PN-ABP-825

Best available copy -- page 3 missing

PN-ABP-825

AGENCY FOR INTERNATIONAL DEVELOPMENT
PPC/CDIE/DI REPORT PROCESSING FORM

ENTER INFORMATION ONLY IF NOT INCLUDED ON COVER OR TITLE PAGE OF DOCUMENT

1. Project/Subproject Number: 645-0229-3-80036

2. Contract/Grant Number: 645-0229-C-00-9019

3. Publication Date: April/May 1993

4. Document Title/Translated Title: Plant and Vegetable Diseases Report

5. Author(s)

1. Dr. Alan A. MacNab
2. Chemonics International
3.

6. Contributing Organization(s)

7. Pagination: 52

8. Report Number:

9. Sponsoring A.I.D. Office: USAID/Swaziland

10. Abstract (optional - 250 word limit)

11. Subject Keywords (optional)

1.
2.
3.
4.
5.
6.

12. Supplementary Notes

13. Submitting Official: Betsy Kalombo

14. Telephone Number: (202) 466-5340

15. Today's Date: August 27, 1993

DO NOT write below this line

16. DOCID

17. Document Disposition: DOCRD [] INV [] DUPLICATE []

AID 590-7 (10/88)

PN-AEP-825

PLANT AND VEGETABLE DISEASES REPORT

COMMERCIAL AGRICULTURAL PRODUCTION AND MARKETING PROJECT

Contract No. 645-0229-C-00-9019

Prepared in association with:

United States Agency for International Development

and

The Ministry of Agriculture and Cooperatives

Prepared by:

Dr. Alan A MacNab

April - May, 1993

TABLE OF CONTENTS

		Page
SECTION I	INTRODUCTION	1
	A. Objectives	1
	B. Background	1
SECTION II	SCOPE OF WORK DISCUSSION	3
	A. Survey of Diseases on Sweet Corn, Tomato, and Peppers	3
	B. Development of a Calendar-Based Chemical Control Program	3
	C. Review of Current Disease Controls for Vegetables	3
	D. Uses of Integrated Pest Management	3
	E. Training for Field Assistants	4
	F. Farmer Field Days	4
	G. General Comments	4
	H. Vegetable Disease Recommendations	6
ANNEX A	DISEASES OBSERVED ON TOMATOES, PEPPERS, AND SWEET CORN	A-1
ANNEX B	SPRAY SCHEDULES FOR TOMATOES, PEPPERS, AND SWEET CORN	B-1
ANNEX C	IN-SERVICE REIVEW WITH FIELD ASSISTANTS	C-1
ANNEX D	FARMER FIELD DAYS	D-1
ANNEX E	CHARTS FOR FARMER FIELD DAYS	E-1
ANNEX F	SCOPE OF WORK	F-1

SECTION I
INTRODUCTION

A. Objectives

Dr. Alan A. MacNab served as a short-term plant pathologist/vegetable disease consultant from April 16 to May 8, 1993. This consultant was fielded to work with the project production team in identifying and treating diseases related to vegetable crops. His scope of work (Annex F), included identifying the major disease problems associated with the Commercial Agricultural Production and Marketing (CAPM) project's winter production crops, revising the current calendar-based chemical control program, reviewing current disease controls for vegetables listed in the Farmer's Handbook, examining the potential for using integrated pest management procedures and, training farmers and CAPM field staff.

The focus of this effort was field-oriented and directed toward activities that would directly benefit the farmers. This report is a brief summary of the consultant's findings and recommendations accompanied by supporting documentation.

B. Background

The redirected CAPM project is assisting small-scale farmers in production of vegetables programmed in response to market demands. The project is currently working with more than 140 farmers in three regions of the country on approximately 100 ha. of land. The project provides a program for planting for farmers as well as support through regular visits by project field assistants to evaluate and advise farmers throughout the growing season. The major production constraint faced by farmers in Swaziland is plant disease.

CAPM's 1993 winter production program focuses on four major crops in three production regions. Fresh market variety tomatoes are being produced in the northern region of the country, NOMA 1400 processing tomatoes for the fresh market are being produced in the Siphofaneni area, and sweet corn and sweet peppers are being produced in the central region. Production cost estimates show that as much as one-third of the total production costs are associated with control of diseases. Plant disease damage is often responsible for major reductions in crop quality and yields.

Foliar and soil borne diseases are problems for a wide range of vegetable crops. Foliar diseases caused by numerous organisms are present in summer and winter. The primary crops the project is focusing on, tomatoes, green peppers and sweet corn, are especially vulnerable. Other local crops that are disease sensitive include cabbage, onion, vine and bush squash, green beans, potatoes, sugar peas and carrots.

A list of major diseases that occur on tomatoes include Early Blight, Bacterial Wilt, Late Blight, Septoria Leaf Spot, Bacterial Spot or Canker, and Fusarium and Verticillium Wilts. Pepper diseases include several viruses, Powdery Mildew, and what appears to be Anthracnose and/or Alternia. Sweet corn diseases include Maize Streak Virus and rusts.

A wide range of agricultural chemicals are available to farmers through South African companies. Application methods predominantly involve the use of small-size applicators such as the knapsack sprayer. The emphasis on disease control to date centers almost completely on the use of chemicals. Little attention has been given to forecasting or using Integrated Pest Management (IPM) approaches with vegetable crops.

Since this production/marketing program is at an early stage of development, the production of high quality produce is more important now than attempting to cut a few disease control sprays. When the production/marketing program is well established, it may be worthwhile to evaluate disease forecasting systems. In preparation of that time, the consultant demonstrated a tomato disease forecasting system now in use in parts of North America.

E. Training For Field Assistants

A formal training session was conducted for four project field assistants (Themba Magagula, Boniface Dlamini, Cornelius Dlamini, and Richard Magagula). In addition, the Horticulture Specialist and the Production Advisor attended. Resources used during the session included colored slides showing disease symptoms and concepts, colored photographs, and written materials summarising information related to diseases observed or of concern during previous field observations with the field assistants. An outline of material presented is included in Annex C.

All field assistants were very attentive, anxious to learn, and interested in discussing disease-related needs. If possible, it is suggested that CAPM field assistants be given additional opportunities for in-service training. Examples might include having all field assistants participate in a 1-day field tour to all production regions of Swaziland. Each field assistant could arrange for the field visit(s) in his/her region, and could share information that may be useful to the other field assistants. In addition, it may be useful for the Horticulture Specialist and the Production Advisor to make observations in South Africa's vegetable production areas, and when possible, to take the field assistants along to learn from such tours. It might be possible to join a tour already organized for South African vegetable producers.

F. Farmer Field Days

Three farmer field days were held and included presentations on disease identification and control. One field day was held in each of the three production regions. A program for each meeting, and a summary of disease related material presented is included in Annex D. Charts prepared as support materials are included in Annex E.

G. General Comments

1. Sweet Corn

Streak disease in corn is very important to be aware of and if ignored is likely to limit production for at least part of the year. Although Curaterr, an insecticide soil treatment applied at planting, appears to provide significant control, additional control is needed. Applied research is needed to help identify appropriate varieties with resistance to streak, and to determine plant age beyond which virus symptom appearance will not significantly affect yield and quality.

A simple experiment would involve making observations in a planting weekly, marking plants each week as they develop new symptoms, and at harvest time, determining for each plant whether a good cob is produced. It should be possible to complete one of the following sentences:

"If plants have streak symptoms by the time they are weeks of age, they likely will not produce a usable ear."

"If plants do not have streak symptoms by the time they are weeks of age, they likely will produce a usable ear."

2. **Tomato**

Early blight appears to be the most significant tomato defoliation disease. This disease could be controlled adequately if growers start with disease-free transplants, rotate tomatoes with unrelated crops, and spray weekly with a broad spectrum fungicide such as Bravo or Dithane M45.

3. Peppers

Water mold root rot may be the most significant pepper disease. Trench irrigation may promote this disease. Major controls include good seedbed management, and careful water management after transplanting.

4. **Sunscald and Blossom-end Rot of Pepper and Tomato**

Sunscald and blossom-end rot in pepper and tomato plants are serious disorders. They can be minimized by maintaining good leaf cover to combat sunscald and providing an even water supply to fight blossom-end rot.

5. Spray Coverage

Most sprays are applied by hand-operated backpack sprayers. Considerable attention is needed by the spray operator to obtain good coverage. A strong educational effort to promote good spray coverage is important.

6. Pesticide Safety

Most sprays are applied by hand, some by children; it is therefore important to provide a strong educational effort to promote the chemical's safe handling.

7. Insect Control

Leonard Sabandza, an entomologist at Swaziland's Malkerns Research Station, is an important resource for vegetable growers with regard to a wide variety of insect control problems. He can provide good information on control of the leafhopper which transmits the streak virus of sweet corn.

8. Spray Schedules

At this time, it is the consultant's opinion for growers to follow a calendar-based spray program. When growers can consistently attain good control of common diseases and insects, it will be possible to consider timing sprays on the basis of forecast and pest monitoring programs.

9. Production of Disease-free Transplants

Producing disease-free seedlings is an essential control for many diseases and includes both field-soil seedbeds and tray plants.

H. Needs for Additional Vegetable Disease Work

1. Virus Identification

- Begin identifying specific viruses that are associated with specific crops. This will require use of the ELISA technique. Antisera will need to be purchased and brought into Swaziland for these tests.

2. Disease Diagnosis

- Help teach the Swaziland Entomologist and Horticulturists how to use lab techniques to diagnose and confirm diagnosis of some vegetable diseases. This would include: observations of fungal structures with a dissecting microscope, making wet mounts of fungi, confirming fungal identification using a compound microscope, and if possible, fungus isolation and culturing.

3. Disease Survey

- Expand survey of vegetable diseases and in-service education with horticulturists and field assistants. An adequate disease survey is necessary to serve as the basis of a good disease control program. This needs additional attention.

4. Disease Control Recommendations

- A comprehensive review of the vegetable disease controls may be helpful to the horticulturist. This could be done by correspondence.

ANNEX A

Diseases Observed on Tomato, Peppers, and Sweet Corn

Tomato Early Blight:

North: 1st fields by stakes	Tomato#1	Early blight, 10% defoliation.
North: 2nd field, trelles	Tomato#2, first ripe	Early blight, >10% defoliation.
North: 2nd field, trelles	Tomato#2 fruit grading	Early blight stem end rot present.
Southeast: Lindumane	Tomato, pre bloom	No leaf spots yet, good growth.
Southeast: Lindumane	Tomato, first ripe	Early blight, 5% defoliation.
Southeast: Makhaya	Tomato#1, 50% harvested	Early blight, 30% defoliation.
Southeast: Makhaya	Tomato#2, first ripe	Early blight, amount?
Southeast: Makhaya	Tomato#1, 50% harvested	Early blight, 30% defoliation.
Southeast: Makhaya	Tomato#2, first ripe	Early blight, amount

Tomato Late Blight:

North: 1st fields, stakes	Tomato#1	Late blight, trace defoliation.
Southeast: Makhaya	Tomato#1, 50% harvested	Late blight reported; now hot/dry?
Southeast: Makhaya	Tomato#1, 50% harvested	Late blight reported; now too hot/dry

Tomato Water Mold Root Rot and Other Wilts:

Southeast: Makhaya	Tomato#2, first ripe	Wilting; <2% of plants; water mold/salts?
North: 1st fields, stakes	Tomato, fruit stage	Root knot nematode, trace wilted plants

Tomato Fruit Disorders:

North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Amer. boll worm; major now.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Bact. speck.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Catfacing.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: E.Blight stem end rot.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Rhizoctonia soil-rot.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Bacterial soft rot; injury.
Southeast: Lindumane	Tomato, first ripe	Mites heavy.

Other Crops and Diseases:

Central: Nora Raid	Squash, 20 leaf stage	Virus, 70% of plants
Central: Nora Raid	Squash, 20 leaf stage	Powdery mildew, 20% leaf area covered
Central: Nora Raid	Cabbage, seedling stage	Soluble salts?, most affected
Central: Nora Raid	Onion, seedling stage	Soluble salts?, most affected
Northeast: VIF	Snap Bean, full bloom	No problems
Central: Brian Stein	Snap beans, blossom	Rust; most plants affected
Central: Vickery	Vegetable seedlings	Some light color; generally very good.
Central	Cabbage, field seedbed	Downy mildew, heavy
Central	Broccoli, harvest stage	Alternaria leaf spot, heavy

ANNEX B

Spray Schedules for Tomatoes, Peppers, and Sweet Corn

TOMATO
WINTER INSECT AND DISEASE CONTROL PROGRAM

Week (from planting)	Product	No. tablespoon per: 15 l	20 l	Remarks
2	Copper oxychloride	8	10	Bacterial spot, Early
	plus Dithane M-45	16	20	Blight & Late Blight
3	Bravo 50 sc or	4	5	Early Blight &
	Dithane M-45	16	20	Late Blight
4	Copper oxychloride	8	10	Bacterial spot, Early
	plus Dithane M-45	16	20	Blight & Late Blight
	Patron (Cyromazine)	1	1.5	Leaf Minor
	Talstar	1	1.5	Red Spider
5	Bravo 50 sc or	4	5	Early Blight &
	Dithane M-45	16	20	Late Blight
6	Copper oxychloride	8	10	Bacterial spot, Early
	plus Dithane M-45	16	20	Blight & Late Blight
	Curacron	3	4	Aphids, Red Spider, Leaf Minor
7	Bravo 50 sc or	4	5	Early Blight &
	Dithane M-45	16	20	Late Blight
8	Copper oxychloride	8	10	Bacterial spot, Early
	plus Dithane M-45	16	20	Blight & Late Blight
	Patron	1	1.5	Leaf Minor
	Talstar	1	1.5	Red Spider
9	Bravo 50 sc or	4	5	Early Blight &
	Dithane M-45	16	20	Late Blight
10	Copper oxychloride	8	10	Bacterial spot, Early
	plus Dithane M-45	16	20	Blight & Late Blight
	Curacron	3	4	Bollworm, Looper, Red Spider, Aphids

11	Bravo 50 sc or Dithane M-45	4 16	5 20	Early Blight & Late Blight.
12	Bravo 50 sc or Dithane M-45 Curacron	4 16 3	5 20 4	Early Blight & Late Blight Bollworm, Looper, R.S.M. Aphids
13	Bravo 50 sc or Dithane M-45	4 16	5 20	Early Blight & Late Blight
14	Bravo 50 sc or Dithane M-45 Curacron	4 16 3	5 20 4	Early Blight & Late Blight Bollworm, Looper, R.S.M. Aphids
15	Bravo 50 sc or Dithane M-45	4 16	5 20	Early Blight & Late Blight

PEPPER
WINTER INSECT AND DISEASE CONTROL PROGRAM

Week (from planting)	Product	No. tablespoons per: 15 l	20 l	Remarks
3	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
5	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
	Malathion 25 wp	6	8	Aphids
7	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
	Kelthane 18.5 wp	3	4	Mites
9	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
	Malathion 25 wp	6	8	Aphids
11	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
	Kelthane 18.5 wp	3	4	Mites
13	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
	Malathion 25 wp	6	8	Aphids
15	Copper oxychloride	8	10	Bacterial spot,
	Dithane M45	12	15	Powdery mildew
	Kelthane 18.5 wp	3	4	Mites

The number of tablespoons of product to be used are calculated on the basis of 300 litres of spray being required to cover one hectare. One level full match box is equal to 1 tablespoon (15 ml).

This list is intended as a guide only. In some cases, other chemicals may be effective. The same chemical is often sold under several different trade names. The use of a particular trade name is not intended to be discriminatory nor is it an endorsement of the product.

ANNEX C

In-Service Review With Field Assistants

In-Service Review With Field Advisors

Alan A. MacNab

A. Introduction

1. What is this thing we call plant disease? _____
2. Are all plant problems caused by disease organisms? _____
3. Why might disease organisms seem to be mysterious? _____
4. What conditions need to occur for disease to become important? _____
5. Importance of understanding the farmer and his needs. _____
6. Importance of knowledge (from experience and other resources). _____
7. What are some common control methods? _____
8. Why do we use specific controls for each specific disease? _____
9. Why do we need to follow the label (instructions) when we use pesticides? _____

B. Sweet Corn

1. Viruses; mycoplasmas? Streak _____
2. Leaf diseases: Leaf spots and rust _____

C. Pepper

1. Bacterial spot _____
2. Water-mold root rot and wilt (also on tomato) _____
3. Fruit rots
   a. Blossom-end rot _____
   b. Sun scald or sunburn _____
   c. Alternaria fungus rot, frequently following injury _____
4. Viruses
   a. Fruit symptoms _____
   b. Leaf symptoms _____

D. Tomato

1. Bacterial speck, spot, and canker _____
2. Early blight, on leaves and fruit _____
3. Late blight, on leaves and fruit _____
4. Buckeye rot, fruit only! _____
5. Anthracnose ripe fruit rot _____
6. Viruses _____

E. Some General Topics

1. Overhead irrigation and fungicides _____
2. Caution with carbofuran (Curator) _____
3. Tomato late blight and hot weather _____
4. Tomato anthracnose ripe fruit rot _____
5. Soil condition _____
6. Aphid population? _____
7. Hoe cultivation and roots _____
8. Combination of copper oxychloride with Dithane M-45 _____
9. Development of resistance in fungi _____

F. Messages for Grower Meetings

Sweet Corn	Peppers	Tomatoes
1. Streak _____	1. Bacterial spot _____	1. Bact. spot, speck, canker
2. Rust _____	2. Cercospora spot _____	2. Early vs. Late blight _____
3. Leaf spots _____	3. Water-mold root rot/wilt	3. Water-mold root rot/wilt
4. _____	4. Fr. rots =BER,sunburn,Alt	4. FR =BER,sun,Alt,Anth _____
5. _____	5. Viruses _____	5. _____
6. _____	6. _____	6. _____
7. _____	7. _____	7. _____

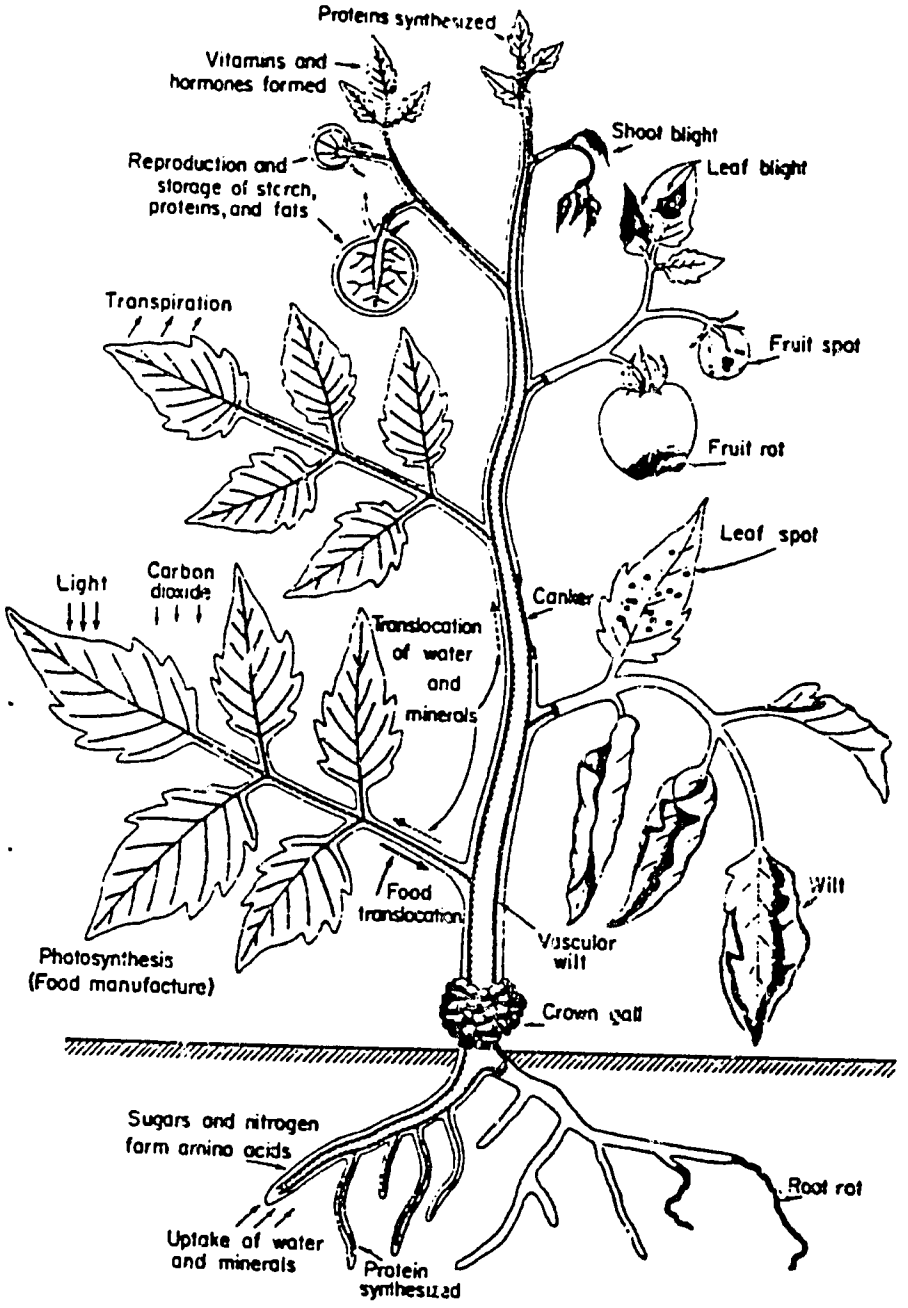


FIGURE 1.
Schematic representation of the basic functions in a plant and of the interference with these functions caused by some common types of plant diseases.

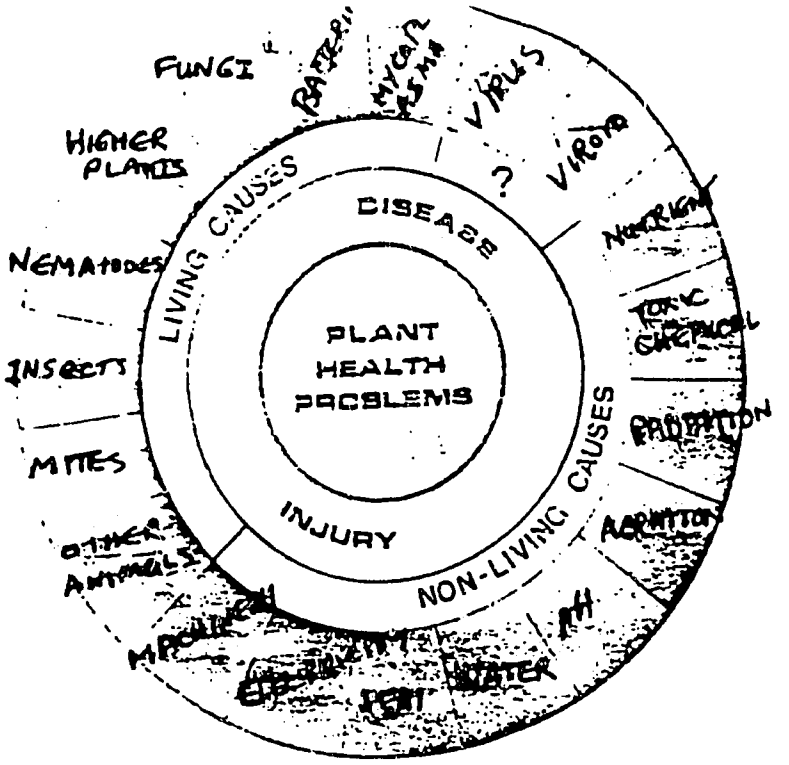


Figure 1-2. Biotic and abiotic factors that cause plant injury and disease. (Courtesy of A. A. MacNab and W. Merrill.)

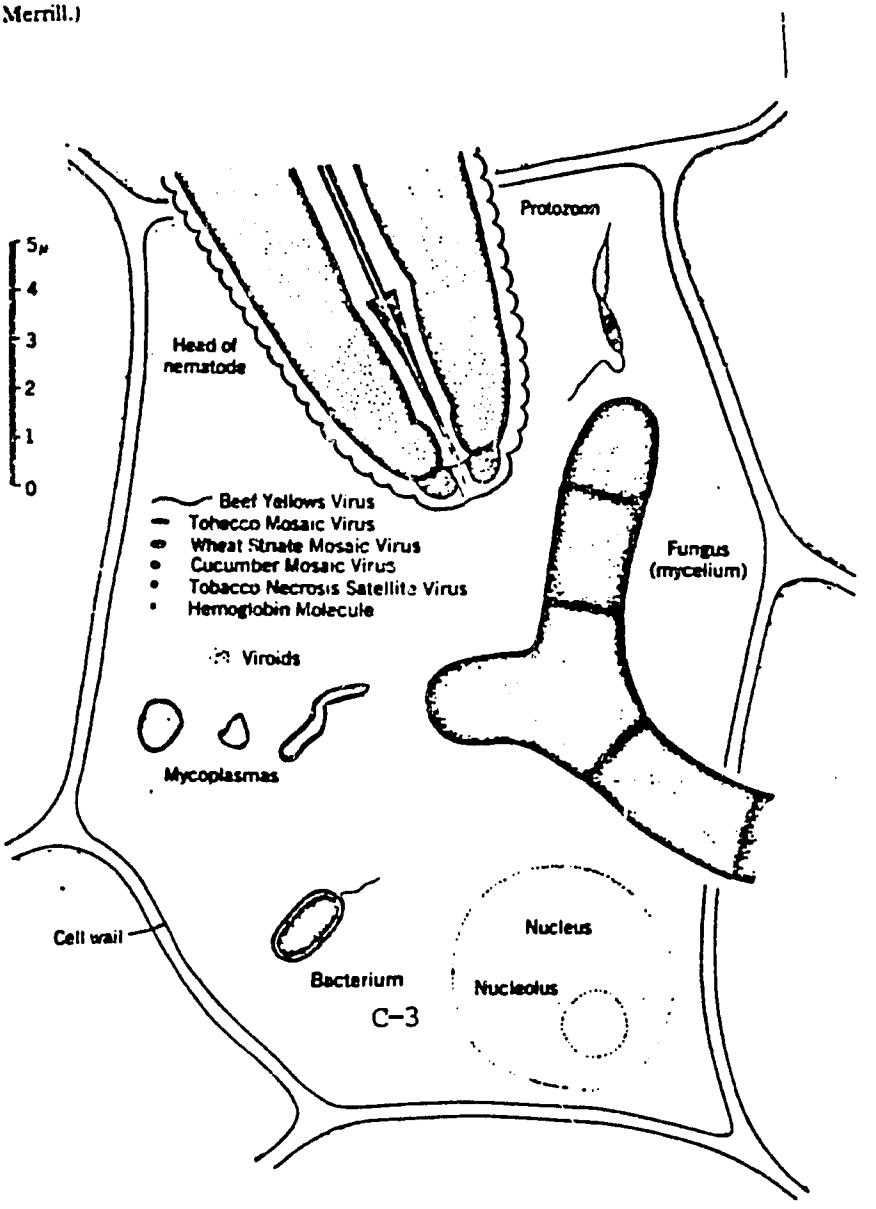


Figure 1-3. Schematic diagram of the shapes and sizes of certain plant pathogens in relation to a plant cell. (From Agrios, 1978; courtesy of Academic Press.)

A. Sweet Corn Leaf Problems:

1. Streak (V; mycoplasma or virus; leafhopper vector)	Slide-	
2. Leaf spots (F = Helminthosporium, Phyllosticta, Colletotrichum)	Slide	Photo
3. Rust (F = Puccinia sorghi)	Slide	

B. Pepper Leaf Problems:

1. Bacterial spot (B = Xanthomonas vesicatoria; same on tomato)	Slide
1. Stunting, mottling & distortion of new leaves (V = virus)	Slide
2. Cercospora leaf spot (F = Cercospora capsici)	

C. Pepper Fruit Problems:

1. Blossom-end rot (Calcium deficiency associated with low moisture)	Slide-
2. Sunburn (E = environment)	Slide-
3. Alternaria fruit rot (F = Alternaria tenuis; Alternaria solani)	Slide
4. Bacterial soft rot (B = Erwinia carotovora; associated with injury)	
5. Yellow (chlorotic) spotting within fruit wall (V = virus)	Slide

D. Pepper Root and Wilt Problems:

1. Water mold root rot/wilt (F = Phytophthora/Pythium)	Slide-
2. Verticillium wilt (F = Verticillium albo-atrum or V. dahlia)	
3. Root pruning (M = mechanical)	

E. Tomato Leaf Problems:

1. Late blight on leaves (F = Phytophthora infestans)	Slide	
2. Early blight on leaves (F = Alternaria solani)	Slide	Photo
3. Virus (V)	Slide	
4. Mites (M)		

F. Tomato Fruit Problems:

1. American boll worm (Worm)		
2. Late blight on fruit (F = Phytophthora infestans)	Slide	Photo
3. Buckeye rot on fruit (F = Phytophthora parasitica)	Slide	Photo
4. Early blight on fruit (F = Alternaria solani)	Slide	Photo
5. Rhizoctonia soil rot (F = Rhizoctonia solani)		Photo
6. Bacterial speck & spot (B = Psudomonas & Xanthomonas)	Slide	Photo
7. Bacterial soft rot, following injury (B = Erwinia carotovora)		
8. Fruit distortion, poor pollenation (P)		
9. Blossom-end rot; not seen (Calcium)		Photo
10. Anthracnose ripe fruit rot; not seen (F = Colletotrichum)	Slide	Photo

G. Tomato Root Problems:

1. Root knot nematode (N)
2. Water mold (Phytophthora, Pythium) root rot (F)

H. Other Tomato Problems:

Bacterial canker (B); not seen but beware of inoculum survival on wooden stakes used previously for tomatoes.

I. Other Vegetable Problems:

1. Squash; viruses (likely aphid-borne); severe; need resistance.
2. Squash; powdery mildew; can control with fungicide if started early.
3. Cabbage; wilting from excessive soluble salts; avoid by good mixing.
4. Snap (Green) Beans; no diseases seen; I understand rust is a concern (Some rust resistant varieties in the US include Opus, Greenway, and Spurt).

Sweet Corn Streak

Cause: Virus or mycoplasma

Occurrence:

Central: Muzi Dlamini, plants 15-20 cm high (5% of plants with Streak)
Central: Muzi Dlamini, plants 30-40 cm high (13% of plants with Streak)
Central: Muzi Dlamini, plants 45-50 cm high (34% of plants with Streak)
Central: Dale Allen, start of tasseling (78% of plants with Streak)
Central: Dale Allen, plants 15-20 cm high (11% of plants with Streak; Currator used)
Central: Dale Allen, plants 30+ cm high (88% of plants with Streak; Currator not used)
Central: Nora Raid, plants about 40 cm high (29% of plants with Streak)

Symptoms: Plant yellowing starting on the new leaves; yellow streaking frequently between veins. Plants are stunted when symptoms appear early.

Source: Infected corn and grasses; possibly including sugar cane.

Transmission: Leaf hoppers (evidence from Swaziland Entomologist); others?

Prevalence and Importance:

Seasonal development: Little in early-season (August) plantings. Much in late-season (February and later) plantings.

Prevalence: I saw more corn virus/mycoplasma problems in 2 days here than I saw in Pennsylvania in 20 years. All plantings at or beyond the 15 cm-height stage had some plants with streak symptoms! Percent plants with symptoms was between 5% (youngest plantings) and 78% (older plantings).

Importance: Although one can not be positive without doing a controlled test, I expect that plants with severe yellowing before tasseling will not produce a useful ear. I do not know about plants with less severe symptoms. It is possible that plants infected late could produce useful ears if plants have adequate moisture and nutrients.

Control:

1. Varietal resistance/tolerance: I think Challenger was supposed to have some tolerance to the most important sweet corn virus in South Africa. I hope there are varieties with better tolerance to "streak" here in Swaziland! Variety trials are warranted. I believe this will be the most important control in the future.

2. Insect vector control:

a. Carbofuran (Curator) applied to soil at planting time appears to be important. Although more effective systemic insecticides may be available (eg. Gaucha), no pesticide should be used unless it is labelled for the use.

b. Insecticide sprays. Sprays might be useful, especially if an extended period is required for the insect to transmit the virus/mycoplasma to the plant. (For some aphid-borne viruses, transmission time is so short (eg. half a minute) that it is difficult to kill an aphid before it has transmitted the virus.) Insecticide sprays would likely be less effective in small fields and narrow strips than in large plantings in square fields.

3. Planting time: In areas or fields where streak is most severe, it may be necessary to establish dates beyond which new plantings should not be made. It appears that August plantings are less affected by streak, and that plantings after January are more severely affected by streak.

4. Plant vigor: For some corn viruses, it appears that plants tolerate late infection if there is adequate moisture and nutrition. Effect of the virus seems to be more severe if plants are under moisture and/or nutrient stress.

Sweet Corn Leaf Diseases

Diseases: Rust (F) and Fungal leaf spots (F)

Occurrence: Central = Muzi Dlamini (trace)

Cause: Fungi

Symptoms:

Rust: Initially, small slightly elongated yellowish (chlorotic) spots appear on the leaf. Soon, rusty brown blisters (pustules) develop within the yellowish spots. When the blister matures, it cracks open and exposes reddish-brown spores. Usually, the first symptoms appear on part of a top surface of a leaf where dew develops first at night. When the disease is severe, leaves and flag-leaves on ears can be completely covered with the dusty appearing spores.

Leaf Spots: There are several fungi that cause leaf spots. Although the different fungi (Helminthosporium spp., Phyllosticta sp., and Colletotrichum sp.) cause somewhat different sizes and shapes of leaf spots and a microscope is needed to identify the fungi, it likely is not necessary to distinguish among the different spots caused by fungi because the controls are similar for most of them.

Source:

Rust: Spores are dry and can survive floating and blowing in the air for long periods of time. Therefore, they can be introduced with air currents and winds from areas where the disease is present before corn is planted in a specific area or field. I expect there is some corn growing somewhere in Swaziland at all times of the year.

Leaf Spots: The fungus survives in refuse from previous crops. When weather promotes fungus growth in and on the refuse, new spores are produced and these can be wind-borne to corn plants. In addition to spores produced on corn refuse, spores can be introduced with air currents and winds from fields and areas where disease already is present on plants.

Transmission/spread: Air/wind borne.

Prevalence and Importance: In April, I saw a trace amount of rust and leaf spot/blight. This amount was not significant. If symptoms appear before whorl and possibly tassel stage, disease could become significant by harvest time if weather promotes development.

Control:

1. Fungicides such as Bravo and Dithane M-45 provide some control of rust and leaf spots if applications are started when symptoms appear. However, note that control is not perfect. In fact, growers might think they are not getting control unless they leave a strip without fungicide for comparison.

2. Varieties with resistance/tolerance: There is some difference in varietal reaction to rust. If rust becomes an important factor in production, try to identify locally adapted varieties with rust tolerance. Varieties listed as having some tolerance to rust include: Earlibelle (a medium early fresh market variety) and More (a processing variety).

Pepper Virus Problems

Occurence:

Central:	Muzi Dlamini	Pepper, new buds	Virus, 1 plant.
Central:	Dale Allen	Pepper, new buds	Crinkle new growth only; virus?
Southeast:	Lindumane	Pepper, harvest	Crinkling of new growth only.

Transmission, Cause, and Source: Although there are many viruses that can affect peppers, most can be put into one of two groups:

(1) Those that can be spread mechanically.

a. Tobacco Mosaic Virus (TMV); from seed, debris from previous crops, weeds, transplants, nearby infected crops (tomato, potato), contaminated tools and workers.
b. Others = PVX, TSV.

(2) Those that can be spread by insects, usually aphids.

a. Potato Virus Y (PVY), Tobacco Etch Virus (TEV), and Pepper Mottle Virus (PeMoV) are similar but not identical; from infected weeds, potato and tomato.
b. Cucumber Mosaic Virus (CMV); from reservoir hosts including many weeds and cultivated plants.
c. Others = BBMV and AMV.

Symptoms: Symptoms seldom are characteristic enough to indicate which virus is responsible for the symptoms.

However, usually it is possible to determine "infection by virus" on the basis of symptoms. Symptoms that indicate infection by virus include the following. All of these symptoms will not occur; it is possible for only one of these symptoms to be present:

a. New leaves: leaf mosaic, mottle, crinkle; death of tip growth.
b. Old leaves: stunting, vein discoloration, leaf drop.
c. Overall plant: stunting, bushy appearance, wilting.
d. Stems and petioles: Death of tissue in streaks on stems and petioles.
e. Fruit: roughness, malformation, mottling, yellowing in spot or stripe patterns, dead areas on fruit, reduced wall thickness, reduced yield.

Prevalence and Importance: In most fields observed during late April, we saw very few plants with typical virus symptoms. However, considering the prevalence of viruses (likely aphid-borne) on cucurbits, I expect that viruses could be important on peppers during periods of the year when aphids are prevalent.

In the Siphonanini area, we saw several very nice fields of peppers that apparently were not affected by viruses before the first harvest in April. At the same time, we observed virus-like symptoms on about 80% of the plants, but only on the newest leaves. Since such a high percentage of plants had symptoms, I wondered if some other factor was causing the symptoms. If I saw this in the United States, I would suspect a herbicide or growth regulator cause, possibly introduced as a contaminant.

Control:

1. Resistance/tolerance: Grow varieties with resistance to virus whenever possible. Most varieties have some resistance to TMV. Varieties with resistance to viruses in addition to TMV include: (a) Super Sweet-860, a sweet thick-walled type with resistance to TMV and PVY, and (b) Tam Mild Chile-2, a hot pepper with resistance to TMV, PVY and Etch.
2. Transplants: Start with transplants that are free of viruses transmitted both mechanically and by aphids.
3. Do not touch plants any more than necessary before harvest.
4. Weed Control: Control weeds which can be sources of the virus.
5. Insect Control: Control insects, especially aphids which can be important vectors of many viruses. However, note that control of aphid borne viruses is minimal through use of insecticides because aphids entering a field seldom can be killed by the insecticide before they feed on a plant and transmit the virus (within half a minute).

Pepper and Tomato Bacterial Spot

Cause: Bacteria = Xanthomonas vesicatoria

Occurrence: When we observed fields late in April, I did not see any Bacterial Spot on peppers or on tomatoes. However, this disease could be a problem in this environment. In my opinion, preventive measures are important to avoid potential problems in the future.

Symptoms: Both leaves and fruit can be affected. In the field, small brown spots appear on both young and old leaves; affected leaves may appear somewhat ragged because leaf tissue frequently tears around the leaf spots. Severely affected leaves may turn yellow, and frequently fall from the plant. Fruit spots are raised and scab-like. Three ways that bacterial spot differs from Cercospora leaf spot:

		Bacterial spot	Cercospora spot (pepper)
(1)	Leaf spot shape	Irregular and ragged	Circular
(2)	Leaf spot margin	Indistinct	Distinct dark margin
(3)	Fruit symptoms	Present	Absent

Source: Seed; infected transplants; residue from diseased plants (2 years)

Transmission/Spread: Bacteria that is present on seed, pepper and tomato crop residue, or diseased pepper and tomato plants can be splashed to other plants. Following infection, the bacterial cells can survive in a dry crust on the surface of plants. Therefore, bacteria are not air-borne during dry weather. However, during rainy periods, the dry crust dissolves and wet bacterial cells are free to be moved by workers and their tools, and by splashing and blowing rain to othe plants.

Prevalence and Importance: Not seen in plantings observed in late April; however, this disease is a potential problem.

Control:

1. Start with quality seed that is free of the bacterial spot organism.
2. Start with transplants free of the bacterial spot organism.
2. Follow a rotation that provides a minimum of 2 years without peppers or tomatoes.
3. In areas where bacterial spot has been present, make weekly applications of a fixed copper (copper oxychloride) mixed with mancozeb (Dithane M-45).

Pepper Cercospora Leaf Spot

Cause: Fungus = Cercospora capsici.

Occurrence:

Northeast: Vuvulane Irrigated Farm, boy's field, most plants affected but only low leaves.
Northeast: Vuvulane Irrigated Farm, man's field by house, trace leaf spot.

Symptoms: Circular spots on leaves. Usually spots have light gray centers with dark margins. Severely affected leaves may turn yellow and drop.

Source: Seed; survives 1 year in residue from infected plants; adjacent fields with diseased plants.

Transmission/Spread: Growth of fungus on seed, pepper crop residue or diseased pepper plants that are nearby; dry spores can be air-borne to plants.

Prevalence and Importance: Present in few of the plantings observed. Where present, occurred only on the oldest leaves. Not resulting in significant defoliation.

Control:

1. Start with quality seed. The treatment used for bacterial spot also may be helpful.
2. Follow the rotation recommended for bacterial spot control (2 years without peppers).
3. If needed, fungicides used for bacterial spot would be helpful.

22

Pepper and Tomato Water-Mold Root Rot

Cause: Fungi = Phytophthora sp.; Pythium sp.

Pepper Occurrence:

Northeast: Vuvulane Irrigated Farm, boy's field, 1% of plants wilted.

Northeast: Vuvulane Irrigated Farm, man's field by house, 1% of plants wilted overall; 20% wilted in limited wet area; water table possibly at 1 meter; wants sub-soil drainage.

North: First pepper field today; <5% of plants wilted; suspect started in plant bed.

Southeast:	Lindumane	Pepper, harvest	Water mold rot rot.
Southeast:	Makhaya	Pepper, blossom	Wilt; trace; water mold/salts?

Tomato Occurrence:

North: 3rd field, 3-wk field; about 5% of plants wilted and with root rot; scattered plants; problem originated in seedling bed; had to sort seedlings before transplanting.

Southeast:	Makhaya	Tomato#2, first ripe	Wilt; <2% plants; water mold/salts?

Symptoms: Isolated plants wilted in a scattered pattern within a field. When dug up, observed some roots to be discolored with a wet rot evident on the outside of affected roots, and sometimes on the outside of the buried portion of stems.

Source: Soil-inhabitant; promoted by wet conditions; where absent, can be introduced with contaminated soil.

Transmission/Spread: Moved from field to field and plant to plant in irrigation water and in soil. The irrigation water likely is an important factor affecting spread of this fungus.

Prevalence and Importance: Present in several of the plantings observed. Where present, from 1% to 20% of plants affected. Most affected in wettest areas of fields.

Control:

1. Start with transplants from seed beds without root rot. If it is necessary to sort plants (to remove plants with root rot) before transplanting, you can be certain that some plants that appear healthy at transplanting actually are infected and will develop symptoms of root and stem rot.

2. Minimize the period of time when plant stems and roots are submerged in irrigation water. As soon as possible after plants overcome transplant shock, it may be beneficial to move soil to the stem area, thus shifting the irrigation trench further from the plant stems, so that the stems no longer are submerged in irrigation water. By irrigating soil further from the base of the plant, the plant will be forced to produce more or longer roots, and at least some of these will be exposed to less saturated conditions during irrigation.

3. If necessary, Ridomil soil treatment may provide some control. In some countries, it can be applied at planting, 30 days after planting, and 60 days after planting. However, since this treatment would be expensive, I suggest that it be tested in a trial before considering use in commercial fields. Be aware that in New Jersey, where Ridomil treatments for peppers were developed, the most important control recommendation continues to focus on improved drainage around plants. Also be aware that, although Ridomil is highly effective against the water molds, there are cases where the water molds have developed resistance to Ridomil, and therefore can no longer be controlled by Ridomil. If an "over-dependence" on Ridomil is avoided now, it is likely that Ridomil will maintain effective for a longer period, and therefore be available when it may be needed most.

Tomato Early Blight and Late Blight

Cause:

Early blight: Fungus = Alternaria solani
Late blight: Fungus = Phytophthora infestans

Early Blight Occurrence:

North: 1st fields by stakes	Tomato#1	Early blight, 10% defoliation.
North: 2nd field, trelles	Tomato#2, first ripe	Early blight, >10% defoliation.
North: 2nd field, trelles	Tomato#2 fruit grading	Early blight stem end rot present.
Southeast: Lindumane	Tomato, pre bloom	No leaf spots yet, good growth.
Southeast: Lindumane	Tomato, first ripe	Early blight, 5% defoliation.
Southeast: Makhaya	Tomato#1, 50% harvested	Early blight, 30% defoliation.
Southeast: Makhaya	Tomato#2, first ripe	Early blight, amount?

Late Blight Occurrence:

North: 1st fields by stakes	Tomato#1	Late blight, trace defoliation. Why not more? Possibly due to dry/hot.
Southeast: Makhaya	Tomato#1, 50% harvested	Late blight reported; now hot/dry?

Occurrence: Both early blight and late blight in April in the northern area.

Early blight in April at the Londumane farm in the eastern area; late blight reported present at other times.

Symptoms: Early blight: Many small spots with concentric rings; starts on oldest leaves; slow development; spread upward on the plant. Can affect fruit at stem end but is slow to develop.

Late blight: Few large spots on any of the leaves; white mold evident on the underside of the leaf at the margin between the dead and the living tissue. Fast development is possible; a field could be wiped out within 2 weeks if environment promoted disease and no fungicide sprays were applied. Fruit can be affected quickly at the green stage; half the surface on a fruit can be affected within a few days.

Source: Early blight: Seed, transplants, at least 1-year survival in refuse from diseased plants, air-borne spores from nearby plantings of potatoes or tomatoes.

Late blight: Infected potato tubers in cull piles or infected tubers used for seed, winter grown tomatoes and potatoes, transplants, air-borne spores from nearby plantings of potatoes or tomatoes.

Prevalence and Importance: During April, early blight was the major defoliation disease affecting tomatoes in both the northern and eastern areas; late blight was observed in April only in the northern area, but not in the eastern area. It is possible that temperature has been too high in the east to support late blight development; late blight was reported in the eastern area at other times. It appears that a regular fungicide program is warranted on all tomatoes.

Control: 1. Start with disease-free transplants.
2. Rotate with other crops to allow at least 2-years without tomatoes or potatoes.
3. Fungicides:

a. Early blight: Start fungicide applications soon after plants are established, and continue at weekly intervals at least until harvest begins. Be aware that Bravo and Dithane M-45 are only protectants, and have no systemic activity, and therefore must cover all parts of the plant to be protected. Keep the pressure up in the backpack sprayer to promote a fine spray mist, and try to cover the lower surface of leaves as well as the top surface. Note that Ridomil does not control early blight.

b. Late blight: The fungicides used to control early blight also are effective as protectants against late blight. Although Ridomil/Bravo and Ridomil MZ can be more effective against late blight, it may be wise to use these materials only when necessary to control late blight. If Ridomil/Bravo or Ridomil MZ applications are needed, they can be applied at 2-week intervals. If late blight is bad, Dithane M-45, Bravo, or a copper fungicidecan be applied between the Ridomil/Bravo or Ridomil MZ applications. Use of the broad spectrum materials (Dithane M-45, Bravo, copper fungicide) will help minimize the chance that the late blight fungus will develop resistance to the highly effective Ridomil materials.

Other Crops and Diseases:

Central: Nora Raid	Squash, 20 leaf stage	Virus, 70% of plants
Central: Nora Raid	Squash, 20 leaf stage	Powdery mildew, 20% leaf area covered
Central: Nora Raid	Cabbage, seedling stage	Soluble salts high?, most affected
Central: Nora Raid	Onion, seedling stage	Soluble salts high?, most affected
Northeast: Vuvulani Irrigated Farm	Snap Bean, full bloom	No problems
North: 1st fields, stakes	Tomato, fruit stage	Virus, <1% of plants; sm.lvs, sl.yellowing
North: 1st fields, stakes	Tomato, fruit stage	Root knot nematode, trace wilted plants
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Amer. boll worm; major now.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Bact. speck.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Catfacing.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: E.Blight stem end rot.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Rhizoctonia soil-rot.
North: 2nd fields, trelles	Tomato, first ripe	Fr.Grading: Bacterial soft rot; injury.
Southeast: Lindumane	Tomato, first ripe	Mites heavy.
Southeast: Lindumane	Pepper, harvest	Sunscald.
Southeast: Lindumane	Pepper, harvest	Water mold rot rot.
Southeast: Lindumane	Pepper, harvest	Crinkling of new growth only; virus?
Southeast: Lindumane	Pepper, harvest	Verticillium? or water mold effect?
Southeast: Makhaya	Tomato#1, 50% harvested	Early blight, 30% defoliation.
Southeast: Makhaya	Tomato#1, 50% harvested	Late blight reported; now too hot/dry?
Southeast: Makhaya	Tomato#2, first ripe	Early blight, amount?
Southeast: Makhaya	Tomato#2, first ripe	Wilting; <2% of plants; water mold/salts?

ANNEX D

Farmer Field Days

FARMER FIELD DAY
COMMON DISEASES AND INSECTS OF TOMATO
NORTHERN REGION
3 MAY 1993

10:00	Opening	J. Sifundza
	Purpose of Field Day	
	Relationship to March Field Day	
	Importance of controlling crop pests	
10:20	Common Diseases of Tomato and their Control	A. MacNab
	Early blight	
	Late blight	
	Root rots (Water mold)	
	Bacterial wilt	
	Fruit disorders	
	Blossom-end rot	
	Sunscald	
	Bacterial spot	
	Catfacing	
	Alternaria	
	Seedbed management	
11:30	Tea	
11:45	Common Insects of Tomato and their Control	L. Sibanze
	Red spider mite	
	American bollworm	
	Aphids	
	Leafminer	
12:45	Handling of Pesticides	D. Grenoble
	Measuring	
	Mixing	
	Safety considerations	
1:15	Applying Pesticides to the Cro	J. Sifundza
	Sprayers (including nozz	
	Coverage	
	Time of application	
	Safety considerations	
1:45	Closing	
1:55	Lunch	

DISEASE AND INSECT MANAGEMENT FIELD DAY
Central

May 4, 1993

Opening

Disease Identification and Control for Pepper and Sweet Corn

Insect Identification and Control

Lunch

Handling Pesticides

Closing

FARMER FIELD DAY

COMMON DISEASES AND INSECTS OF TOMATO AND PEPPER

SIPHOFANENI/SITOBELA

5 MAY 1993

10:00 Opening — J. Sifundza

- Purpose of Field Day
- Relationship to March Field Day
- Importance of controlling crop pests

10:20 Common Diseases of Tomato and Pepper and their Control — A. MacNab

- Early blight - tomato
- Late blight - tomato
- Root rots (Water mold) - tomato & pepper
- Bacterial wilt - tomato & pepper
- Viruses - pepper & tomato
- Bacterial spot - pepper & tomato
- Powdery mildew - pepper
- Cercospora leaf spot- pepper
- Fruit disorders
  - Blossom-end rot - tomato & pepper
  - Sunscald - tomato & pepper
  - Bacterial spot - tomato & pepper
  - Catfacing - tomato
  - Alternaria mold - tomato
  - Bacterial soft rot - pepper
- Seedbed management

11:30 Tea

11:45 Common Insects of Tomato and Pepper and their Control — L. Sibanze

- Red spider mite - tomato
- American bollworm - tomato & pepper
- Aphids - tomato & pepper
- Leafminer - tomato

12:45 Handling of Pesticides — D. Grenoble

- Measuring
- Mixing
- Safety considerations

1:15 Applying Pesticides to the Crop — J. Sifundza

- Sprayers (including nozzles)
- Coverage
- Time of application
- Safety considerations

1:45 Closing

1:55 Lunch

Disease Educational Material for Grower Meetings

Alan A. MacNab

General Objectives:

1. Diseases are important in vegetable production. Some are important to control.

2. How can we control these diseases? Review controls.

Sweet Corn Diseases

3 Diseases observed in past 2 weeks, BUT only one of major significance.

1. Streak
2. Rust
3. Leaf Spots

Sweet Corn Rust and Leaf Spots: The rust and leaf spot diseases appear to be of minor importance, and I will not say much about them. Rust is well named. The symptoms look like rust. There are several leaf spots caused by tiny fungi that can attack the leaves. Usually special controls will not be warranted. For the leaf spots, rotations will help. For rust, rotations will not help because the tiny spores can be blown into a planting after travelling many miles in the wind. For both rust and leafspots caused by fungi, if these ever do become important, it is possible to slow their development with two fungicides -- Bravo and Dithane M-45.

Let's move on and consider the most important sweet corn disease.

Sweet Corn Streak: What is streak? Streak is a virus disease that is spread by an insect. The insect is a leaf hopper.

Symptoms: Plant specimen. Plant yellowing starting on the new leaves; yellow streaking frequently between veins. Plants are stunted when symptoms appear early.

How important is streak on corn? I have seen a number of fields during the past 2 weeks. I saw more corn virus/mycoplasma problems in 2 days here than I saw back home in 20 years. Of plantings I have observed here, all plantings at or beyond the 15 cm-height stage had some plants with streak symptoms! Percent plants with symptoms was between 5% (youngest plantings) and 78% (older plantings).

I understand that streak importance here **depends on the time of the year.** There is little streak in the early season (August), and much more in the late season (after January).

I expect that you can guess what I saw during the past 2 weeks. The **amount of streak present is related to age of planting and size of the plants when symptoms are observed.** In general, by the time plants are 50 cm high, 1/3 of the plants are affected.

For the fields I observed in the past couple of weeks, the **percent of plants that are affected seems to double during the time it takes for a plant to grow an additional 10 cm.**

ie. 2% affected with 10 cm plants
4% affected with 20 cm plants
8% affected with 30 cm plants
16% affected with 40 cm plants
34% affected with 50 cm plants
60-80% affected with 60 cm plants

An important question to answer if: What is the stage of plant growth when infection would not affect yield and quality of the ears. Whorl stage? New tassel stage?

Control:

1. Varietal resistance/tolerance: I think Challenger was supposed to have some tolerance to the most important sweet corn virus in South Africa. I hope there are varieties with better tolerance to "streak" here in Swaziland! Variety trials are warranted. I expect that resistance will be an important control in the future.

2. Insect vector (leafhopper) control:

a. Carbofuran (Curator) applied to soil at planting time appears to be important. Although some systemic insecticides may be more effective (eg. Gaucha), no pesticide should be used unless it is labelled for the use.

b. Insecticide sprays. Sprays might be useful, especially if an extended period is required for the insect to transmit the virus/mycoplasma to the plant. (For some aphid-borne viruses, transmission time is so short (eg. half a minute) that it is difficult to kill an aphid before it has transmitted the virus.) Insecticide sprays would likely be less effective in small fields and narrow strips than in large plantings in square fields.

3. Planting time: In areas or fields where streak is most severe, it may be necessary to establish dates beyond which new plantings should not be made. It appears that August plantings are less affected by streak, and that plantings after January are more severely affected by streak.

4. Plant vigor: For some corn viruses, it appears that plants tolerate late infection if there is adequate moisture and nutrition. Effect of the virus seems to be more severe if plants are under moisture and/or nutrient stress.

In conclusion, this is a major disease on sweet corn. Current controls include: (1) control of the leafhopper that spreads the virus, (2) choice of the planting time, (3) maintaining good vigor of plants. For the future, I hope there are some major advances in development of varieties with resistance to streak. It is needed!

Growing Transplants Free of Disease (Tomato and Pepper)

How important is this?

What diseases can be introduced with transplants?
Peppers: Bacterial spot, Cercospora leaf spot, Viruses, etc.
Tomatoes: Early blight, Late blight, Water-mold root rot, Bacterial spot, Bacterial speck, and Bacterial wilt, etc.

Practices that help insure good transplants:

a. Start with a well prepared seedbed area. Preparation of the seedbed will consider soil condition and drainage. Good drainage is essential.

b. Sterilize soil with Basamid (dasamet); this helps minimize a wide range of pests in the soil (eg. weeds, insects and pathogens that cause water-mold root rot, and some leaf and fruit rots).

c. Start with good seed that is free of disease causing organisms; sometimes treated by the seed company.

d. Provide adequate spacing between seeds and seedlings in the seed bed. Seedlings must be at least 1 cm apart. Dense plantings will promote many diseases.

e. Try to transplant seedlings before they get too old or too tall. Try to use pepper plants before they are 8-9 weeks old. And try to use tomato plants before they are 5 weeks old. Also, try to transplant seedlings before they are 12-cm tall.

Tomato Leaf Spots (Early Blight, Septoria, and Late Blight)

Symptoms: Two types of disease:

First type of disease: **Small distinct spots** are caused by 2 different pathogens (Alternaria LS, and Septoria LS). Alternaria LS is the most prevalent and most important. Alternaria LS starts on bottom leaves and spreads upward on the plant. It produces dry spores on the leaf spots and these spores are dislodged from the leaf and float around in the air; these spores are blown from plant to plant, and field to field, by wind. The other LS pathogen, Septoria, produces wet spores within a cup-like structure. Whenever it rains, the spores flow out of the cup and are spread to other plants by splashing and blowing rain water. These and other spores are like seeds. When weather is favorable, these spores germinate like seeds and grow into the leaf. These two leaf spots can develop any time during the year when there is adequate dew or rain. Temperature would almost always be favorable. Symptoms always start on the oldest leaves, and progress upward on the plant. Although leaves are killed slowly, more and more leaves are killed each week. By harvest, few good leaves would remain if controls are not followed. Fruit would be small and yield would be low.

Second type of disease: **Large fast-spreading spots** are caused by another pathogen. This is sometimes referred to as Phytophthora blight or late blight. In contrast to the other leaf spots, this one produces large spots that can spread over half a leaf or half a fruit very quickly, sometimes within a few days. If you look very carefully at the underside of a leaf where the blight is spreading on the leaf, you would be able to see a white mold. If the weather is favorable this blight could kill an entire planting within a couple of weeks if controls were not followed. Fortunately, weather does not always favor development of this disease. It can develop only when the air is moist for long periods each day, when there are frequent rains, and when the temperature does not go above 32*Centegrade. In general, this disease is promoted when conditions are wet and temperatures are low to moderate. I saw this disease in northern Swaziland, and understand that it can develop in southeastern Swaziland when the weather is sufficiently cool and wet.

Control:

1. Start with disease-free transplants. If disease is severe on seedlings in the seed-bed, it may not be worth using the plants. If growers ever find that it is difficult to keep seedlings free of leaf spots in the seedbed, consider using sprays of Bravo on tomato seedlings.

2. Rotate crops to allow at least 2-years without tomatoes or potatoes.

3. Fungicides:

a. Small distinct spots that develop slowly (Early blight and Septoria spot): Start fungicide applications soon after plants are established, and continue at weekly intervals at least until harvest begins. Be aware that Bravo and Dithane M-45 are only protectants. They do not move within the plant; therefore they must be sprayed onto all parts of the plant to be protected. Keep the pressure up in the backpack sprayer to promote a fine spray mist, and try to cover the lower surface of leaves as well as the top surface of leaves. Note that the fungicide Ridomil does not control the small-spot leaf spots.

b. Large fast-spreading spots (Late blight): The fungicides used to control the small distinct spots also provide good control of the large fast-spreading spots. If needed, Ridomil MZ could be more effective against this large-spot leaf and fruit disease. I suggest these materials be used only when necessary, likely following consultation with a field assistant. There are two reasons: (1) the disease organism can develop resistance to Ridomil, and (2) Ridomil is more expensive than Bravo and Dithane M-45. If Ridomil MZ applications are needed, they can be applied at 2-week intervals. If the large-spot disease is severe, Dithane M-45, Bravo, or a copper fungicide can be applied between the Ridomil MZ applications. Use of the broad spectrum materials (Dithane M-45, Bravo, copper fungicide) will help reduce the chance that the fungus will develop resistance to the highly effective Ridomil materials.

Bacterial Wilt of Tomato

Symptoms: Lower leaves wilt, followed by wilting of the entire plant. With bacterial wilt, there is no yellowing of leaves whereas there is a yellowing with Fusarium wilt. The tissue within the stem may become discolored and/or hollow.

Controls:

1. Rotation (2-3 years without tomatoes)

2. Resistant varieties whenever possible.

eg. Maxamillion (expensive seed but best resistance)
Rodade
Rotan 4 (but later and somewhat indeterminate)
Zest (expensive, still get 50% Bact. wilt)
Zeal (expensive, still get 50% Bact wilt, but some EB tolerance)

Pepper and Tomato Viruses

Symptoms: stunted plants, small leaves, mottled and crinkled leaves.

Many different types of virus

But only two major groups:
Spread by touch/handling plants. eg. TMV.
Spread by insects (esp. aphids). eg. CMV, TEV, Pepper Mottle

Control:

a. Resistance: Many varieties are resistant to TMV. It is worth using these.

b. Many viruses survive in weeds -> Kill weeds around fields. This is helpful for many virus diseases.

c. One virus is in tobacco products (TMV) -> If you smoke, wash hands well before touching plants.

d. Aphids spread many viruses, and can do this quickly (less than 1 minute). Control aphids as well as possible.

e. Old affected plantings are a source of virus for new plantings. As soon as harvest is complete, cut off the plants and plow them under. This is a good practice for all crops including cotton and corn.

Tomato and Pepper Fruit Disorders

1. Pepper and Tomato: Blossom End Rot

2. Pepper and Tomato: Sunscald

3. Pepper Bacterial Spot on Fruit

4. Pepper Alternaria mold (secondary)

5. Pepper bacterial soft rot
   Try not to wash fruit.
   If fruit needs to be washed, use water that is warmer than the fruit. When wash water is cooler than the fruit, bacterial soft rot bacteria can be "sucked" into the fruit, and this can result in rot later. Wipe dry if possible.

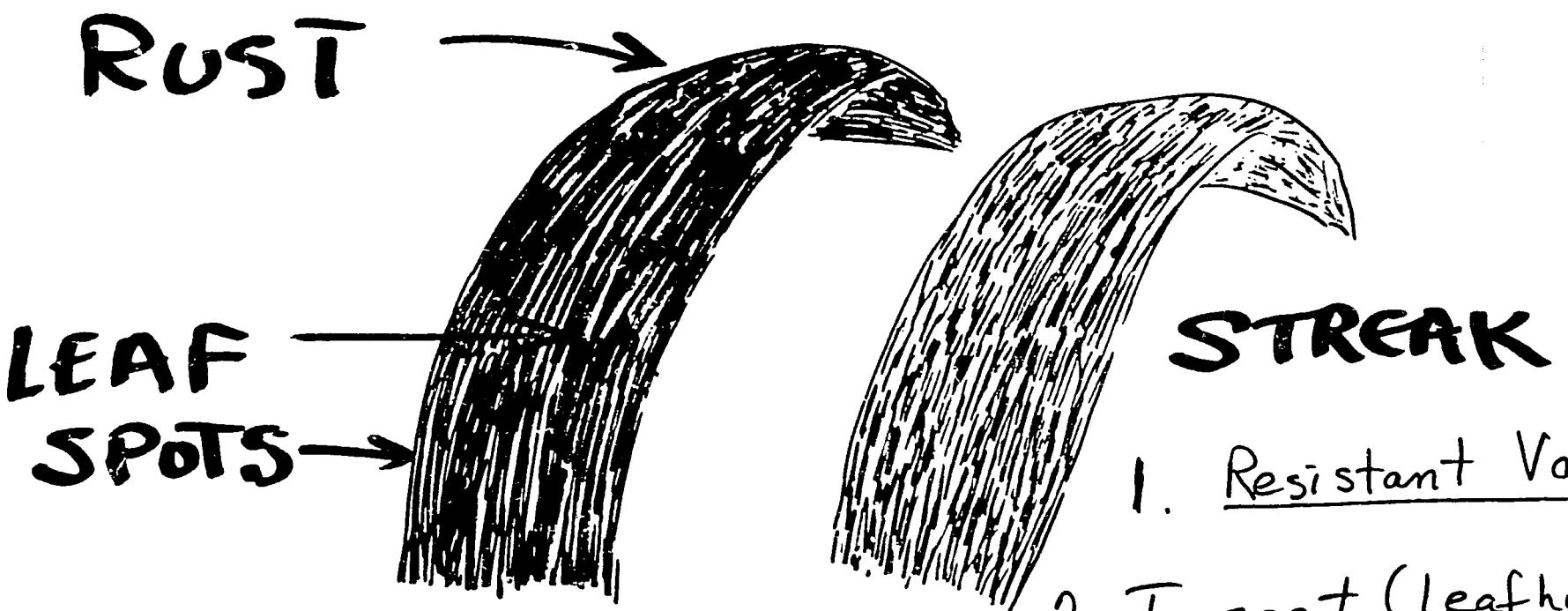
6. Pepper Virus
   Rough fruit with yellow or brown spots or streaks.

7. Tomato Stem-end Fruit Rot (Early Blight); control same as for the leaf spots that develop slowly.

8. Tomato Fruit Rot caused by the leaf blight that causes large dead areas on leaves (Late Blight); control same as for the leaf spots that develop rapidly.

ANNEX E

Charts for Farmer Field Days



E-1

1. Resistant Varieties?

2. Insect (Leafhopper) Control

Rust & Leaf Spots

Fungicides possible if needed.

Fair Control.

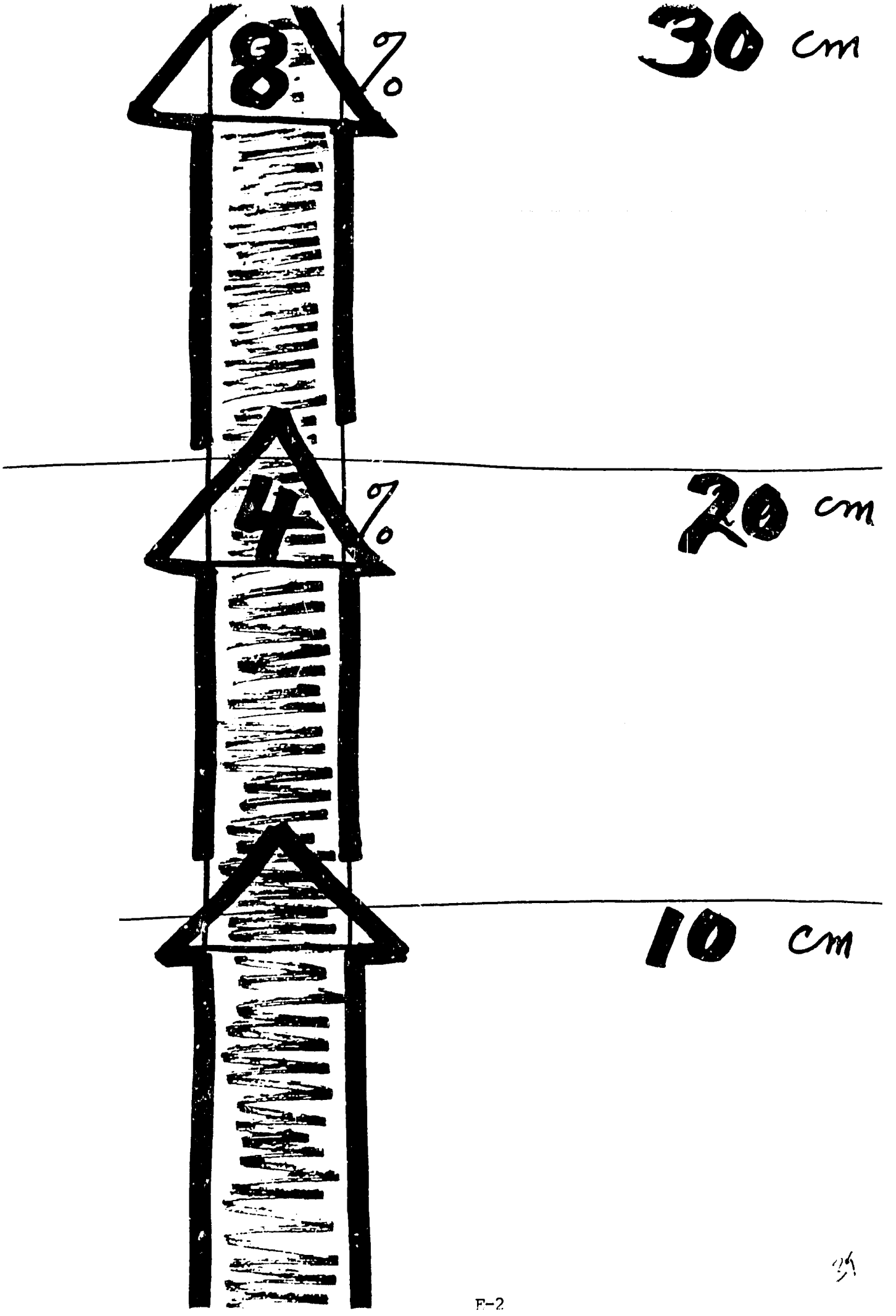
3. Planting Time

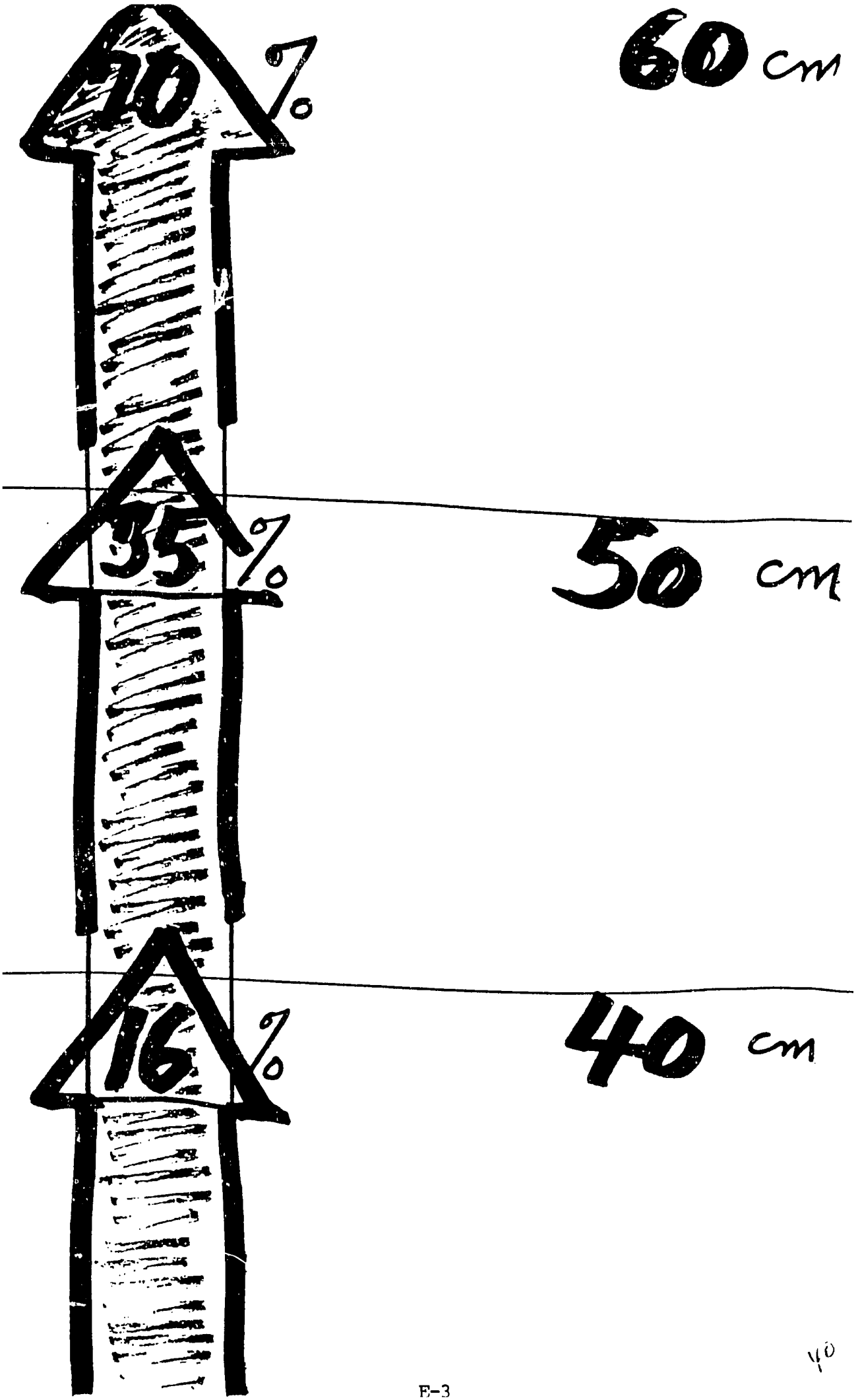
Aug Sep Oct Nov Dec Jan Feb Ma

4. Vigor of Plant

Good roots
Enough water
& Nutrition

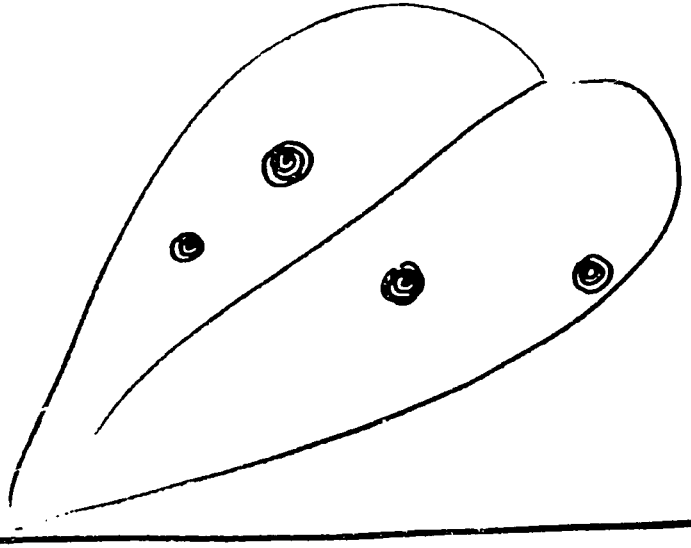
Broken roots
Drought
Low fert

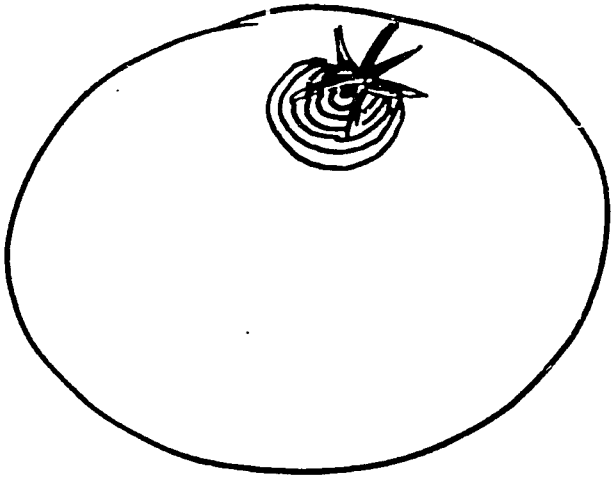

8 %
30 cm
4 %
20 cm
10 cm



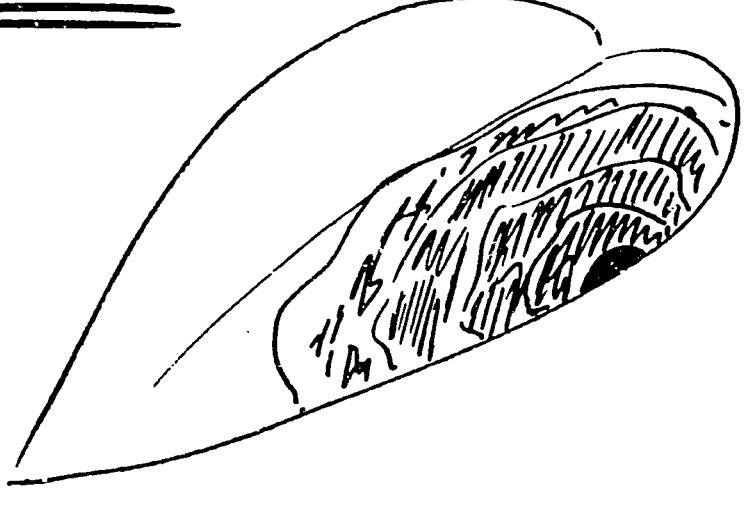
40

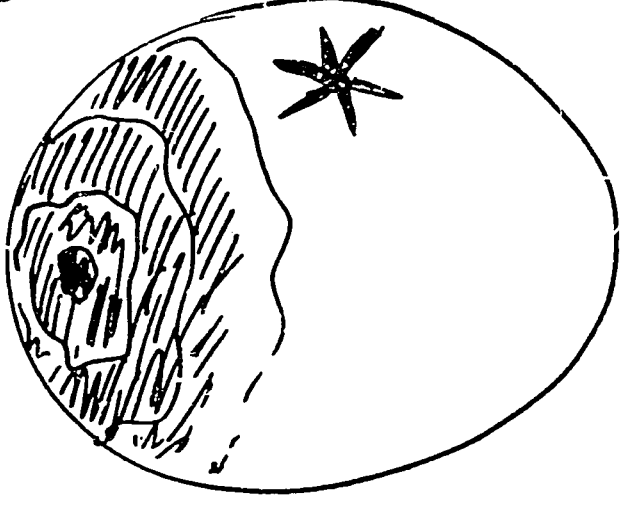
SMALL SPOTS ; OLD LEAVES FIRST



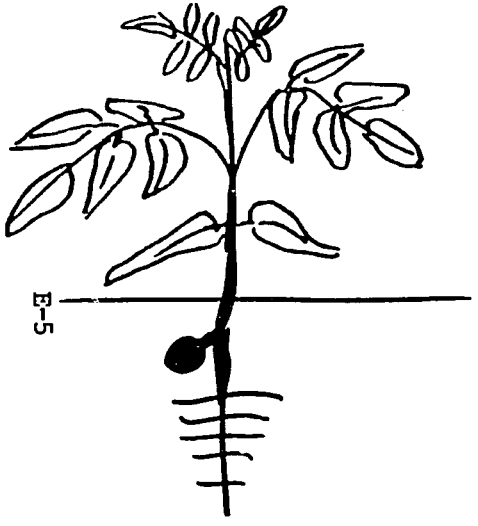


LARGE FAST-SPREADING SPOTS

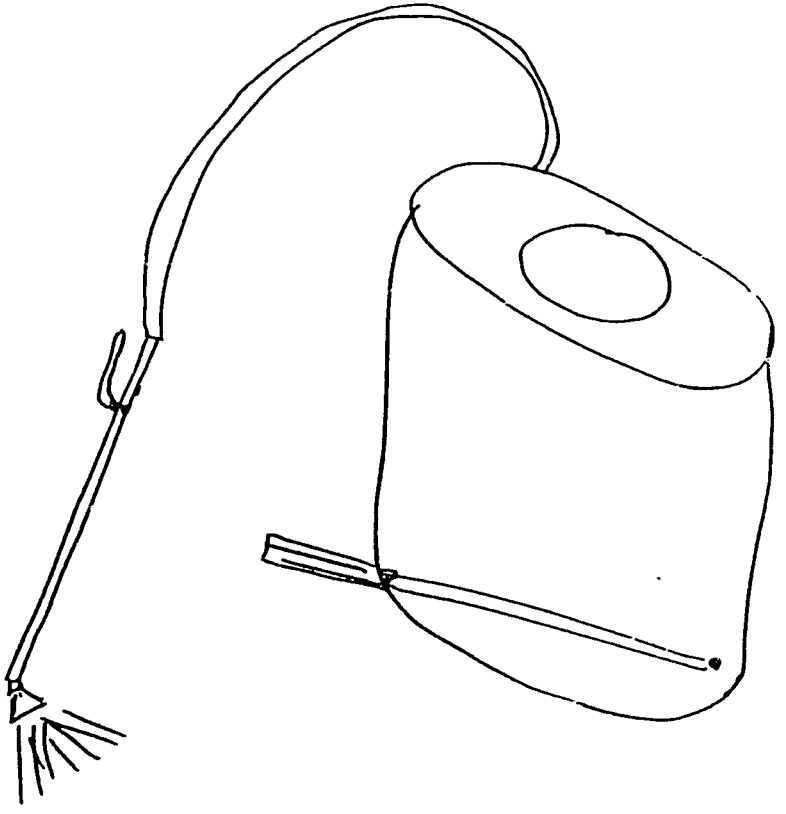




CONTROL OF BLIGHTS



At least
2-years
without
Tomato or
Potatoes

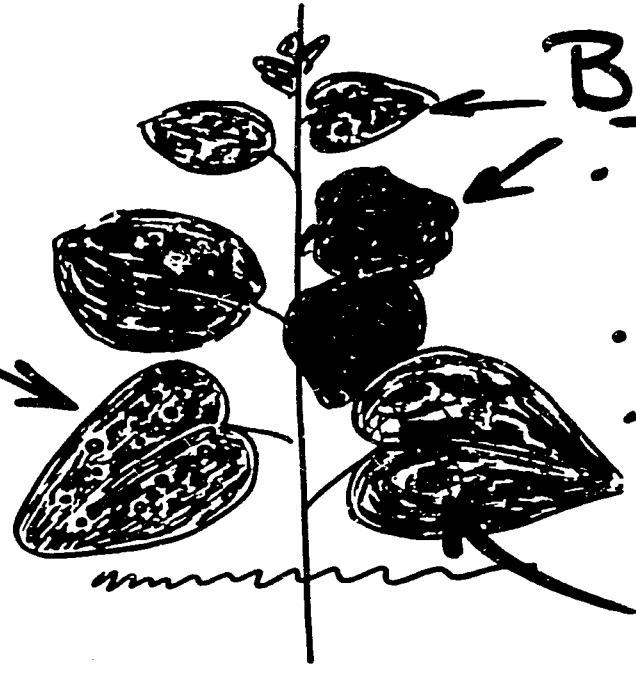


ROTATION

SEED + TRANSPLANTS

FUNGICIDES

PEPPER LEAF SPOTS



Bacterial Spot

- Small dark spots; lvs. + fruit
  - irregular shapes + leaf tearing
- Both young + old leaves
- Fruit = Raised corky.

Cercospora Spot

- Oldest leaves
- Round spots
- Light spots with dark halo

Powdery Mildew

Yellowish spots → Dry spots with P.M. mold

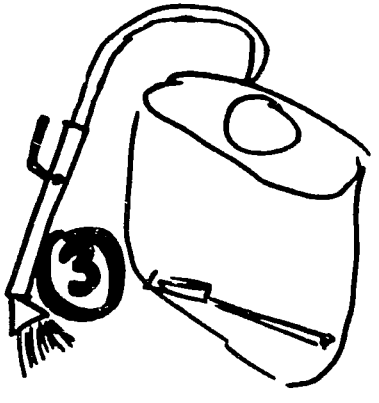
Controls:

1.

   SEED + TRANSPLANTS

2.

   ADEQUATE FERTILITY

3. 

   SPRAY: Copper Oxychloride + Dithane M-45

E-6

PEPPER / TOMATO VIRUSES

Symptoms

Plant Size

Leaf Size

Leaf texture
+ color
- crinkled
- mottled / mosaic

2 types of Virus:

1. Spread by touch + handling (TMV)

2. Spread by insects = aphids, leafhopper
CMV, TEV, Pepper Mottle.

Control:

Variety Resistance (TMV)

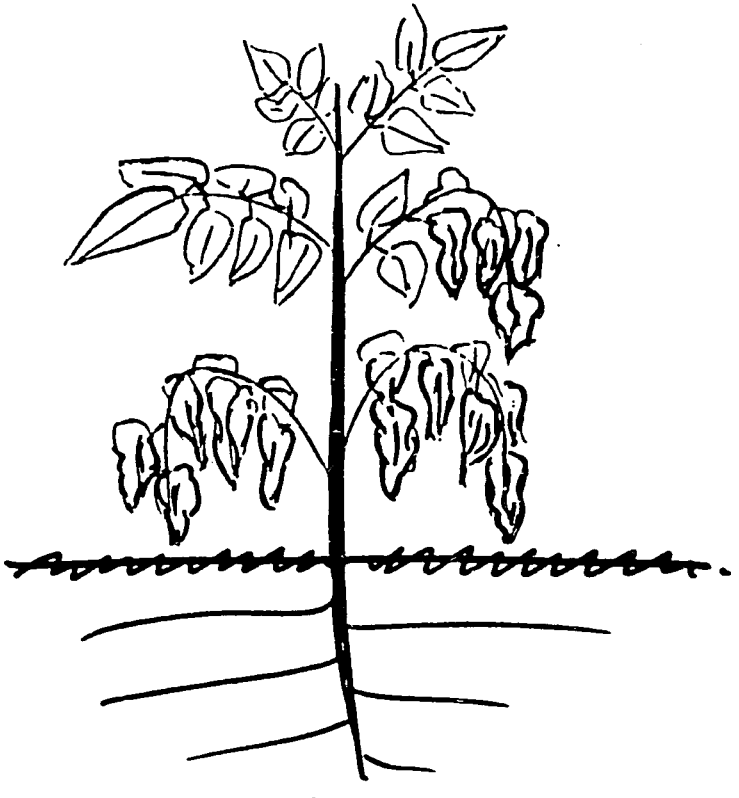
Source = Weeds → Control weeds.

Source in tobacco products = TMV.
Wash hands well.

Aphids spread many viruses.
Need aphid control = difficult!
Spread fast by aphids.

Source = old plantings.
After harvest, cut off + plow down plants. (Incl. cotton + corn plantings aphid source)

BACTERIAL WILT



Lower Leaf wilting
↘ Later entire plant
(No yellowing)
Inside stem = discolored/hollow

Controls:

① Rotation: 2-3 yrs without Tomatoes

② Resistant Varieties

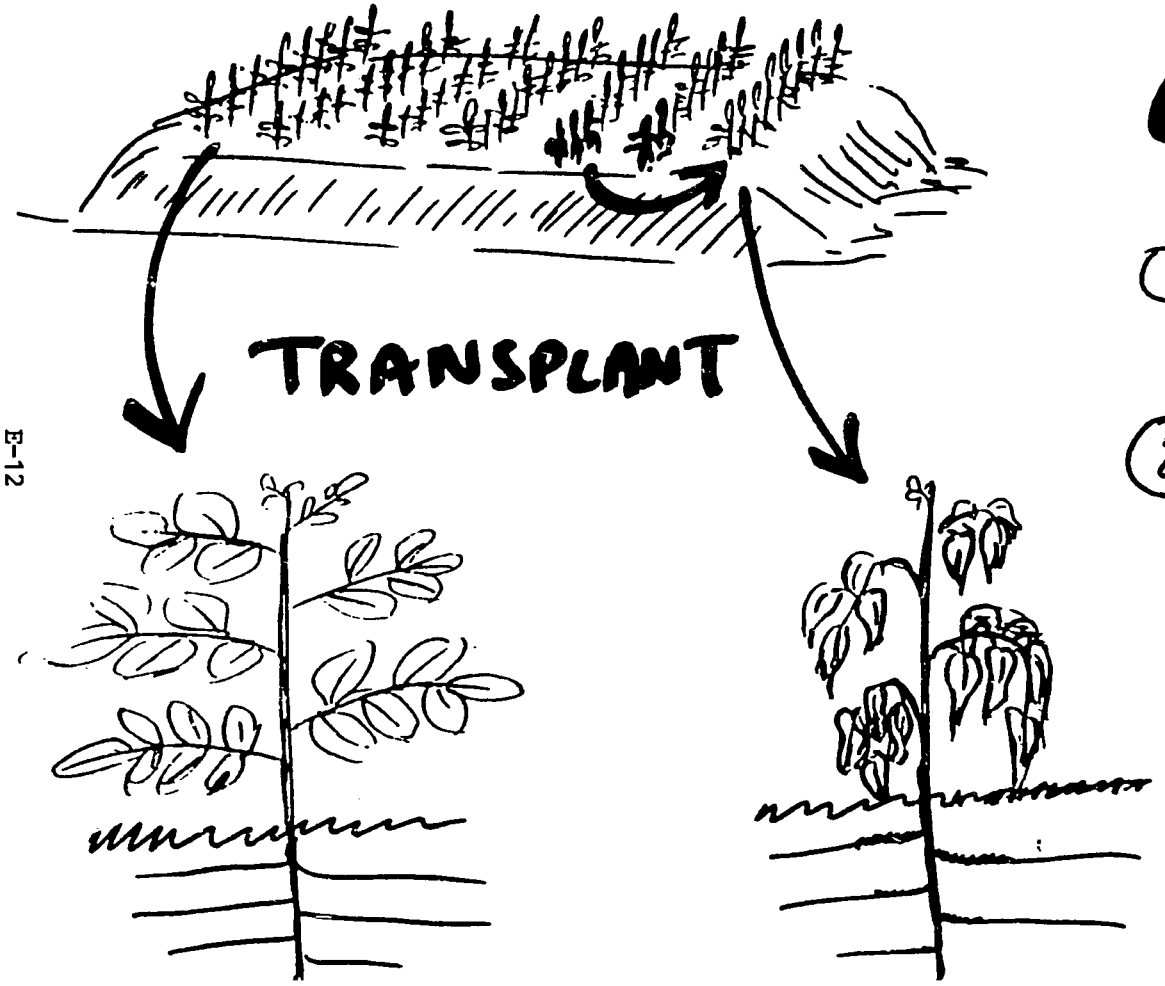
Maxamillion (Expensive; good res.)

Rodade

Rotan 4 (later var; some indeterminate)

Zest } Expensive seed; still 50% Bact. wilt
Zeal }

WATER-MOLD ROOT ROT OF TOMATO + PEPPER



Controls:

1. Good Transplants

2. Irrigation
   minimize time roots + stem are submerged.

3. Ridomil soil tr
   Possible but expensive; could loose effectiveness.

SEEDBED MANAGEMENT

Why important? → STRONG TRANSPLANTS WITHOUT DISEASE

What diseases could develop in seedbeds?

Pepper: Bact. spot ; Cercospora L.S.; Viruses ; Water-Mold Root Rot.

Tomato: E.B.; L.B; Water Mold Root Rot ; Bact. Spot/Speck/Wilt/Canker.

E-13

Some important things to consider:

ⓐ Start with well-prepared seedbed area (soil condition + drainage)

ⓑ Soil treatment with Basamid to kill pathogens, insects, weeds.

ⓒ Good Seed ; usually treated by seed company.

ⓓ Good Spacing ; between seeds + seedlings (1 cm+) — stocky / Tolerate sun/wind.

ⓔ Transplant before too old or too tall — Before 12 cm. tall.
Pepper at 8-9 weeks. Tomato at 5 weeks.

ANNEX F

Scope of Work

SHORT TERM CONSULTANCY REQUIREMENT
PLANT PATHOLOGIST/VEGETABLE DISEASE SPECIALIST

BACKGROUND

The redirected CAPM project is assisting small-scale farmers in production of vegetables programmed in response to market demands. The project is currently working with more than 140 farmers in three regions of the country involving nearly 100 ha. The project provides a program for planting to farmers and then support through regular visits to evaluate production and provide advice to farmers. The major production constraint faced by farmers in Swaziland in general and in the project is plant diseases.

RATIONALE:

This production season focuses on four major crops in three production regions. Fresh market variety tomatoes are being produced in the northern region, NEMA 1400 processing tomatoes for the fresh market are being produced in the Siphofaneni area, and sweet corn and sweet peppers are being produced in the central region. Production cost estimates show that as much as 1/3 of total production costs are associated with control of diseases. Disease damage is often responsible for major reductions in crop yields and quality as well.

Foliar and soil borne diseases are problems for a wide range of vegetable crops. Foliar diseases caused by numerous organisms are present in summer and winter. The primary crops the project is focusing on are especially vulnerable. In addition, other important crops affected include cabbage, onion, vine and bush squash, green beans, potato, sugar peas, and carrot.

A list of major diseases on tomato includes (listed in likely order of frequency of occurrence), Early Blight, Bacterial Wilt, Late Blight, Septoria Leaf Spot, Bacterial Spot or Canker, and Fusarium and Verticillium Wilts. Pepper diseases include several viruses, Powdery Mildew, and what appears to be Anthracnose and/or Alternia. Sweet corn diseases include Maize Streak Virus and Rusts.

A wide range of agricultural chemicals are available to farmers through South African companies. Application methods predominantly involve the use of small size applicators such as the knapsack sprayer. The emphasis on control to date centers almost totally on the use of chemicals. Little emphasis has been put on forecasting or the use of Integrated Pest Management (IPM) approaches with vegetable crops.

The CAPM Project proposes a Plant Pathologist/Vegetable Disease Specialist be fielded to work with the Project Production Team in dealing with disease problems in vegetable crops.

DURATION AND TIMING OF ASSIGNMENT:

The work will require a period of 3 to 4 weeks for the Plant Pathologist/Vegetable Disease Specialist. This assignments should commence in mid-April.

QUALIFICATIONS:

The Plant Pathologist/Vegetable Disease Specialist should have a PhD in Plant Pathology with an emphasis on vegetable crops. In addition, S/he must have at least 10 years experience in applied plant pathology. Experience working with farmers and familiarity with field symptoms of diseases and in determining proper control measures is essential. Experience working in Southern Africa or similar areas would be desirable.

STATEMENT OF WORK:

A Statement of work is found on the following page.

CONSULTANT DESIRED:

Dr. Alan A. MacNab from Pennsylvania State University is the desired consultant for this position. He is a recognised authority on vegetable diseases associated with the crops produced in Swaziland. His CV is attached.

50

STATEMENT OF WORK FOR PLANT PATHOLOGIST/VEGETABLE DISEASE SPECIALIST:

The consultant, working under the direction of the Horticultural Specialist and the Production Advisor of the CAPM project will perform the following duties:

1. Survey production fields with the Horticultural Specialist and the Production Advisor to identify diseases present and establish identification methods to be used by field staff in the future.

2. Assist the CAPM production section in developing an effective disease control programs for both winter and summer to be presented to farmers as a recommendation for selected vegetables. This will include a calendar based program of chemical controls as well as cultural practices whenever possible.

3. Make recommendations for introducing an IPM approach for selected vegetable crops, and if feasible outline a procedure to be followed.

4. Review current disease control recommendations used by the CAPM production section and develop a draft proposal for updating and improving future recommendations.

5. Conduct a one day training session for four Field Assistants on disease identification and appropriate control measure. This will be a combined pest control session held in conjunction with an entomologist.

6. Assist in planning and presenting three farmer field days covering pest identification and control measures, one in each region the project is currently working.

7. Present a seminar on diseases of vegetable crops to a group of horticulturists and other interested vegetable production, possible at the University of Swaziland.

51