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

Hafiz Ibrahim Abdelrahim Ibrahim

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University of Khartoum

Supervisor

Dr. Mohamed Osman Idris

Department of Crop Protection
Faculty of Agriculture
University of Khartoum
June ٠٠٠٢
DEDICATION

To my family

Father, mother, brother and sisters.

To everyone 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 16th century, then to the old world continents (Hedrik, 1991 and Rick, 1971).

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 50 years (Wener, 2002). It is highly nutritive and the richest source for lycopene. In the last decade, Tomatoes were grown annually on a total area of about 1 million hectare in open fields and about 93000 hectare under cover control farms (Acta-Horticulture, 2003). The worldwide production of this crop in 2003 was approximately 98 million metric tons (MMT) (Kemmert, 2004).

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, 1991 and Abdlmageed et al., 1993). The area under Tomato production has remarkably increased. In 1991 the area located for Tomato production was estimated as 311.000 hectare and the amount produced about 711.000 MT. In 2002 the area allocated for Tomato production was 401.000 hectare and the amount of production was 450.000 MT. (FAO, 1993). The major areas of production in the Sudan are Khartoum State, Northern Gezira and many parts of the Northern and Eastern States (Ali, 1993).

The crop is subject to many pests and diseases starting from the cotyledon stage up to harvest (Kisha, 1984; Brader et al., 1985). In the last decade Early Blight Disease was reported as one of the most important handicaps of Tomato production quantitatively and qualitatively (Mohamed, 1997; Mohyeldin, 1997). Yield loss amounting to 3.0 – 4.0% was reported by Eltayeb (1989). All of the previous attempts to control Early Blight Disease through cultural practices and application of fungicides which are registered in The Sudan for the control of powdery mildew did not work (Abusin, 1992). 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:

1. Disease incidence.
2. Disease severity.
3. Yield.
CHAPTER TWO
LITERATURE REVIEW

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, 1891). It causes leaf spots and tuber blight on Potato and leaf spots, fruit rot and stem lesions on Tomato (Paulgrow, 1971).

Walker (1921) reported that the Early Blight Pathogen (*Alternaria solani*) was first described by Ellis and Martin in 1881 from dying Potato leaves and was called *Macrosorium solani*. It was also found pathogenic on Tomato crop. *A. solani* is widely spread in the tropics, subtropics and temperate zone (Anon., 1891). Hooker et al. (1891) reported that the fungus has worldwide distribution and infects many types of Solanaceous plants, both cultivated and weeds.

Miller and Pollard (1891) 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, 1941). Tarr
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.

**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: Moniliiales, family: Dematiaceae. It is a member of genus *Alternaria* that attacks members of family Solanaceae as well as other host plants (Alexopolous and Mims, 1979).

*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, 1979). Culture of *A. solani* vary widely in pathogenicity. Some are saprophytic, while others are highly pathogenic (Rich, 1984). A'racy *et al.* (2001) reported that, the fungus is readily cultured on artificial media such as V-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 9–11 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 (1992) reported that *A. solani* produces large pear shaped conidia (51–91 × 0.51–0.3 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 6–10 micrometers in diameter and up to 100 micrometers long. Colonies are gray–brown to black.

**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, 1933; Agrios, 1997).
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., 1990). Warm temperatures and high relative humidity favour infection (Ohms and Fenwick, 1971; Harrison et al., 1960; Easton et al., 1974). Tiny wounds caused by blowing sand favour disease development, especially if followed by dew, fog or rain (Rotem, 1978). 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, 1974). The mycelium of the fungus remains dormant in dry infected leaves for a year or more. Conidia have been found to retain viability for 17 months at room temperature (Rsmehtrotra, 1981). 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., 1984). High nitrogen and low phosphorous fertilizers resulted in the lowest
incidence of *A. solani* infection (Barchay *et al.*, 1989; Soltanpour and Harrison, 1994).

**Symptomatology:**

Symptoms are initially observed on older, senescing leaves (Rands, 1971; Pscheidt, 1985). Walker (1981) 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*. (1991) 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, 1991). Tomato crop is susceptible to *A. solani* at all growth stages but susceptibility increase as plants mature (Vloutaglou and Kalogerakis, 2002).

Kemmitt (2002) 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.

**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, 1998; Dorozhkin and Ivanyuk, 1997; Hafiz, 1987). Eltayeb (1989) 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 ١٠٪ as reported by Haware (٨٦). 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,٩٤). The severe epidemic of early blight may reduce potato and tomato yields by as much as ٠ to ٪٠ (Blackinski et al.,٩٨). Foolad et. al.,(٨٦) found that the disease causes plant defoliation which reduces yield, fruit quality and contributes to significant crop loss.

**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 (٠٠) reported that, the disease is controlled primary though the use of resistant cultivars, cultural practices and foliage fungicides.

**Cultural Control Measures:**

Anderson and Frago (٠٠) 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., 1991). Incorporation of cultivars resistance in a reduced spray strategy to suppress early and late blight of potato has been emphasized by Shtienberg et al., (1991). Kemmitt (2002) 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, 2002).

**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, 1994). Stevenson (1994) reported 18–34% increase in yield in
well sprayed areas. Timely spraying with fungicides is the best method of protection against the disease (Singh, 1981). Ivanyuk (1981) 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 (2002) 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 (1991) and Mckay (1990) reported that Bordeaux mixture and insoluble Copper are only moderately effective, Nabam plus Zinc sulfate, Zineb and Ziram are more effective. Ramakrishana and Kandasway (1991) showed that the most effective and economic control measure of Early Blight on Tomato was achieved though the use of Dithane M-₄₅ (Mancozeb) followed by Benlate (Benomyl) and Difolatan (Captafol). Guddewar et al., (1997) 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 35 days after planting with 7 more sprays at intervals of 7 days.
According to Daman and staud (1992), 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-54 (Mancozeb) has been reported by Shuja (1991) and Siddiqui et al. (1991). Dithane (Mancozeb) M-54 has been reported as very effective fungicide against Early Blight having protective and eradicative properties (Rizvi, 1991).

Anderson and Frago (1992) reported that protective fungicides (i.e. Maneb, Mancozeb, Chlorothalonil and Triphenyl tin hydroxide) are effective against Early Blight when applied at approximately 7–10 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., 2002). Fadl et al. (1992) in laboratory tests with 3 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., 1981) provides control when applied as foliar spray, by reducing spore germination,
intercellular growth of the fungus and sporulation. Ridomil Gold (Mancozeb + Metalaxyl) 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.
CHAPTER THREE

MATERIALS AND METHODS

١٫٣ Experimental Site:

The experiment was conducted during winter season of ٤٠٠٢/٥٠٠٢ in The Demonstration Farm Of The Department Of Horticulture Of The Faculty Of Agriculture–University Of Khartoum, Shambat (Latitude ٥١٤'N and Longitude ٢٣٢٣'E and Altitude ٠٨٢ meters above Sea level).

٢٫٣ Climate:

The climate is semi arid, tropical with an average annul rainfall of ٠٦١ mm. coming mostly during July–September. The mean maximum and mean minimum temperatures are as high as ٢٤٤ C in summer and around ٢١٣ C in winter, respectively (Adam, ٦٩٩١).

٣٫٣ Soil:

The soil is clay loamy type, slightly alkaline with pH ٧٥–٧٥ which suits tomato production (Elhassan, ٨٨٩١).

٤٫٣ Materials:

The materials used in this experiment were Tomato seed var. Peto. This variety was chosen because it is popular among Tomato
growers. The fungicide used was Ridomil (Metalaxyl), Urea (42\%/N) and Knapsack sprayer five liters capacity (15 Ib./inch).

٣.٣ The Experiment:

٣.٣.١ 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 ٣×٣ plots. The plot size was ٣×٣ meters. Each plot comprises two mastaba of ٥٫٢×١ meters each. Mastaba run east–west.

٣.٣.٢ Sowing:

The seeds were sown in the last week of December ٤٠٠٢, in the northern side of the mastaba by direct seeding, at the rate of ٦–٨ seeds per hole at spacing of ٠٢ cm. between holes.

٣.٣.٣ 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.
٤٫٥٫٣ Watering:

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

٤٫٥٫٣ Weeding:

Hand weeding was performed ٧٠, ١٢ and ٢١ weeks after sowing.

٥٫٥٫٣ Fertilization:

Urea fertilizer (٧٪٥N) in a granular form was applied manually in two splitted doses ٧١ and ١١ weeks after sowing at the rate of ٠٥ Kg/fed.

Foliar fertilizer, special liquid fertilizer (Amainos) was added at ٢١، ٣١، ٤١، ٥١ weeks after sowing at the rate of (٦٫٥ ml/L) using a Knapsack sprayer.

٦٫٥٫٣ 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, ٧٠٪ more and

less than the proposed dose (Table No.1). Each treatment was replicated four times. The statistical design adopted was the Completely Randomized Block Design (CRBD).

**Spraying:**

The fungicide was applied at the appearance of Early Blight symptoms at the three concentrations chosen at \( \frac{8}{9} \), \( \frac{1}{10} \) and \( \frac{1}{11} \) weeks after sowing using Knapsack sprayer five liters capacity (\( \frac{1}{12} \) Ib./ inch).

**Harvesting:**

Harvesting of fully mature fruits started \( \frac{1}{14} \) weeks after sowing and continued for four weeks. Picking of Tomato fruits at the ripening stage was performed every \( \frac{1}{15} \) to \( \frac{1}{16} \) days.

**Weighing:**

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

**Data Collection:**

**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>
<thead>
<tr>
<th>Fungicide</th>
<th>Symbol</th>
<th>Designation</th>
<th>Dose (kg/fed.)</th>
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<tr>
<td>Ridomil</td>
<td>A</td>
<td>20% more</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Proposed dose</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>20% less</td>
<td>0.70</td>
</tr>
<tr>
<td>Control</td>
<td>D</td>
<td>No chemical</td>
<td>0.00</td>
</tr>
</tbody>
</table>
\textbf{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 \(8\) weeks–old. And then every \(41\) days. The percentage of disease incidence was calculated as follows:

\[
\text{Percentage Of Disease Incidence} = \frac{\text{No. Of Diseased Plants}}{\text{Total No. Of The Plants}} \times 100
\]

\textbf{Disease Severity:}

Disease severity was assessed one time when the plants were \(21\) weeks–old. The percentage of disease severity was assessed from the leaves of the whole infected plants, it was calculated as follows:

\[
\text{Percentage Of Disease Severity} = \frac{\text{No. Of Infected Leaves Of Plants}}{\text{Total No. Of The Leaves Of Plants}} \times 100
\]
٤،١٤ Yield:

٤،١٤،٧ Number Of Fruits Per Plant:

It was calculated as follows:

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

٤،١٤،٨ Discarded Fruits:

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

\[
\frac{\text{No. Of Discarded Fruits}}{\text{Percentage Of Discarded Fruits}} = \frac{\text{Total No. Of Fruits}}{}
\]

٤،١٤،٩ Yield Per Unit Area:

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

\[
\frac{\text{Yield in kg/Mastaba}}{\text{Area Of Mastaba}} = \frac{\text{Percentage Of Yield in kg/ha.}}{}
\]

٤،٩ 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 (٤٨٩١٤).
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.(1): Right: Healthy Leaf  Left: Infected Leaf
Plate No. (a): Healthy fruit (a)

Discarded fruits (b) and (c)
The results presented in Figure No.(1) and Appendix Table No.(3) clearly showed that the use of Ridomil (Metalaxyl) at the three concentrations resulted in variable reductions in the disease incidence (mean of 0.05–13.81%) in comparison with the control treatment (36.16%). The highest percentage of disease incidence of 36.16% was reported for treatment D(control) and the lowest percentage of 54% was reported for concentration A(1,80 kg/fed).

The statistical analysis revealed significant differences among the four treatments.

**Disease Severity:**

The results presented in Figure No.(2) and Appendix Table No.(4) clearly showed that the use of Ridomil at the three concentrations resulted in variable reductions in the disease severity (mean of 65.4–70.7%) in comparison with the control treatment (69.8%). The highest percentage of disease severity of 69.8% was recorded for treatment D(control) and the lowest percentage of 65.4% was reported for concentration A(1,80 kg/fed).

The statistical analysis revealed significant differences among the four treatments.
Legend:

A= \text{\`}\text{\`\.} \text{kg/fed.}

B= \text{\`}\text{\`\`} \text{kg/fed.}

C= \text{\`}\text{\`\`\`} \text{kg/fed}

D= \text{\`}\text{\`\`\`} \text{kg/fed}

Figure No. (1): 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 5%.
Figure No. (2): Effect Of Ridomil Treatments On Early Blight Disease Severity In Tomato Crop

Legend:

A = \text{\textbullet \textbullet \textbullet \textbullet} kg/fed.
B = \text{\textbullet \textbullet \textbullet} kg/fed.
C = \text{\textbullet \textbullet} kg/fed
D = \text{\textbullet} kg/fed

\text{\textbullet}, \text{\textbullet} Yield:
Number Of Fruits:

The results presented in Figure No. (3) and Appendix Table No. (5) 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 \( \cdot, \cdot, \cdot \) kg/fed.). The use of Ridomil at concentration of \( \cdot, \cdot, \cdot \) kg/fed. resulted in the highest number of fruits per plant (\( i.e \, \cdot, \cdot, \cdot \)).

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

Discarded Fruits:

The results presented in Figure No. (4) and Appendix Table No. (6) clearly showed that the use of Ridomil at the three concentrations resulted in variable reductions in the percentages of discarded fruits (mean of \( \cdot, \cdot, \cdot \) – \( \cdot, \cdot, \cdot \) %) in comparison with the control treatment (\( \cdot, \cdot, \cdot \) %). The highest percentage of discarded fruits of \( \cdot, \cdot, \cdot \) % was recorded for treatment D (control) and the lowest percentage of \( \cdot, \cdot, \cdot \) % was recorded for concentration A (\( \cdot, \cdot, \cdot \) kg/fed.).
Figure No. (3): Effect Of Ridomil Treatments On Number Of Fruits Per Plant In Tomato Crop

Legend:

A= ٥٢٫١ kg/fed.
B= ٠٠٫١ kg/fed.
C= ٥٧٫٠ kg/fed.
D= ٠٠٫٠ kg/fed.
Figure No.(4): Effect Of Ridomil Treatments On Discarded Fruits In Tomato Crop

Legend:

A= ٥٢٫١ kg/fed.
B= ٠٠٫١ kg/fed.
C= ٥٧٫٠ kg/fed.
D= ٠٠٫٠ kg/fed.
The statistical analysis revealed significant differences among the four treatments.

**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 ٣٥٫٨٣–٥٠٫٥٪) in comparison with the control treatment (٦٩٫٤٪). The highest percentage of increase of ٥٠٫٥٪ was recorded for concentration C(٥٧٫٠٠٠kg/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= \( \text{\textdagger, \textdagger\textdagger}\) kg/fed.

B= \( \text{\textdagger\textdagger\textdagger}\) kg/fed.

C= \( \text{\textdagger\textdagger\textdagger}\) kg/fed.

D= \( \text{\textdagger\textdagger\textdagger}\) 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 \( 0.05\% - 36.16\% \). The use of Ridomil at concentration of \( 52.1 \) kg/fed. clearly retarded the development of the disease. This result agreed with the findings of Soltanpour and Harrison (1984), Platt(1983), Fadl *et al.*, (1983), Latif *et al.*, (1991) and Abusin (1994) 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 \( 65.4 - 69.8\% \). The use of Ridomil at concentration of \( 52.1 \) kg/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(1983), Platt(1983), Guddewar(1994), Shuja(1995)
and Siddiqui et al., (1991) 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 57.0 kg/fed. resulted in the highest number of fruits per plant of 80.9. The highest yield of 05.4 kg/ha. with an increase of 98.5 kg/ha. in comparison with the control were recorded when Ridomil at the concentration of 57.0 kg/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 52.1 kg/fed. resulted in the least percentage of discarded fruits of 80.2%. This result agreed with the finding of Klokocar et al., (1991) 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., (1989) who reported that the applications beginning at six 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 (٥٢٫١ kg/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 ٥٧٫٠ kg/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 ٥٧٫٠ kg/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.
More fungicides to be tested with the timing of initial spray and frequency of sprayings.

Vertical resistance of many Tomato varieties.


REFERENCES

Abdelmageed, A. H. Gruea, N. and Gyer, B.(\(\text{ရ tensors}\)). On International Agriculture research for Development. October \(\text{ရ tensors}\), Gottingen, Germany.


Acta–Horticulture, Application of International Society for Horticulture Science Vol.\(\text{ရ tensors}\). PP: \(\text{ရ tensors}\)–\(\text{ရ tensors}\) No.\(\text{ရ tensors}\).

Adam, H. S.(\(\text{ရ tensors}\)). The Agriculture climate. Dar Alsala Publication \text{၁st} Ed. P:\(\text{ရ tensors}\)(Arabic).

Agrios, G. N.(\(\text{ရ tensors}\)). Plant pathology. \text{၃nd} Ed. Academic press, New York. PP:\(\text{ရ tensors}\).

Agrios, G.N.(\(\text{ရ tensors}\)). Pant pathology. \text{၃rd} Academic press. PP:\(\text{၃ tensors}-\text{၃ tensors}\).

Alexopolous, C. J. and Mims, C. W.(\(\text{ရ tensors}\)). The causal agents of early blight disease. Introductory Mycology. \text{၃rd} Ed. PP: \(\text{၃ tensors}-\text{၃ tensors}\).


Anonymous(\(\text{ရ tensors}\)). Seed potatoes in the Sudan. Reported of The Identification of mission. Department of Horticulture, Sudan PP: \(\text{ရ tensors}\).

Anonymous(\(\text{ရ tensors}\)). Literature and sample of fungicides. Acrobat MZ \(\text{၃ tensors} /\text{၃ tensors} \) g kg\text{⁻¹} WP for BASF chemicals and polymers Pakistan (Pvt.) Ltd.


Kemmitt, G. (2002). Early blight of potato and tomato. The Plant Health Instructor Do 1:1–1.94/PH 1–2.93–0.9–1.


Vloutoglou, I.; and Kalogerakis, S. N. (1990). Effect of inoculum concentration, wetness duration and plant age on development of early...


APPENDICES

AppendixTable No.(1): Early Blight Disease Incidence % Prior To The First Spray.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fungicide</th>
<th>Designation Symbols</th>
<th>Total Number Of Plants</th>
<th>Disease Incidence%</th>
<th>Replicates</th>
<th>Total</th>
<th>Means%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R₁</td>
<td>RII</td>
<td>RIII</td>
</tr>
<tr>
<td>Ridomil</td>
<td>A</td>
<td>١٤</td>
<td>, , , ,</td>
<td>, , , ,</td>
<td>, , ,</td>
<td>, , ,</td>
<td>, , ,</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>١٤</td>
<td>, , , ,</td>
<td>, , , ,</td>
<td>, , ,</td>
<td>, , ,</td>
<td>, , ,</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>١٤</td>
<td>, , , ,</td>
<td>, , , ,</td>
<td>, , ,</td>
<td>, , ,</td>
<td>, , ,</td>
</tr>
<tr>
<td>Control</td>
<td>D</td>
<td>١٤</td>
<td>, , , ,</td>
<td>, , , ,</td>
<td>, , ,</td>
<td>, , ,</td>
<td>, , ,</td>
</tr>
</tbody>
</table>
Appendix Table No.(١): Early Blight Disease Incidence % Prior To The Second Spray.

<table>
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<tr>
<th>Treatments</th>
<th>Fungicide</th>
<th>Designation Symbols</th>
<th>Total Number Of Plants</th>
<th>Disease incidence%</th>
<th>Replicates</th>
<th>Total</th>
<th>Means %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RІ</td>
<td>RII</td>
<td>RIII</td>
</tr>
<tr>
<td></td>
<td>Ridomil</td>
<td>A</td>
<td>٤٠</td>
<td>١٢,٠٠</td>
<td>٣٧,٠٠</td>
<td>٢٠,٠٠</td>
<td>١٢,٠٠</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>٤٠</td>
<td>١٢,٠٠</td>
<td>١٢,٠٠</td>
<td>١٢,٠٠</td>
<td>٢٠,٠٠</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>٤٠</td>
<td>٢٠,٠٠</td>
<td>٣٣,٣٣</td>
<td>٨,٠٠</td>
<td>٢٠,٠٠</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>D</td>
<td>٤٠</td>
<td>٢٠,٠٠</td>
<td>٣٧,٠٠</td>
<td>١٢,٠٠</td>
<td>٢٨,٠٧</td>
</tr>
</tbody>
</table>
Appendix Table No.(∗): Early Blight Disease Incidence % Prior To The Third Spray.

<table>
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<tr>
<th>Treatments</th>
<th>Fungicide</th>
<th>Total Number Of Plants</th>
<th>Disease Incidence%</th>
<th>Replicates</th>
<th>Total</th>
<th>Means %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R₁</td>
<td>RII</td>
<td>RIII</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>40</td>
<td>37,00</td>
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<td>0,...</td>
<td>72,00</td>
</tr>
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<td></td>
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<td>37,76</td>
<td>37,76</td>
<td>0,...</td>
<td>02,24</td>
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<td>B</td>
<td>40</td>
<td>37,00</td>
<td>22,00</td>
<td>0,...</td>
<td>50,...</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>37,76</td>
<td>02,24</td>
<td>0,...</td>
<td>50,...</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>40</td>
<td>50,... 02,24</td>
<td>72,00</td>
<td>87,00</td>
<td>79,30</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>50,... 02,24</td>
<td>50,...</td>
<td>30,...</td>
<td>79,30</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>40</td>
<td>50,... 02,24</td>
<td>72,00</td>
<td>87,00</td>
<td>79,30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50,... 02,24</td>
<td>50,...</td>
<td>30,...</td>
<td>79,30</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>40</td>
<td>50,... 02,24</td>
<td>72,00</td>
<td>87,00</td>
<td>79,30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50,... 02,24</td>
<td>50,...</td>
<td>30,...</td>
<td>79,30</td>
</tr>
</tbody>
</table>

* Actual Data  
** Transformed Data  
Means With The Same Letters Were Not Significantly Different From Each Other According To LSD Test At 5%.
Appendix Table No.(4): Early Blight Disease Severity (%).

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Designation Symbols</th>
<th>Total Number Of Plants</th>
<th>Disease Severity %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Replicates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R¹</td>
<td>RII</td>
</tr>
<tr>
<td>Ridomil</td>
<td>A</td>
<td>40</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.07</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>40</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.13</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>40</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>40</td>
<td>2.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.72</td>
</tr>
</tbody>
</table>

Control

D 40 2.37 2.13 2.01 2.92 2.38 11.81 2.36 8.96a
### Appendix Table No.( HANDLE ) Number Of Fruits Per Plant.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total Number Of Plants</th>
<th>Replicates</th>
<th>Total</th>
<th>Mean %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R'</td>
<td>RII</td>
<td>RIII</td>
</tr>
<tr>
<td>Fungicide</td>
<td>Designation Symbols</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Ridomil</td>
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<td>8,20</td>
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<tr>
<td></td>
<td>B</td>
<td>40</td>
<td>0,00</td>
<td>8,20</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>40</td>
<td>0,00</td>
<td>8,20</td>
</tr>
<tr>
<td>Control</td>
<td>D</td>
<td>40</td>
<td>0,00</td>
<td>8,20</td>
</tr>
</tbody>
</table>

*Note: Values with the same letter are not significantly different at the 0.05 level of probability.*
Appendix Table No.(۷): Percentage Of Discarded Fruits.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fungicide</th>
<th>Total Number Of Plants</th>
<th>Total</th>
<th>Means %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R¹</td>
<td>RII</td>
<td>RIII</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>۴۰</td>
<td>۱۰,۰۷</td>
<td>۱,۰۷</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>۴۰</td>
<td>۱۰,۰۷</td>
<td>۹,۳۸</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>۴۰</td>
<td>۲۰,۰۷</td>
<td>۸,۷۰</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>۴۰</td>
<td>۰,۶۸</td>
<td>۲,۳۶</td>
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</tbody>
</table>

* Significant at 0.05 level of probability.
** Significant at 0.01 level of probability.
### Appendix Table No. (\(^7\)): Yield In kg/ha. (\%) 

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Designation Symbols</th>
<th>Total Number Of Plants</th>
<th>Replicates</th>
<th>Total</th>
<th>Means %</th>
<th>***% Increase Or Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ridomil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>40</td>
<td>R¹</td>
<td>66.9,8</td>
<td>64.8,77</td>
<td>72,4,9</td>
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<td>B</td>
<td></td>
<td>40</td>
<td>RII</td>
<td>73.11</td>
<td>71.2,8</td>
<td>72.7,8</td>
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<td>40</td>
<td>RIII</td>
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<td>72.1,8</td>
<td>72.6,8</td>
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<tr>
<td><strong>Control</strong></td>
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<td>40</td>
<td>RIV</td>
<td>78.8,8</td>
<td>92.8,7</td>
<td>78.8,8</td>
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</table>

*** Calculated As Follows: 
Treatments- Control X \( \cdot \cdot \) 
Control
AppendixTable No.8:
ANOVA Table For Disease Incidence% Prior To The Third Spray.

<table>
<thead>
<tr>
<th>Source Of Variation</th>
<th>D.F</th>
<th>SS</th>
<th>MS</th>
<th>F-Calculated</th>
<th>F-Tabulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replicates</td>
<td>4</td>
<td>1371.19</td>
<td>342.797</td>
<td>4.88</td>
<td>3.26</td>
</tr>
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<td>Treatments</td>
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<td>87.07</td>
<td>29.023</td>
<td>31.40</td>
<td>3.49</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>30.48</td>
<td>1.453</td>
<td>1.85</td>
<td>1.49</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>90.58</td>
<td>0.883</td>
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</table>

AppendixTable No.9:
ANOVA Table For Disease Severity %.

<table>
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<th>Source Of Variation</th>
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<th>SS</th>
<th>MS</th>
<th>F-Calculated</th>
<th>F-Tabulated</th>
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<td>Treatments</td>
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<td>40.42</td>
<td>13.47</td>
<td>9.48</td>
<td>3.49</td>
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<tr>
<td>Error</td>
<td>21</td>
<td>22.42</td>
<td>1.074</td>
<td>1.84</td>
<td>1.49</td>
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<td>Total</td>
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<td>84.89</td>
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AppendixTable No.(①): ANOVA Table For Number Of Fruits Per Plant.

<table>
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<th>Source Of Variation</th>
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<th>MS</th>
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<th>F-Tabulated</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5%</td>
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<td></td>
<td>0.41</td>
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<td></td>
<td></td>
<td></td>
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<td>0.90</td>
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AppendixTable No.(⑪): ANOVA Table For Discarded Fruits %.

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<th>F-Tabulated</th>
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<td></td>
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<td></td>
<td>5%</td>
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<td>0.93</td>
<td>3.26</td>
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<td>0.41</td>
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<td>3.49</td>
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<td></td>
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<td>0.90 *</td>
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<tr>
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<td></td>
<td></td>
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Appendix Table No. (٤٢): ANOVA Table For Yield In kg/ha. (%).

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ACKNOWLEDGMENTS

Above all I render my thanks to the merciful Allah who offered me all things to accomplish this study.

I would like to express my deep appreciation and sincere thanks to my supervisor Dr. Mohamed O. Idris Associate Professor of Plant Pathology, for his inspiring guidance, keen interest, helpful suggestions and continuous participation through this study. Thanks are extended to Dr. El Tom E. Ali of Agronomy Department, Faculty of Agriculture for his great help in the analysis of the data, typing the thesis and encouragement.

Thanks are also due to the staff and postgraduate students of the Crop Protection Department, University of Khartoum for their encouragement and interest. Lastly but not least, I also thank my friends who have encouraged me during the writing of this thesis.
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<td>Effect Of Ridomil Treatments On Early Blight Disease Severity In Tomato Crop.</td>
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<td>Effect Of Ridomil Treatments On Number Of Fruits Per Plant In Tomato Crop.</td>
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ﺍﺜﺒﺕ

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ﺍﻻﺨﺭﻯﺍﻟﻭﺍﺤﺩ

ﺒﺎﻟﺘﺭﻜﻴﺯﺍﺕ

ﻤﻘﺎﺭﻨﺘﻬﻤﺎ

ﻋﻨﺩ

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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 **٤٠٠٢/٥٠٠٢** 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 ٠٠٫١ kg/fed., ٪٥٢ more ٥٢٫١ kg/fed. and ٪٥٢ less ٥٧٫٠ kg/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 ٪٠٠٫٥٤ and the least disease severity of ٪٦٥٫٤ were recorded when Ridomil at concentration of ٥٢٫١ kg/fed. was applied.
The highest number of fruits per plant of ٨٠٫٩ and the highest yield of ٩٨٫٥٥ kg/ha. with an increase of ٠٥٫٤٥ kg/ha. in comparison with the control treatment, were recorded when Ridomil at concentration of ٥٧٫٠ kg/fed. was applied. The least percentage of discarded fruits of ٨٠٫٣% was recorded when Ridomil at concentration ٥٢٫١ kg/fed. was applied.

The use of Ridomil at concentration of ٥٢٫١ kg/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 ٥٧٫٠ kg/fed. proved to be effective in increasing of the number of fruits per plant and yield compared to the other two concentrations.