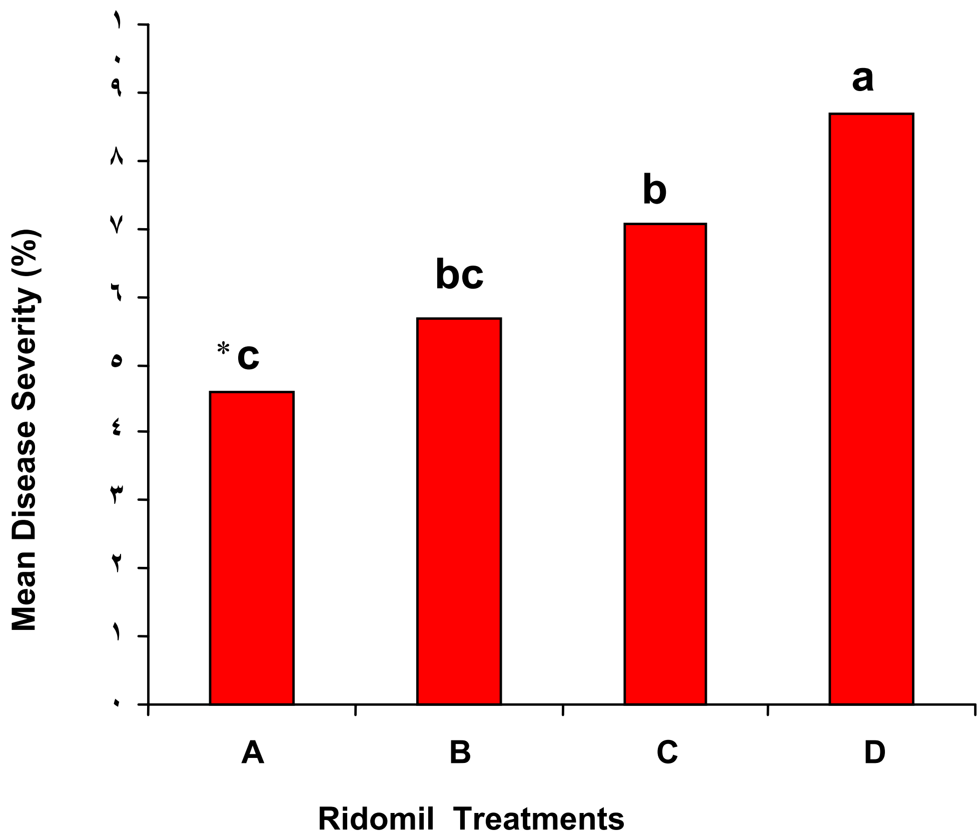

Figure No (٢): Effect Of Ridomil Treatments On Early Blight Disease Severity In Tomato Crop

Legend:

A= ١,٢٥ kg/fed.

B= ١,٠٠ kg/fed.

C= ٠,٧٥ kg/fed

D= ٠,٠٠ kg/fed

٤,٣ Yield:

٤,٣,١ Number Of Fruits:

The results presented in Figure No.(٣) and AppendixTable No.(٥) clearly showed that the use of Ridomil at the three concentrations resulted in an increase in the number of fruits per plant in comparison with the control treatment except in treatment B(proposed dose, Ridomil ١kg/fed.). The use of Ridomil at concentration of ٠,٧٥kg/fed. resulted in the highest number of fruits per plant (*i.e* ٩,٠٨).

In spite of the noticeable increase in the number of fruits, the statistical analysis revealed no significant differences among the four treatments.

٤,٣,٢ Discarded Fruits:

The results presented in Figure No.(٤) and AppendixTable No.(٦) clearly showed that the use of Ridomil at the three concentrations resulted in variable reductions in the percentages of discarded fruits (mean of ٢,٠٨–٣,٨١٪) in comparison with the control treatment (٣,٩٨٪). The highest percentage of discarded fruits of ٣,٩٨% was recorded treatment D(control) and the lowest percentage of ٢,٠٨٪ was recorded for concentration A(١,٢٥kg/fed.).

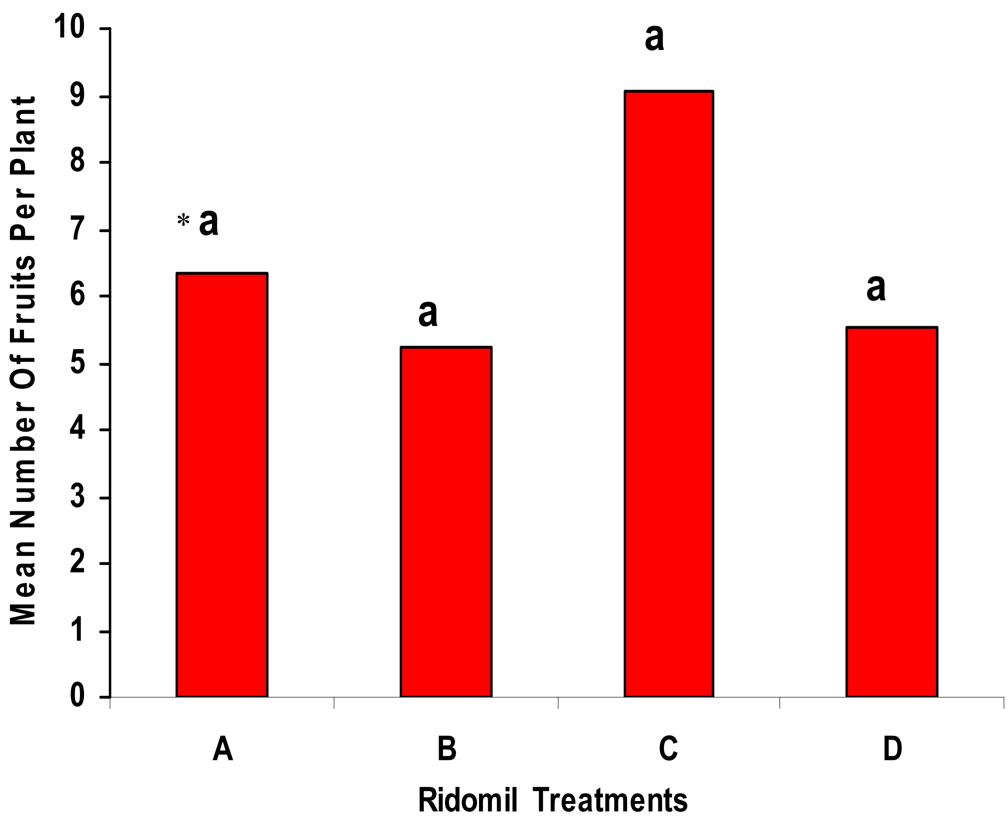

Figure No. (3): Effect Of Ridomil Treatments On Number Of Fruits Per Plant In Tomato Crop

Legend:

A= ١,٢٥ kg/fed.

B= ١,٠٠ kg/fed.

C= ٠,٧٥ kg/fed.

D= ٠,٠٠ kg/fed.

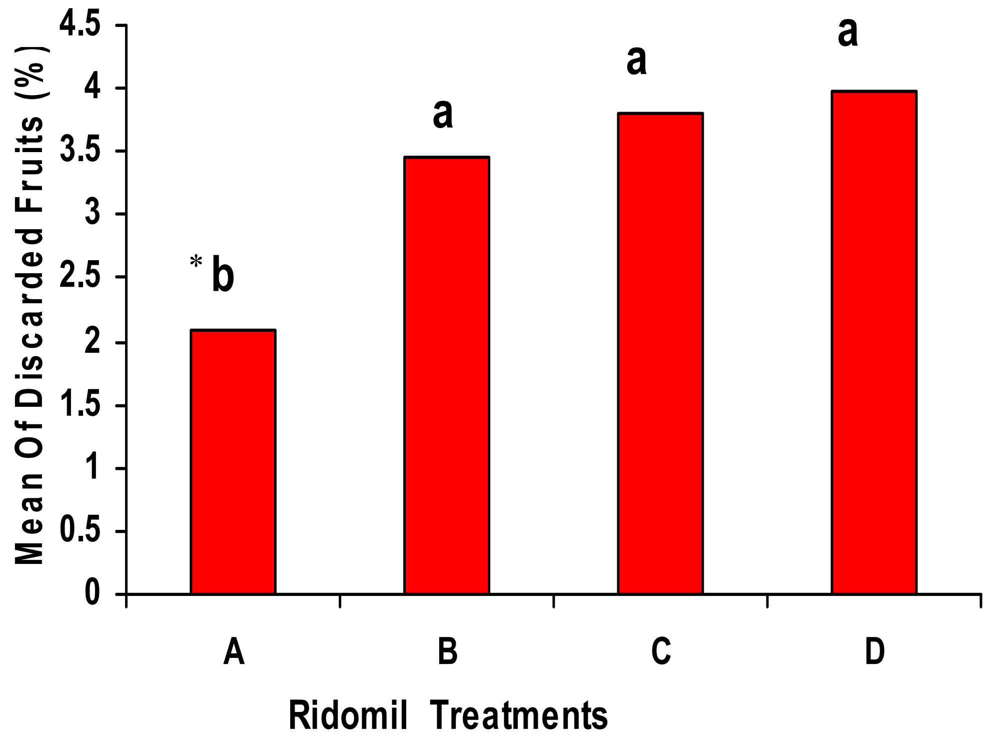

Figure No.(4): Effect Of Ridomil Treatments On Discarded Fruits In Tomato Crop

Legend:

A= ١,٢٥ kg/fed.

B= ١,٠٠ kg/fed.

C= ٠,٧٥ kg/fed.

D= ٠,٠٠ kg/fed.

The statistical analysis revealed significant differences among the four treatments.

٤,٣,٣ Yield Per Unit Area:

The resulted presented in Figure No.(٥) and AppendixTable No.(٧) clearly showed that the use of Ridomil at the three concentrations resulted in variable increases in the yield (mean of ٣٨,٥٣–٥٤,٥٠٪) in comparison with the control treatment (٣٤,٩٦٪). The highest percentage of increase of ٥٤,٥٠٪ was recorded for concentration C(٠,٧٥kg/fed.).

In spite of the noticeable increase in the yield, the statistical analysis revealed no significant differences among the four treatments.

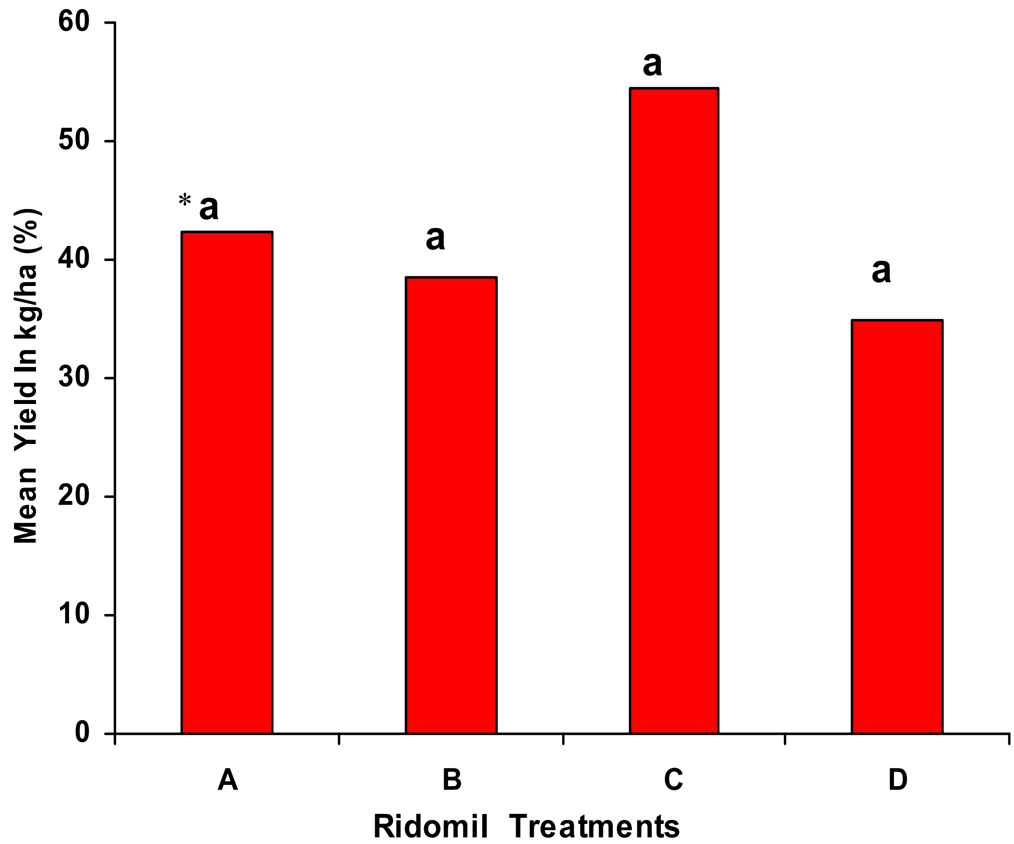

Figure No.(5): Effect Of Ridomil Treatments On Yield Per Unit Area For Tomato Crop

Legend:

A= ١,٢٥ kg/fed.

B= ١,٠٠ kg/fed.

C= ٠,٧٥ kg/fed.

D= ٠,٠٠ kg/fed.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

In attempt to control Early Blight Disease incited by *Alternaria solani* to gain high Tomato yield, the fungicide Ridomil (Metalaxyl) was applied at three concentrations.

The results clearly showed that Early Blight Disease is a potential threat to Tomato production in The Sudan. The mean disease incidence reported on Tomato from the field experiment was ٤٥,٠٠-٦١,٦٣٪. The use of Ridomil at concentration of ١,٢٥kg/fed. clearly retarded the development of the disease. This result agreed with the findings of Soltanpour and Harrison (١٩٧٤), Platt(١٩٨٣), Fadl *et al.,(*١٩٨٥), Latif *et al.,*(١٩٩١) and Abusin (١٩٩٤) who reported that the disease incidence of Early Blight was reduced in plots treated with the chemicals application.

The mean disease severity reported in Tomato was ٤,٥٦–٨,٩٦٪. The use of Ridomil at concentration of ١,٢٥kg/fed. clearly retarded the development of the disease. The results clearly showed that the use of the fungicide Ridomil reduced the disease severity. This result agreed with the findings of Anon(١٩٨٣), Platt(١٩٨٣), Guddewar(١٩٩٢), Shuja(١٩٩٥) and Siddiqui *et al.,(*١٩٩٥) who reported that the chemical application reduce severity of the disease.

Regarding the yield in the terms of number of fruits per plant and yield, Ridomil at the concentration of ٠,٧٥kg/fed. resulted in the highest number of fruits per plant of ٩,٠٨ . The highest yield of ٥٤,٥٠kg/ha. with an increase of ٥٥,٨٩kg/ha. in comparison with the control were recorded when Ridomil at the concentration of ٠,٧٥kg/fed. was used. No significant differences were detected between all concentrations.

Another important parameter of yield is the percentage of discarded fruits. The use of Ridomil at the concentration of ١,٢٥kg/fed. resulted in the least percentage of discarded fruits of ٢,٠٨٪. This result agreed with the finding of Klokocar *et al.,*(١٩٩٧) who reported the chemical application to control of Early Blight Disease increased Tomato yield.

The results obtained are encouraging. This agreed with Shtienberg *et al.,(*١٩٨٩) who reported that the applications beginning at sex to seven weeks after planting were the first to make a positive contribution in the disease suppression. This timing was consistent regardless of the inoculation date or the susceptibility group of cultivars tested.

The use of Ridomil at concentration of (١,٢٥kg/fed.) proved to be the most effective in combating Early Blight Disease compared with the other treatments. Because it reduced the percentage of the disease incidence and the disease severity and discarded fruits. Also the use of Ridomil at concentration of ٠,٧٥kg/fed. proved to be the most effective in an increase of the number of fruits per plant and yield when it is compared to the other two concentrations. Because it reduced the percentage of the disease incidence and the disease severity and discarded fruits. Also the use of Ridomil at concentration of ٠,٧٥kg/fed. proved to be the most effective in an increase of the number of fruits per plant and yield when it is compared to the other two concentrations.

Proposals For Further Study:

١–Identification of the isolates of this fungus (if any).

٢–Studies on the epidemiology of the disease.

٣–Laboratory experiments may determine more appropriate concentration (s) of Ridomil (Metalaxyl) to be tested.

٤–Studies on the significance of Early Blight Disease as a threat to Tomato production and distribution of *Alternaria solani* in The Sudan.

٥–More fungicides to be tested with the timing of initial spray and frequency of sprayings.

٦–Vertical resistance of many Tomato varieties.

REFERENCES

Abdelmageed, A. H. Gruea, N. and Gyer, B.(٢٠٠٣). On International Agriculture research for Development. October ٢٠٠٣, Gottingen, Germany.

Abusin, R.M.A.(١٩٩٤). A study on the chemical and cultural control of early blight disease (*Alternaria solani* Ell. And Mart.) Jones and Grout on potato. M. Sc. Thesis, University of Khartoum.

Acta–Horticulture, Application of International Society for Horticulture Science Vol.٤٣. PP:٢٧–٢٨ No.٢(٢٠٠٣).

Adam, H. S.(١٩٩٦). The Agriculture climate. Dar Alsala Publication ١st Ed. P:٥٧(Arabic).

Agrios, G. N.(١٩٧٨). Plant pathology. ٢nd Ed. Academic press, New York. PP:٧٠٣.

Agrios, G.N.(١٩٩٧). Pant pathology. ٣rd Academic press. PP:٣٠٠-٣٠٣.

Alexopolous, C. J. and Mims, C. W.(١٩٧٩). The causal agents of early blight disease. Introductory Mycology. ٣rd Ed. PP:٥٦٦–٥٦٧.

Ali, A. E.(١٩٩٣). Tomato fruit and seed yield and quality as affected by plant population and site of planting under Sudan condition. M. Sc. Thesis, University of Khartoum.

Anderson, S. D. and Frago, D.(٢٠٠٠). Early blight of potato Extension fact sheet. Department of plant pathology. *North. Darcota State University of Agriculture and applied Science.*

Anonymous(١٩٨٣). Seed potatoes in the Sudan. Reported of The Identication of mission. Department of Horticulture, Sudan PP:٢٢.

Anonymous(٢٠٠٢). Literature and sample of fungicides. Acrobat MZ ٩٠/٦٠٠ g kg^{-1} WP for BASF chemicals and polymers Pakistan (Pvt.) Ltd.

A'racy, C. J.; Eastbum D.M. and Schumann, G. L.(٢٠٠١). IIIustraterd Glossary of Plant Pathology. The plant health instructor Do ١:١٠,١٠٩٤/PH ١-١-٢٠٠١-٠٢١٩-٠١.

Barclay, G.M.; Murphy, H. J; Manzer, F. E. and Hutchinson, F. E.(١٩٧٣). Effect of differential rates of nitrogen and phosphorus on early blight in potatoes. *Am Potato. J.* ٥٠:٤٢-٤٨.(cf. Rich,١٩٨٣).

Brader, L.; Buckx, E. J.; Davies, J.C. and Reed, W.(١٩٨٥). In : Pesticides application principles and practices. Ed. P. J. Haskell Clavendon Press Oxford.

Cooke, L. R.; Clifford and M. E. Holgate (١٩٨١). Control of potato late blight with systemic fungicides Sci. ١٢:٦٧٨.

D. Blackinski; D. Shtienberg; A. Dinoor; U. Kafkafi; L. S. Suikowski; T. A. Zitter and W. E. Fry(١٩٩٦). Influence of foliar application of nitrogen and potassium on Alternaria disease in potato, tomato and cotton. *Phytoparasitica* ٢٤(٤):٢٨١-٢٩٢.

Dahman, H. and T. Stanb(١٩٩٢). Protective, curative and eradicative activity of difenoconazol against (*Venturia inaequalis, Cercospora arachidicol and Alternaria solani*). *Plant Disease.* ٧٦:٧٧٤-٧٧٧.

Dillard, H.; D. Cole; T. Hedgen; A. Turner, D. Utete; B. Muere; Agubba and P. Wilkinson(١٩٩٥). Early blight of tomatoes. Zimbabwe Horticultural Crops Pest Management. NYSAES, Geneva NY.

Dorozhkin, N. A. and Ivanyuk, V. G.(١٩٧٩). Epiphytotics of dry leaf spot of potato and tomato. *Mikologiyai Fitopathologiya.* ١٣:٣١٤-٣٢١.

Easton, G. D. Nagle, M. E. and Bailey, D. L.(١٩٧٦). Lack of foliar protection from early blight by aircraft applied fungicides on sprinkler–irrigated potatoes. *Plant Dis. Rep.* ٥٩:٩١٠–٩١٤.(Abstract).

Elhassan, M.(١٩٨٨). A study on the effects of salinity on the nutrient status and yield of foster grape fruit (*Citrus paradisi* Mact.). M. Sc. Thesis, University of Khartoum.

Eltayeb, A. E. (١٩٨٩). A study on early blight disease (*Alternaria solani* Ell. and Mart.) Jones and Grout on potato tomato in Khartoum North District. M. Sc. Thesis, University of Khartoum.

Fadl, F. A.; N. George and I. M. Elfangary.(١٩٨٥). Chemical control of tomato early blight disease in Egypt. Agric. Res. Rev. ٦٣:١٢١-١٢٦.

FAO. (١٩٩٩) Years book series production statistical summary of tomatoes. Vol.٥٣.

FAO. (٢٠٠٠) Years book series production statistical summary of tomatoes. Vol.٥٤.

Foolad, M. R.; Zhang, L. P.; Khan, A. A.; Nino-liu, D.; Lin, G. Y.(٢٠٠٢). Identification of QTLS for early blight *(Alternaria solani)* resistance in tomato using back cross populations of a *(Lycopersicon esculentum)* XI–hirsutum cross. *Theoretical and Allied Genetic* ٢٠٠٢,١٠٤:٦-٧,ref. (Abstract).

Gomez, K. W. and Gomez, A. A.(١٩٨٤). Statistical procedures for Agriculture Research. ٢nd Ed. John Willey and sons. Inc. New York. PP:٢٨٧.

Guddewar, M. B.; Saleem, M.; Chand, P.; and Shukla, A.(١٩٩٢). Field evaluation of fungicides against potato early blight (*Alternaria solani*). Plant Protection Bulletin Faridabad. ٤٤:٣٤–٣٥.(Abstract).

Hafiz, A. T. I.(١٩٨٦). Plant diseases. Pakistan Agriculture Research Council. ٢٠٨-٢٠٩ and ١٨١.

Harrison, M. D.; Livingston, G. H. Oshima, N.(١٩٦٥). Epidemiology of potato early blight in Colorado, initial infection, disease development and influence of environmental factors. *Am. Potato J.*٤٢:٢٧٩–٢٩١.(cf. Rich,١٩٨٣).

Haware, M. P.(١٩٦٨). Assessment of losses due to early blight disease on potato. *JNVKVV. Res. J.* ٢:٦٧–٦٨.(Abstract).

Heald, F. D.(١٩٣٣). Manual of plant disease. ٢nd Ed. PP:٦٧٢–٦٧٩.

Hedrick, U. P.(١٩١٩). Sturtevant notes on edible plants. J. B. Lyon Co. Albany. N. Y. ٦٨٦.

Hooker, W.J.(١٩٨١). Compendium of potato disease. American Phytopathological Society. St. Paul. MN. PP:١٢٥.

Ibrahim, A. S.(١٩٩٢). The effect of staking and spacing on tomato earliness, yield and quality in Khartoum Area.

Ivanyuk, V. G.(١٩٨٣). Resistance of some Solanaceous crops to (*Macrosporium solani*) induced by physiologically active agents. *Sel, Skokhoz Gaistvennaya Biologiya*. ٨:٥٨–٦٥.(Abstract).

Kemmitt, G.(٢٠٠٢). Early blight of potato and tomato. The Plant Health Instructor Do ١:١٠–١٠٩٤/PH ١–١– ٢٠٠٢–٠٨٠٩–٠١.

kisha, J. S. A.(١٩٨٤). White fly (*Bemisia tabaci*) infestation on tomato varieties and a wild Lycopersicon species. Tests of Agro-chemicals and cultivars. N°٥. (Ann. Appl. Bio. ١٠٤, Supplement, PP:١٢٤–٥.

Klokocar, Smit. Z.; Indjic, D.; Jakavljev, R.; N. Dzi, F.(١٩٩٧). Problems in control of early blight in tomato. Proceedings of the First Balkan Symposium on Vegetables and Potatoes, Belgrade, Yugoslavia, ٤-٧June ١٩٩٦ :Vol.٢. Acta-Horticulture-١٩٩٧. No.٤٦٢, ٦٦٧-٦٧٢; ٩ ref.(Abstract).

Lancashire, E. R. and Counter, B. F.(١٩٤٠). Tomato production in ١٩٤٠. *The review of applied mycology*. ١٩:٦٢٢.

Latif, M.; Ilyas, M. B.; Dogar, M. A.(١٩٩١). Screening of patoto germplasm and fungitoxicants against early blight disease. *Journal of Ahricultural Research* (Pakistan). ٢٩:٩٣–٩٧.

Mckay, R.(١٩٥٥). Potato disease. ١st Ed. The Sign of Three Candles, Dublin. PP:١٢٦.

Miller, P. R. and Pollar, H. L.(١٩٧٦). Multilingual compendium of plant disease. *Am. Phytopathol. Soc.*(cf. Rich,١٩٨٣).

Mohamed, W. M.(٢٠٠٢). A study on the chemical control of early blight disease (*Alternaria solani* Ell. and Mart.) Jones and Grout on tomato crop (*Lycepersieon esculentum* Mill.). M. Sc. Thesis, University of Khartoum.

Mohyeldin, Z.H.(٢٠٠٢). A study on the chemical control of early blight disease (*Alternaria solani* Ell. and Mart.) Jones and Grout on potato crop (*Solanum tuberosum* L.). M. Sc. Thesis, University of Khartoum.

Nancy Pataky.(١٩٩٩). Tomato leaf spots. University of Illinois Extension.

Ohms, R. E. and Fenwik, H. S.(١٩٦١). Potato early blight symptoms cause and control. *Idah, Agric. Exten. Serv. Bull*. ٣٤٦.(Abstract).

Paulgrow (٢٠٠٠). Definition of tomato early blight. seen *Via Net.*

Platt, H. W.(١٩٨٣). The Effect of Metalaxyl, Mancozeb and Chlorothalonil on early blight, yield and tuber rot of potato. Canadian Journal of Plant Pathology. ١:٣٨-٤٢.(Abstract).

Pscheidt, J.W.(١٩٨٥). Epidemiology and control of potato early blight, caused by *(Alternaria solani*). Ph. D. Dissertation, University of Wisconsin, Madison.

Ramakrishnan, L. and Kandasway, T. K.(١٩٧٨) . Efficiency of fungicides on control of Alternaria leaf spot of tomato. *Agriculture J*. ٦٥:١٢٢–١٢٣.

Rands, R. D.(١٩١٧). Early blight of potato and related plants. Wisconsin Agriculture Experimental Station Research Bulletin. ٤٢:١-٤٨.

Rich, A. E.(١٩٨٣). Potato disease. Academic Press. New York, London. PP:٢٣٨.

Rick, C. M.(١٩٧٦). Tomato in N. W. Simmonds (Ed.). Evaluation of crop plants. PP:٢٦٨ Longman. London.

Rizvi, S. I.(١٩٩٥). Chemical control of early blight of patoto (Abstr). Bibliography on Potato in Pakistan Abstracts and database. Pak Swiss Potato Development Project. PARC, Islamabad PP:٨٠

Rotem, J.(١٩٥٩). The Influence of sand storm in the Negev on the sensitivity of potatoes and tomatoes to the early blight disease. *Bull. Res. Counc. Isr. Sect.* D,١٠٠–١٠٢.(Abstract).

Rotem, J.(١٩٦٤). The effect of weather on dispersal of Alternaria spores in a semi–arid region of Israel. *Phytopathology*. ٥٤:٦٢٨–٦٣٢.

Rowe, R. C.; Sally A. M. and Richard, M. R.(١٩٩٦). Early blight of potato and tomato. Ohio state University Extension Fact Sheet. Plant Pathology Department.

Rsmehrotra (١٩٨٠). Plant pathology. PP:٥٣٣-٥٣٧.

Shtienberg, D.; Dostera, M. A.; Pelletier, J. R. and Fry, W. E.(١٩٨٩). Use of simulation model to develop a low-risk strategy to suppress early and late blight in potato foliage. *Phytopathology*. ١٥:٥٩٠-٥٩٥.

Shtienberg, D. and W. E. Fry (١٩٩٠). Influence of host resistance and crop rotation on initial appearance of potato early blight. Plant Dis. ٧٤:٨٤٩-٨٥٢.

Siddiqui, H. A.; A. L. Khanzada and U. H. Usmani(١٩٩٥). Investigations on chemical control of early blight of potato caused by (*Alternaria solani* Ell and Mart.) Jones and Grout. (Abstr).Bibliography on potato in Pakistan. Abstract and database Pak Swiss Patoto Development Project PARC. Islamabad. PP:٨٠

Singh, R. S.(١٩٨٣). Plant disease. ٥th Ed. Oxford and IBH Publishing Co. Calcutta. PP:٦٠٨.

Soltanpour, P. N.; and Harrison, M. D.(١٩٧٤). Interrelationship between nitrogen and phosphorous fertilization and early blight control of potato. *Am. Potato J.* ٥١:١–٧(c.f by Rich,١٩٨٣).

Tarr, S. A. J.(١٩٥٥). The fungi and plant disease of the Sudan. Oxford University Press. PP:١٢٧.

Vloutoglou, I.; and Kalogerakis, S. N.(٢٠٠٠). Effect of inoculum concentration, wetness duration and plant age on development of early blight (*Alternaria solani*) and on shedding of leaves in tomato. *Plant Pathology*. ٤٩:٣،٣٣٩–٣٤٥.(Abstract).

Walker, J. C.(١٩٥٢). Disease of Vegetable Crops.١st Ed. Mc GROW-Hill Book Company, Inc. PP:٥٢٩.

Walker, J. C.(١٩٦١). Plant Pathology.٣rd Ed. PP:٣٠٨-٣١٦.

Watte, B. A.(١٩٩٤). Early blight of tomato. University of Maine Fact Sheet.

Zvi-Howard Wener(٢٠٠٠).Importance of tomato. www.agrisupportonline. Article/htm.

APPENDICES

AppendixTable No.(١): Early Blight Disease Incidence % Prior To The First Spray.

Treatments		Total Number Of Plants	Disease Incidence%					Total	Means%
			Replicates						
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV		
Ridomil	A	٤٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠
	B	٤٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠
	C	٤٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠
Control	D	٤٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠

AppendixTable No.(٢): Early Blight Disease Incidence % Prior To The Second Spray.

Treatments		Total Number Of Plants	Disease incidence%					Total	Means%
			Replicates						
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV		
Ridomil	A	٤٠	١٢,٥٠	٣٧,٥٠	٢٥,٠٠	١٢,٥٠	٣٧,٥٠	١٢٥,٠٠	٢٥,٠٠
	B	٤٠	١٢,٥٠	١٢,٥٠	١٢,٥٠	٢٥,٠٠	٣٧,٥٠	١٠٠,٠٠	٢٠,٠٠
	C	٤٠	٢٥,٠٠	٣٣,٣٣	٠,٠٠	٢٥,٠٠	٥٠,٠٠	١٣٣,٣٣	٢٦,٦٧
Control	D	٤٠	٢٥,٠٠	٣٧,٥٠	١٢,٥٠	٢٨,٥٧	٣٧,٥٠	١٤١,٠٧	٢٨,٢١

AppendixTable No.(٣): Early Blight Disease Incidence % Prior To The Third Spray.

Treatments		Total Number Of Plants	Disease Incidence%					Total	Means%
			Replicates						
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV		
Ridomil	A	٤٠	٣٧,٥٠ ٣٧,٧٦	٣٧,٥٠ ٣٧,٧٦	٥٠,٠٠ ٤٥,٠٠	٦٢,٥٠ ٥٢,٢٤	٦٢,٥٠ ٥٢,٢٤	٢٥٠ ٢٢٥	٥٠,٠٠* ٤٥,٠٠**b
	B	٤٠	٣٧,٥٠ ٣٧,٧٦	٦٢,٥٠ ٥٢,٢٤	٥٠,٠٠ ٤٥,٠٠	٥٠,٠٠ ٤٥,٠٠	٧٥,٠٠ ٦٠,٠٠	٢٧٥ ٢٤٠	٥٥,٠٠ ٤٨,٠٠ b
	C	٤٠	٥٠,٠٠ ٤٥,٠٠	٦٦,٦٧ ٤٥,٧٠	٦٢,٥٠ ٥٢,٢٤	٨٧,٥٠ ٦٩,٣٠	٨٧,٥٠ ٦٩,٣٠	٣٥٤,١٧ ٢٨١,٥٤	٧٠,٨٣ ٥٦,٣١ ab
Control	D	٤٠	٥٧,١٤ ٤٩,٠٨	٥٧,١٤ ٤٩,٠٨	٧٥,٠٠ ٦٠,٠٠	١٠٠,٠٠ ٩٠,٠٠	٧٥,٠٠ ٦٠,٠٠	٣٦٤,٢٨ ٣٠٨,١٦	٧٢,٨٦ ٦١,٦٣ a

* Actual Data
** Transformed Data
Means With The Same Letters Were Not Significantly Different From Each Other According To LSD Test At ٥٪.

AppendixTable No.(٤): Early Blight Disease Severity (%).

Treatments		Total Number Of Plants	Disease Severity %					Total	Mean%
			Replicates						
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV		
Ridomil	A	٤٠	٠,١٤ ٣,٥٧	١,١٧ ٦,٠٢	٠,٨٨ ٣,٣٨	١,٢٨ ٦,٢٩	٠,٩٣ ٣,٥٣	٤,٦٧ ٢٢,٧٩	٠,٩٣* ٤,٥٦**c
	B	٤٠	٠,٥٢ ٤,١٣	٢,٥٠ ٩,١٠	٠,٨٨ ٣,٣٨	٠,٦٨ ٤,٧٣	١,٥٦ ٧,٠٤	٦,١٤ ٢٨,٣٨	١,٢٣ ٥,٦٨ bc
	C	٤٠	٠,٩٠ ٥,٤٤	١,٧٦ ٧,٤٩	١,٠٤ ٥,٧٤	١,٥١ ٧,٠٤	٢,٨٦ ٩,٦٣	٨,٠٧ ٣٥,٣٤	١,٦١ ٧,٠٧ b
Control	D	٤٠	٢,٣٧ ٨,٧٢	٢,١٣ ٨,٣٣	٢,٠١ ٨,١٣	٢,٩٢ ٩,٨١	٢,٣٨ ٩,٨١	١١,٨١ ٤٤,٣٠	٢,٣٦ ٨,٩٦ a

AppendixTable No.(٥): Number Of Fruits Per Plant.

Treatments		Total Number Of Plants	Replicates					Total	Mean %
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV		
Ridomil	A	٤٠	٥,٠٠	٨,٢٥	٣,٠٠	٩,٨٨	٦,٠٠	٣٢,١٣	٦,٤٣ a
	B	٤٠	٣,٧٥	٤,٠٠	٨,٨٨	٥,٦٣	٤,٠٠	٢٦,٢٦	٥,٢٥ a
	C	٤٠	١٣,٣٨	٥,٠٠	٢,٨٨	١٥,٧٥	٨,٣٨	٤٥,٣٩	٩,٠٨ a
Control	D	٤٠	٢,٥٧	٩,٤٣	١,٠٠	٩,٨٦	٤,٧٥	٢٧,٦١	٥,٥٢ a

AppendixTable No.(٦): Percentage Of Discarded Fruits.

Treatments		Total Number Of Plants	Replicates					Total	Means %
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV		
Ridomil	A	٤٠	١٠,٠٠ ٣,١٦	١,٥٢ ١,٢٣	٤,١٧ ٢,٠٤	٣,٨٠ ١,٩٥	٤,١٧ ٢,٠٤	٢٣,٦٦ ١٠,٤٢	٤,٧٣* ٢,٠٨**b
	B	٤٠	١٠,٠٠ ٣,١٦	٩,٣٨ ٣,٠٦	١٦,٩٠ ٤,١١	٢٠,٠٠ ٤,٤٧	٦,٢٥ ٢,٥٠	٦٢,٥٣ ١٧,٣٠	١٢,٥١ ٣,٤٦ a
	C	٤٠	٢٠,٥٦ ٤,٥٣	١٠,٠٠ ٣,١٦	٨,٧٠ ٢,٩٥	٢٤,٦٠ ٤,٩٦	١١,٩٤ ٣,٤٦	٧٥,٨٠ ١٩,٠٦	١٥,١٦ ٣,٨١ a
Control	D	٤٠	٥,٥٦ ٢,٣٦	١٠,٦١ ٣,٢٦	٢٥,٠٠ ٥,٠٠	١٧,٣٩ ٤,١٧	٢٦,٣٢ ٥,١٣	٨٤,٨٨ ١٩,٩٢	١٦,٩٨ ٣,٩٨ a

AppendixTable No.(٧): Yield In kg/ha.(%).

Treatments		Total Number Of Plants	Replicates					Total	Means %	***% Increase Or Decrease
Fungicide	Designation Symbols		R١	RII	RIII	RIV	RV			
Ridomil	A	٤٠	٤٦,٣ ٤٤,٨٨	٤٨,٩٦ ٤٤,٣٧	٢٢,١٩ ٢٨,٠٤	٦٥,٠٨ ٥٣,٧٣	٤٥,٥١ ٤٢,٤٢	٢٢٨,٠٤ ٢١١,٤٤	٤٥,٦١* ٤٦,٢٩**a	+٣٢,٢٤ +٢٠,٩٧
	B	٤٠	٢٣,١١ ٢٨,٧٣	٣٠,٠٦ ٣٣,٣٠	٦٩,٨٩ ٥٦,٦٦	٥٤,٨٤ ٤٧,٧٥	١٩,٦٦ ٢٦,٢٨	١٩٧,٥٦ ١٩٢,٦٣	٣٩,٥١ ٣٨,٥٣ a	+١٤,٥٥ +١٠,٢١
	C	٤٠	٩٨,٤٢ ٨٢,٧٣	١٣,٢٨ ٢١,٣٠	٢٢,٣٧ ٢٨,١٨	١٠٠ ٩٠,٠٠	٥٩,٢٦ ٥٠,٣٠	٣٤٤,١٥ ٢٧٢,٥١	٦٨,٨٣ ٥٤,٥٠ a	+٩٩,٥٥ +٥٥,٨٩
Control	D	٤٠	١٦,٥٢ ٢٣,٩٧	٦٨,٨٨ ٥٦,٠٤	٩,٤٧ ١٧,٨٥	٤٣,٠٣ ٤٠,٩٨	٣٤,٥٣ ٣٥,٩٧	١٧٢,٤٣ ١٧٤,٨١	٣٤,٤٩ ٣٤,٩٦ a	

*** Calculated As Follows:

$$\frac{\text{Treatments- Control}}{\text{Control}} \times ١٠٠$$

AppendixTable No.(٨):
ANOVA Table For Disease Incidence% Prior To The Third Spray.

Source Of Variation	**D.F**	**SS**	**MS**	**F-Calculated**	**F-Tabulated**	
					٥٪	١٪
Replicates	٤	١٣٧١,١٩	٣٤٢,٧٩٧	٤,٨٨	٣,٢٦	٥,٤١ *
Treatments	٣	٨٧٠,٨٧	٢٩٠,٢٩	٤,١٣	٣,٤٩	٥,٩٥ *
Error	١٢	٨٤٣,٠٣	٧٠,٢٥			
Total	١٩	٣٠٨٥,٠٨				

AppendixTable No.(٩): ANOVA Table For Disease Severity %.

Source Of Variation	**D.F**	**SS**	**MS**	**F-Calculated**	**F-Tabulated**	
					٥٪	١٪
Replicates	٤	٢٢,٤٠	٥,٦٠	٣,٠٥	٣,٢٦	٥,٤١ NS
Treatments	٣	٥٤,٠٤	١٨,٠١	٩,٨١	٣,٤٩	٥,٩٥ **
Error	١٢	٢٢,٠٤	١,٨٤			
Total	١٩	٩٨,٤٨				

AppendixTable No(١٠): ANOVA Table For Number Of Fruits Per Plant.

Source Of Variation	**D.F**	**SS**	**MS**	**F-Calculated**	**F-Tabulated**	
					٥٪	**١٪**
Replicates	٤	٨٥,٨٧	٢١,٤٧	١,٧٨	٣,٢٦	٥,٤١ NS
Treatments	٣	٤٥,٧٣	١٥,٢٤	١,٢٧	٣,٤٩	٥,٩٥ NS
Error	١٢	١٤٤,٤٤	١٢,٠٤			
Total	١٩	٢٧٦,٠٤				

AppendixTable No.(١١): ANOVA Table For Discarded Fruits %.

Source Of Variation	**D.F**	**SS**	**MS**	**F-Calculated**	**F-Tabulated**	
					٥%	**١٪**
Replicates	٤	٣,١١	٠,٧٨	٠,٩٣	٣,٢٦	٥,٤١ NS
Treatments	٣	١١,١٥	٣,٧٢	٤,٤٢	٣,٤٩	٥,٩٥ *
Error	١٢	١٠,٠٨	٠,٨٤			
Total	١٩	٢٤,٣٤				

AppendixTable No.(١٢): ANOVA Table For Yield In kg/ha.(%).

Source Of Variation	D.F	SS	MS	F-Calculated	F-Tabulated	
					٥٪	١٪
Replicates	٤	١٤٩١,٣٤	٣٧٢,٨٤	١,٠٤	٣,٢٦	٥,٤١ NS
Treatments	٣	١٠٨٣,٤٤	٣٦١,١٥	١,٠١	٣,٤٩	٥,٩٥ NS
Error	١٢	٤٣٠٠,٣٦	٣٥٨,٣٦			
Total	١٩	٦٨٧٥,١٤				

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ملخص الأطروحة

دراسة عن فعالية المبيد الفطرى ريدوميل(ميتالكسيل) لمكافحة مرض الندوة المبكرة فى محصول الطماطم

اجريت هذه الدراسة بغرض مكافحة مرض الندوة المبكرة الذى يسسبه فطر(*Alternaria solani*) على محصول الطماطم باستخدام مبيد ريدوميل(ميتالكسيل). اجريت هذه التجربة فى المزرعة الحقلية بكلية الزراعة، جامعة الخرطوم، شـمبات خـلال الموسـم الـشتوى ٢٠٠٤/٢٠٠٥. فعالية المبيد اختبرت باستعمال ثلاثة تركيزات محتلفة من المبيد (الجرعة الموصى بها ١,٠٠كجم/الفدان، اعلـى تركيـز١,٢٥ كجـم/الفـدان واقـل تركيـز٠,٧٥ كجم/الفدان) وقياس فعالية هذه التركيزات على خفض نسبة المرض، شدة المرض وزيـادة انتاجية المحصول فى الوحدات المعاملة مقارنة بالوحدات غير المعاملة.

اثبت مبيد الرايدوميل(اعلى تركيز١,٢٥ كجم/الفدان) فعاليته فى خفض نسبة المرض الـى (٤٥,٠٠%)، شدة المرض الى (٤,٥٦%) ونسبة الثمارالتالفة الى (٢,٠٨%)، امـا اقـل تركيز من نفس المبيد(٠,٧٥ كجم/الفدان) اعطى اعلـى انتاجيـة(٥٤,٥٠ كجـم/الفـدان) بزيادة(٥٥,٨٩ كجم/الفدان) واكبرعدد من الثمارللنبات الواحد(٩,٠٨).

اثبت مبيد الرايدوميل(اعلى تركيز١,٢٥ كجم/الفدان) انه اكثر فعالية فـى مكافحـة مـرض الندوة المبكرة لانه خفض من نسبة المرض، شدة المرض ونسبة الثمارالتالفة. بينما مبيـد

الرايدوميل(اقل تركيز٠,٧٥ كجم/الفدان) اثبت فعاليته في زيادة عدد الثمار المنتجة للنبـات الواحد والانتاجية عند مقارنتهما بالتركيزات الاخرى.

ABSTRACT

The present study was conducted to assess the efficacy of one fungicide in attempt to control Early Blight Disease caused by (*Alternaria solani* Ell. And Mart.) Jones and Grout on tomato crop (*Lycopersicon esculentum* L.). The effects of this disease was measured in terms of disease incidence, disease severity and yield.

The experiment was conducted during winter season of ٢٠٠٤/٢٠٠٥ in The Demonstration Field Of The Horticultural Department, Faculty Of Agriculture, University Of Khartoum.

The Ridomil (Metalaxyl) fungicide was applied at three different concentrations: Proposed dose ١,٠٠kg/fed., ٢٥٪more ١,٢٥kg/fed. and ٢٥٪ less ٠,٧٥kg/fed. than the proposed dose.

The results showed that the application of Ridomil at the three concentrations resulted in variable reductions in the disease incidence and disease severity in comparison with the control treatment. The least disease incidence of ٤٥,٠٠٪ and the least disease severity of ٤,٥٦٪ were recorded when Ridomil at concentration of ١,٢٥kg/fed. was applied.

The highest number of fruits per plant of ٩,٠٨ and the highest yield of ٥٤,٥٠kg/ha. with an increase of ٥٥,٨٩kg/ha. in comparison with the control treatment, were recorded when Ridomil at concentration of ٠,٧٥kg/fed.was applied. The least percentage of discarded fruits of ٢,٠٨٪ was recorded when Ridomil at concentration ١,٢٥kg/fed.was applied.

The use of Ridomil at concentration of ١,٢٥kg/fed. proved to be the most effective in combating Early Blight Disease other. Because it reduced in the disease incidence and the disease severity and the discarded fruits. While the use of Ridomil at concentration of ٠,٧٥kg/fed. proved to be effective in increasing of the number of fruits per plant and yield compared to the other two concentrations.