THE STUDY OF THE INFLUENCE OF PLANT PARASITIC NEMATODES IN KENAF FIELD ON MAIZE (*Zea mays* L.) POSTHARVEST QUALITY

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The study of the influence of plant parasitic nematodes in kena field on maize (Zea mays L.) post-harvest quality / Aina Marya Zakaria.

Lihat sebelah

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by
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Research Report submitted in partial fulfilment of
the requirements for the degree of
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ENDORSEMENT

The project report entitled **The Study of the Influence of Plant Parasitic Nematodes in Kenaf Field on Maize (*Zea Mays L.*) Post-Harvest Quality** by **Aina Maryam Binti Zakaria**, Matric No **UK 15243** has been reviewed and corrections have been made according to the recommendations by examiners. This report is submitted to the Department of Agrotechnology in partial fulfillment of the requirement of the degree of Science Agrotechnology (Post-Harvest Technology), Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu.

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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

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ABSTRACT

A kenaf field at Telaga Papan, Kuala Terengganu is facing serious problem of low yield outcome believed caused by plant-parasitic nematodes infestation. Plant-parasitic nematodes is a pest that is often overlooked by us as other problems since it mimic other symptoms of diseases and also nutrient deficiency. The objectives of this study is to determine the presence of nematodes in kenaf field from Telaga Papan soil and its effects to the post-harvest quality of maize. Sample soil was taken from Telaga Papan to proceed with bioassay procedures to prove the presence of nematodes in the soil and using the same sample soil, maize was planted to evaluate the post-harvest quality of maize after affected by nematodes. Discovered from this research project is maize from F1 Hybrid cultivar is resistance to root-knot nematodes but not to lesion nematodes since the roots of maize is lacking fine roots and black lesion marks can be observed. The maize post-harvest quality is terribly affected by nematodes because the maturity index of the produce varies from the control produce because nematodes does cause premature aging of produce. With the existence of this project, farmers should beware and never underestimate the effects of nematodes to crops worldwide.

ABSTRAK

Sebuah padang tanaman kenaf di Telaga Papan, Kuala Terengganu menghadapi masalah serius berhubung hasil tanaman yang rendah dipercayai akibat infestasi nematod parasit tumbuhan yang teruk. Nematod parasit tumbuhan adalah perosak yang sering tidak dipandang sebagai ancaman memandangkan simptom-simptom yang dizahirkan menyerupai jangkitan penyakit dan kekurangan nutrien. Objektif kajian ini adalah untuk membuktikan kehadiran nematod di dalam tanah padang tanaman kenaf dari Telaga Papan dan untuk membuat pemerhatian keatas hasil lepastuai jagung akibat jangkitan nematod. Tanah sampel dari Telaga Papan diambil dan kajian diteruskan dengan kajian saintifik untuk memastikan kewujudan nematod di dalam tanah sampel dan dengan tanah dari sumber yang sama, tanaman jagung ditanam untuk meneruskan dengan pemerhatian hasil lepastuai jagung setelah dijangkiti nematod. Penemuan daripada kajian ini adalah jagung daripada kultivar F1 Hybrid resistan terhadap nematod puru akar tetapi tidak kepada nematod lesion memandangkan akar pokok jagung dari tanah sampel kurang memiliki akar yang sihat dan lecur-lecur hitam boleh diperhatikan. Hasil lepastuai jagung pula terjejas teruk akibat nematod kerana indeks kematangan buah berbeza diantara hasil tanah sampel dan juga tanah kawalan kerana nematod boleh menyebabkan hasil pramatang. Dengan adanya projek ini, petani di seluruh dunia sepatutnya lebih berhati-hati dan tidak memandang rendah kesan yang boleh disebabkan oleh nematod.

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LIST OF ABBREVIATIONS

SEM	Scanning Electron Microscope
CPD	Critical Point Drying
°Brix	Degree of Sugar Content (Brix)
%	Percentage
cm	Centimeter
ml	Millimeter
kg/ha	kilogram per hectar

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CHAPTER 1

INTRODUCTION

Maize is the third most important grain crop world-wide, following rice and wheat where maize is grown in most temperate to tropical environments with adequate moisture available (Bridge and Starr, 2007). Maize is high yielding, easy to process, readily digested, and cheaper than other grains. Every part of the maize plant has economic value; the grain, leaves, stalk, tassel, and cob can all be used to produce a large variety of food and non-food products. Maize is largely used as livestock feed and as a raw material for industrial products, despite of mainly used for human consumption since it is an important source of carbohydrate, protein, iron, vitamin B and minerals (International Institute of Tropical Agriculture, 2009).

However, maize have serious trouble when facing plant-parasitic nematodes which are famously known for causing harm to various types of plants and decreasing of plants yield. Plant-parasitic nematodes are microscopic worms that live in the soil and feed on the plants roots to fulfill its lifestyle. The most dangerous plant-parasitic nematodes of maize are several species of the lesion nematodes, *Pratylenchus spp.*, and certain geographical isolates of the root knot nematodes, *Meloidogyne arenaria*, *M. incognita* and *M. javanica* (Bridge and Starr, 2007). Maize is one of the plant that has high infestation rate of nematodes that can decrease maize yield by 10 – 20% or more.

Plant-parasitic nematodes in maize cause symptoms which mimic those caused by numerous other problems, such as nutrient deficiency, insect injury, herbicide damage or soil compaction and because of this, nematodes are difficult to diagnose and consequently often overlooked by most of us (Jackson, 2006).

1.1 Background Of Study

This study is based on the problems faced by the Telaga Papan's farmers due to their low yield of Kenaf plantation by nematode infestation. The soil from the Telaga Papan Kenaf's field was used to evaluate the suitability of maize to suppress nematode population for crop rotation with kenaf.

1.2 Problem Statement

Lembaga Tembakau Negara (LTN) realised the effects of nematodes to their kenaf plantation in Telaga Papan, Kuala Terengganu and was suggested as a mean of suppressing the pathogenic nematode for economic cultivation of kenaf for crop rotation. Chemical application of nematicides is very costly to low valued crop such as kenaf. It has become their biggest concern to find the solutions hence nematodes problem can be overcome to avoid high yield losses to the kenaf plantation.

1.3 Significance Of Study

The purpose of this study is to assure the pathogenicity of nematode genera in Telaga Papan on maize yield and quality by sampling, extracting and observing. So that possible actions can be taken to overcome the nematode problems by appropriate hands to help the farmers at Telaga Papan, Kuala Terengganu. Moreover, this study would provide a useful baseline data for future comparisons.

1.4 Objectives

This study is conducted to determine the effect of nematodes in kenaf field from Telaga Papan soil on the post-harvest quality of maize.

CHAPTER 2

LITERATURE REVIEW

2.1 Plant-Parasitic Nematodes

Plant-parasitic nematodes have become serious problem to many plantations area worldwide and it is important not to disregard this species as pests. The underground damage they can cause is galls, aboveground symptoms and decay of roots; roots are often darker in color than healthy roots. The above-ground symptoms of nematodes infestations often overlooked as other problems such as nutrient deficiency, improper soil pH, herbicide damage and insect injury but only a few knows that the nematodes also can caused the same symptoms. Root-knot nematodes (*Meloidogyne* spp.) are among the most damaging nematodes in agriculture, causing an estimated annual loss of US $100 billion worldwide (Oka et al., 2000). There are chemicals can be used to curb the infestation of nematodes, however the chemicals, nematicides, are very costly to apply for a large plantation area. Alternatively, crop rotation found to be effective as a suppression method of the nematodes population in the soil by non-host or resistance crops. Each crop has certain strengths and weaknesses as a rotational crop for nematode management, and it is important to be aware of the effects of each crop on plant-parasitic nematodes.

2.2. Effect of plant Parasitic Nematodes On Maize (Zea mays L.)

Zea mays L. is one of the most important grain crops used in the human diet in large parts of the world and an important feed component for livestock (McDonald and Nicol, 2005). Maize was commonly regarded as a non-host to several nematode species (Idowu and Fawole, 1990) however, numerous studies have documented damage to maize due to nematodes activity, with total yield loss in the range of 1200-2300 kg/ha reported for high levels of severe infestation in fields managed for the maximum yields (Bridge and Starr, 2007). In some instances, a yield suppression of 1% may be observed for each incremental increase of 1000 nematodes/g roots (Bridge and Starr, 2007). Loss estimated in less developed agriculture systems with fewer inputs and lower yield potentials are lacking. The world demand for maize is high and the fact that the impact of nematode parasitism on maize should never be underestimated.

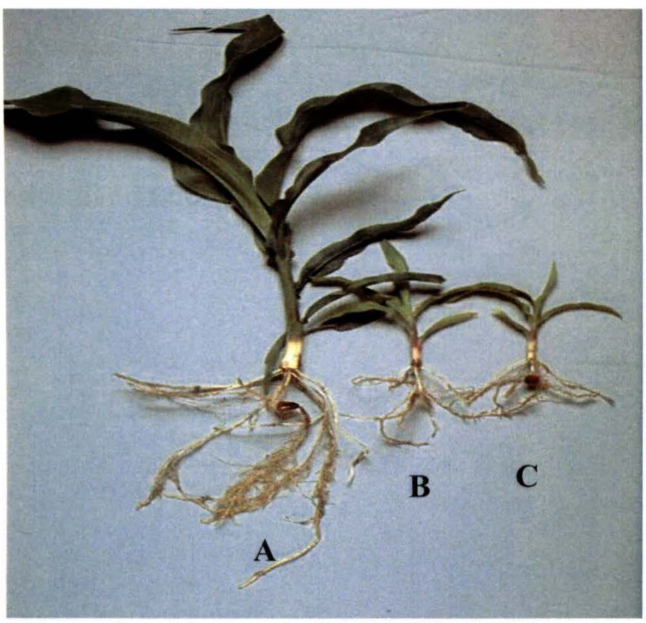

Figure 2.1: Normal maize seedling (A); maize seedlings stunted by nematode feeding (B and C).

Over 60 nematodes species have been found associated with maize in different parts of the world and most of them have been recorded from roots and soil around maize roots, but information on the biology or pathogenicity of many of these species not readily available (McDonald and Nicol, 2005). However, awareness that specific extraction and resistance assessment methods (Ibrahim *et al.*, 1993) may affect quantifications is a major factor when considering the importance of nematodes to a crop such as maize. The most important groups of plant parasitic nematodes to be the major limiting factors in maize production from all over the world are:

i. the root knot nematodes, *Meloidogyne* species;
ii. the root lesion nematodes, *Pratylenchus* species; and
iii. the cyst nematodes, *Heterodera* species (McDonald and Nicol, 2005).

Maize exposed to damaging population densities of nematodes especially lesion nematodes will have roots symptoms of stunted, discolored, lacking fine roots and may contain dark brown or black lesions. It also include aboveground symptoms such as yellowing or chlorosis of foliage, unevenness in the height of the corn plants and small or poorly filled ears (Tylka and Munkvold, 1997). However, other factors also can cause these types of aboveground and belowground symptoms, so nematode damage easily can be misdiagnosed.

CHAPTER 3

MATERIALS AND METHOD

3.1 Soil Sampling

Soil is taken from 5 different parts of Kenaf field in Telaga Papan, Kuala Terengganu. Each sample is mixed together using John Innes mixture to be used in the study and also for observation of nematode presence.

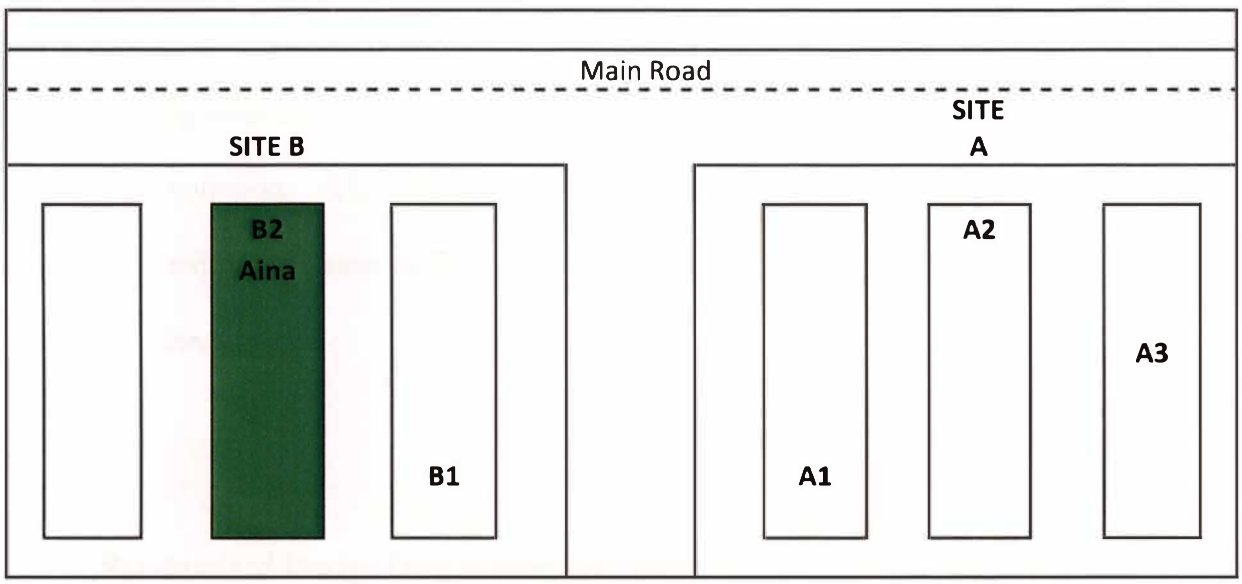

Figure 3.1: Sampling site map, the marked area is the area of my concern.

3.2 Bioassaying Nematode By Using Tomato and Kenaf Plants (Root-Knot Nematode Only)

Bioassaying of nematode was conducted in the greenhouse of UMT. There are two bioassay conducted in this experiment. First bioassay is carried out using the sample soil taken from sampling site and the second bioassay is carried out using the sample soil used to plant the maize after it has been harvested. For the first bioassay, sample soil taken from sampling site is used to plant tomato and kenaf seedlings in 250ml polystyrene cups, 10 replicates for each plant. After 3 weeks of nurturing the tomato and kenaf plants regularly, the plants is taken out carefully without damaging the roots. The roots were washed and stained for detection of *Meloidogyne* females which can be facilitated by staining the roots in Phloxine B for 15-20 minutes (Holbrook *et al.*, 1983). After that, the stained roots were rinsed and examined carefully using disecting microscope for the presence of galls to evaluate the root-knot nematode population. After maize has been harvested, second bioassay has been conducted, using the same method as first bioassay, by using sample soil used to plant the maize.

3.3 Randomized Design Observation On Maize

30 maize seeds was germinated at the greenhouse of UMT for the randomized design observation on maize. The process is divided into two groups. For group 1, sterilized soil is used to plant 15 maize seedlings in the culvert provided at the greenhouse. For group 2, sample soil from sampling site at Telaga Papan, Kuala Terengganu is used to plant another 15 maize seedlings in different culvert. Plants were watered on a daily basis. Fertilization was done monthly to each culvert. Plants

were harvested after 80 days. The factors observed in this experiment are maize growth performance, observation on maize root and post-harvest evaluation of maize.

3.3.1 Staining Of Nematodes In Plant Tissue

Nematodes are translucent and difficult to see in plants tissues so staining would helps to visualize them (Hooper et al., 2005). So, the harvested maize roots from each group were collected and put into sachet. Each sachet is labelled as Group 1 and Group 2. After that, the sachets were boiled in acid fuchsin lactophenol for 2 minutes. They were rinsed thoroughly and immersed in lactoglycerol solution for 4-5 days. Then, the roots were viewed using compound microscope.

3.3.2 Post-harvest Evaluation of Maize

The harvested maize were measured for two parameter; sugar content (^{o}Brix) and index of maturity. Sugar content were measured using refractometer and the mean were recorded for each group (control and sample). Index of maturity for maize were taken by referring to the maturity chart produced by FAMA.

3.4 Root Observation Using Scanning Electron Microscope (SEM)

Before proceeding with SEM procedure, 5 blocks of root-knot are taken and undergo fixation process with DESS solution then washed with sodium cacodylate buffer for about 30 minutes to wash off the DESS solution thoroughly. The specimens then were post fix with 0.1% osmium tetroxide before being washed again with sodium cacodylate buffer. Then, the specimen were dehydrated in 30%, 50%, 70%, 95% and twice in 100% ethanol. The specimen then dried in critical drying point (CPD) by using liquid carbon dioxide as an intermediary fluid. After that, the critical point dried specimens were mounted on the aluminium stub, splutter coated with gold and viewed under scanning electron microscope.

3.5 Statistical Analysis

The experimental design will be use in this expreriment is completely randomized design (CRD) and T-test is the programme used to analyse all the statistical readings.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Bioassay of Kenaf And Tomato Plants

Bioassay is a type of scientific experiment, in this study, to measure the population of nematodes in the Telaga Papan soil on the tomato and kenaf plant because tomato is susceptible to nematode infestation (AVRDC, 2004) while kenaf is the plant originally planted at the sampling site. Referrring to Figure 4.1, the tomato and kenaf are susceptible to nematodes since the gall and egg mass count is very high especially for kenaf. The polystyrene cup used to plant the tomato and kenaf each has a volume of 250 ml, so from the average count of gall for kenaf, 250 ml of soil contained about 15 galls and for tomato, 250 ml of soil contained about 4 galls that indicate the infestation of nematodes. Tomato contained low number of gall because the variety of hybrid tomato used have resistant on certain pests and diseases including root-knot nematodes (Ikisan, 2000). The success of this method is also to prove the existence of plant-parasitic nematodes in the Telaga Papan, Kuala Terengganu soil.

Table 4.1: First bioassay average data for tomato and kenaf after planted for 3 weeks.

		Roots observation	
		Gall	**Egg Mass**
Tomato	Average	4	2
Kenaf	Average	15	7

Second bioassay data is 0 for both tomato and kenaf. This shows that nematode population was suppressed after the maize cultivation. Hence, maize is suitable to be planted as rotational crop with kenaf.

Table 4.2: Second bioassay average data for tomato and kenaf after planted for 3 weeks.

		1st	**2nd**
		Roots observation	
		Gall(s)	**Gall(s)**
Tomato	Average	**4**	**0**
Kenaf	Average	**15**	**0**

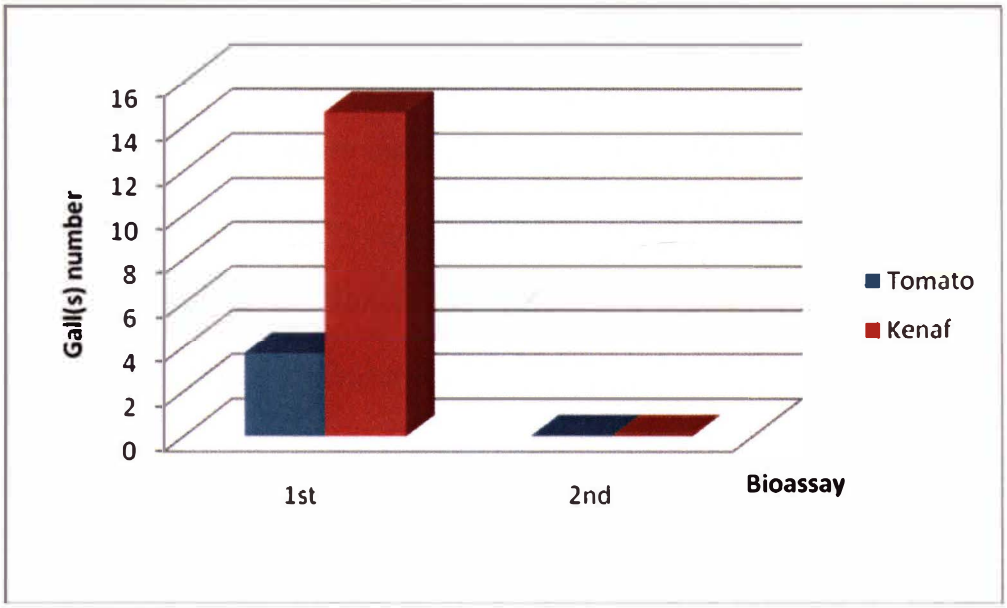

Figure 4.1 : Comparation data for first bioassay and second bioassay for tomato and kenaf galls number.

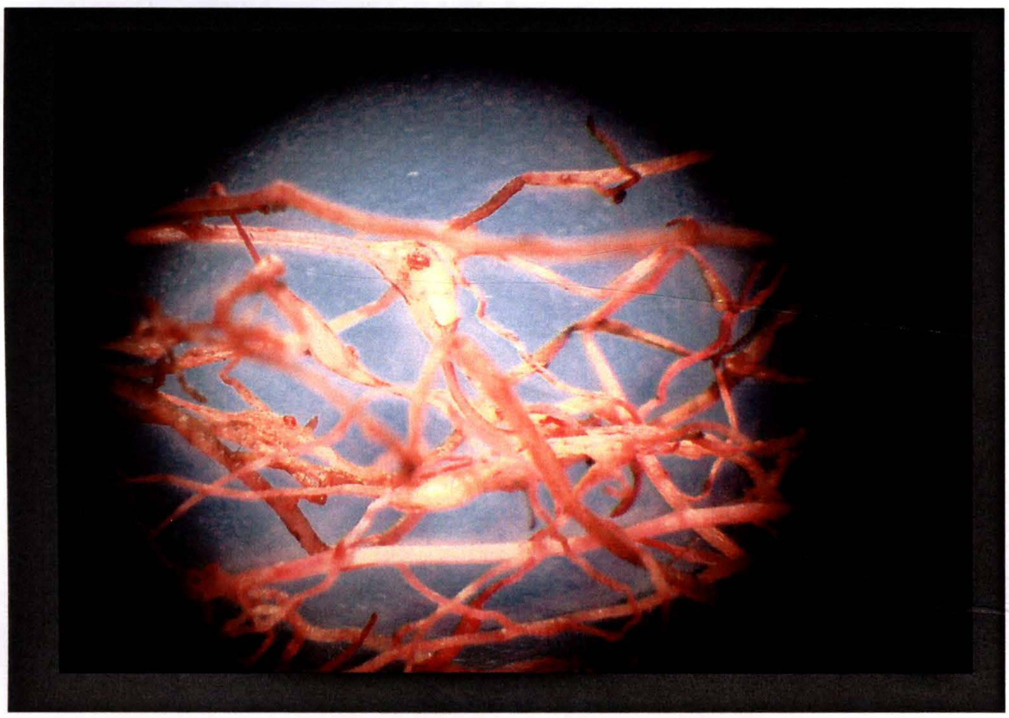

Figure 4.2: Gall and egg mask can be observe using dissecting microscope after staining the root in Phloxine B.

4.2 Randomized Design Observation On Maize

Maize is a tall plant and it has rapid growth especially during the first month. However, there are slight difference in growth between the control set (group 1) and the sample soil set (group 2). The average height of maize for the first month until harvest is recorded in Table 4.3 and shown in Figure 4.3.

Table 4.3: Average height of maize for the first 30 days, 60 days and 80 days (harvest) after planted in culvert.

Treatment	Replicate	Height (cm)			Treatment	Replicate	Height (cm)		
		30 days	60 days	80 days			30 days	60 days	80 days
Sample	1	22	43.5	47	Control	1	44	71.3	72
	2	47	72	73		2	38	56	58
	3	20	42	44		3	47	73	73.5
	4	28.5	46	53		4	64	81.5	84
	5	44	74	76		5	29	47.5	51
	6	57	76.5	78		6	61	97	99
	7	34.5	49.5	52		7	57	81	83
	8	27	38.5	41		8	59.3	82	82
	9	20	35	42		9	39.5	74	76
	10	39.3	58.5	59.5		10	19.7	36	40
	11	36	56	58		11	69	93.5	94
	12	56	72	72		12	28	51	54
	13	23.3	40.5	42		13	21.5	49	52
	14	33	59	61		14	30.6	53	53
	15	43	66	69		15	75	109	110
Average		35.37	55.27	57.83	Average		45.51	70.32	72.1

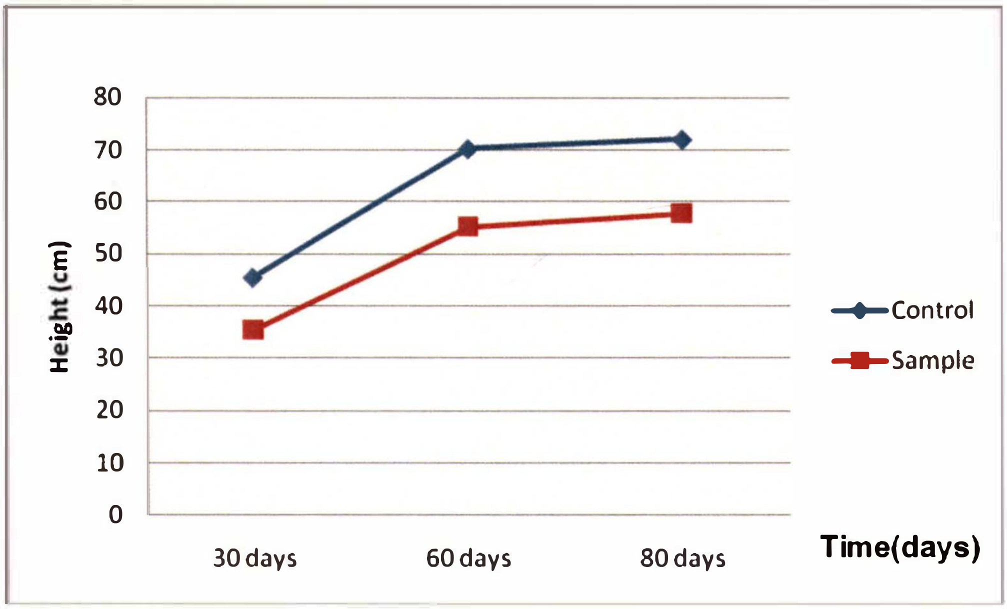

Figure 4.3: Average growth (height) of maize for 30, 60 and 80 days (harvest) after planted in culvert.

The major problem that usually revolves around maize cultivation is pest and diseases, which are caused by several pathogens including fungi, bacteria, virus, and insects. One possible cause of the poor maize growth probably not considered very often is plant-parasitic nematodes. It is found through Figure 4.3 that the growth development of maize in sample soil have relatively low in height compare to maize in the control soil and this is a sign of nematodes infestation. Several other symptoms also can be seen including unevenness in height and small and poorly filled ears. However, the total production is increasing by time, refer Figure 4.4, but very low in quality.

Table 4.4 : Total production of maize for control and sample soil.

	Total Production of Maize	
	Control	Sample
30 days	0	0
60 days	24	20
80 days	30	23

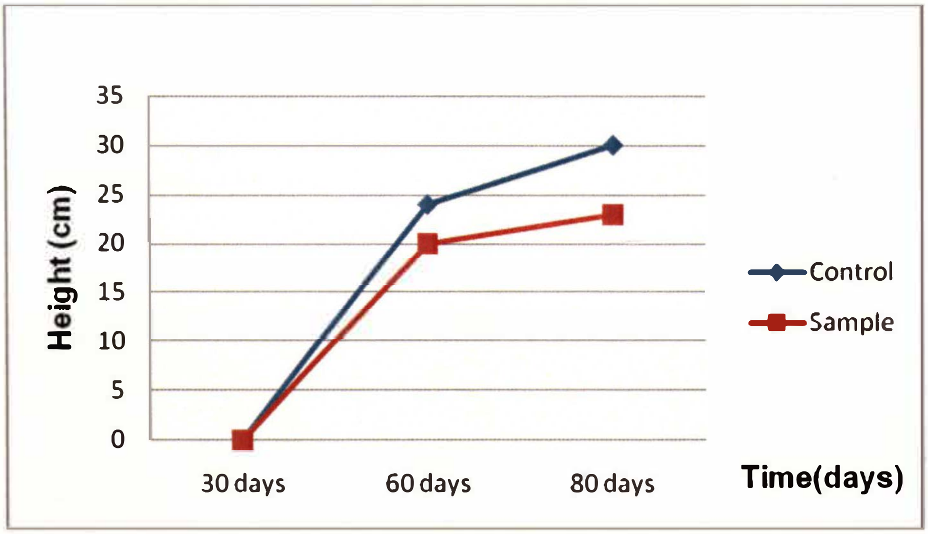

Figure 4. 4 : Total yield of maize for 30, 60 and 80 days (harvest) after planted in culvert.

From Figure 4.5, root observation has been done to observe the existence of nematodes in the maize's root. After diagnosing the maize root from sample soil, it is believed that the nematodes we are dealing with is lesion nematodes from the black lesion marks can be seen on the root and also the lacking of fine roots. The lesions were frequently accompanied by root pruning and rot.

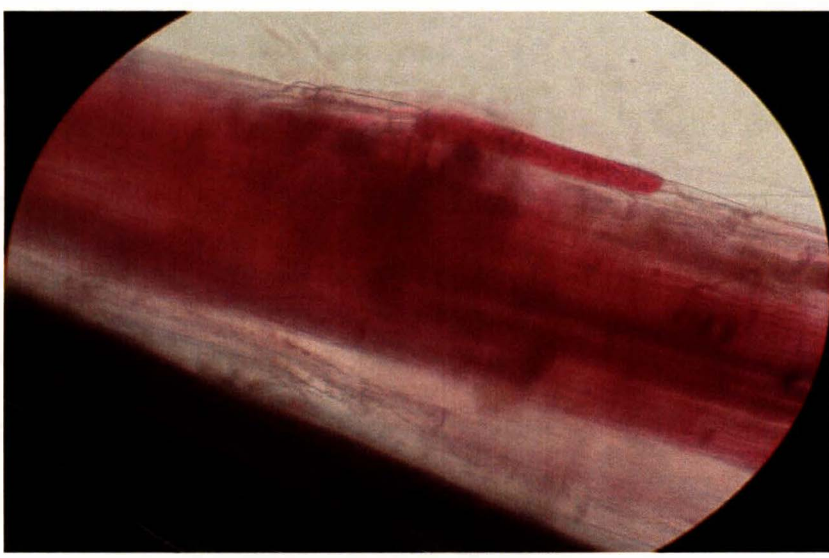

Figure 4.5: Nematode observed using compund microscope in the maize's root around the black lesion marks on the root after stained it in acid fuchsin lactophenol.

However, the presence of many pests and diseases also affected the maize. The biggest problem are common rust and also aphids which infected the ears of maize hence causing some interference with the yield quality.

Figure 4.6: Pest; aphids infected the maize (Left) and disease; common rust on maize's ears (Right), both gave effects on maize yield.

4.2. 1 Post-Harvest Evaluation Of Maize

The evaluation of maize has been done on its sugar content (°Brix), maturity index and physical observation. Overall, for both control and sample yield of maize gave high measurement value of sugar content that is 18 °Brix. The sugar content is very high, it indicates the sweetness of the maize which is from the Sweetcorn F1 Hybrid Corn cultivar. The maturity index during harvest (80 days) for the control soil yield is index 2 and for the sample soil is index 1 measured to the maturity index chart by FAMA. The colour of its flesh is shiny yellow for the control soil and for the sample soil, the yellow colour is a little bit dull however it is still shiny. The yield produced however is not in their best quality and standard since they has been infected by serious disease, that is, common rust. Other factor influencing the yield and quality of maize is high competition to survived in the culvert due to size and number of plant been planted in one culvert making the plants' nutrient take up is uneven. So this situation gave some bad effects to the maize quality and standard post-harvest evaluation. I find that the measurement of sugar content and maturity index is enough to evaluate the post-harvest quality.

4.3 Root Observation Using Scanning Electron Microscope (SEM)

The scanning electron microscope (SEM) is a electron microscope that scan the sample with a high-energy beam of electrons to produce images. From the observation, identifying a nematode is easy if the location of the giant cells can be located. The giant cells produced by the root-knot nematode as a source of food in the vascular tissues of the root to provide nutrients for the nematodes to live and breed with their life cycle of around 17-57 days depending on the host and the soil temperature (Caillaud *et al.*, 2007). Figure 4.7 - 4.8 shows the existence of nematodes in the root of kenaf from Telaga Papan, Kuala Terengganu.

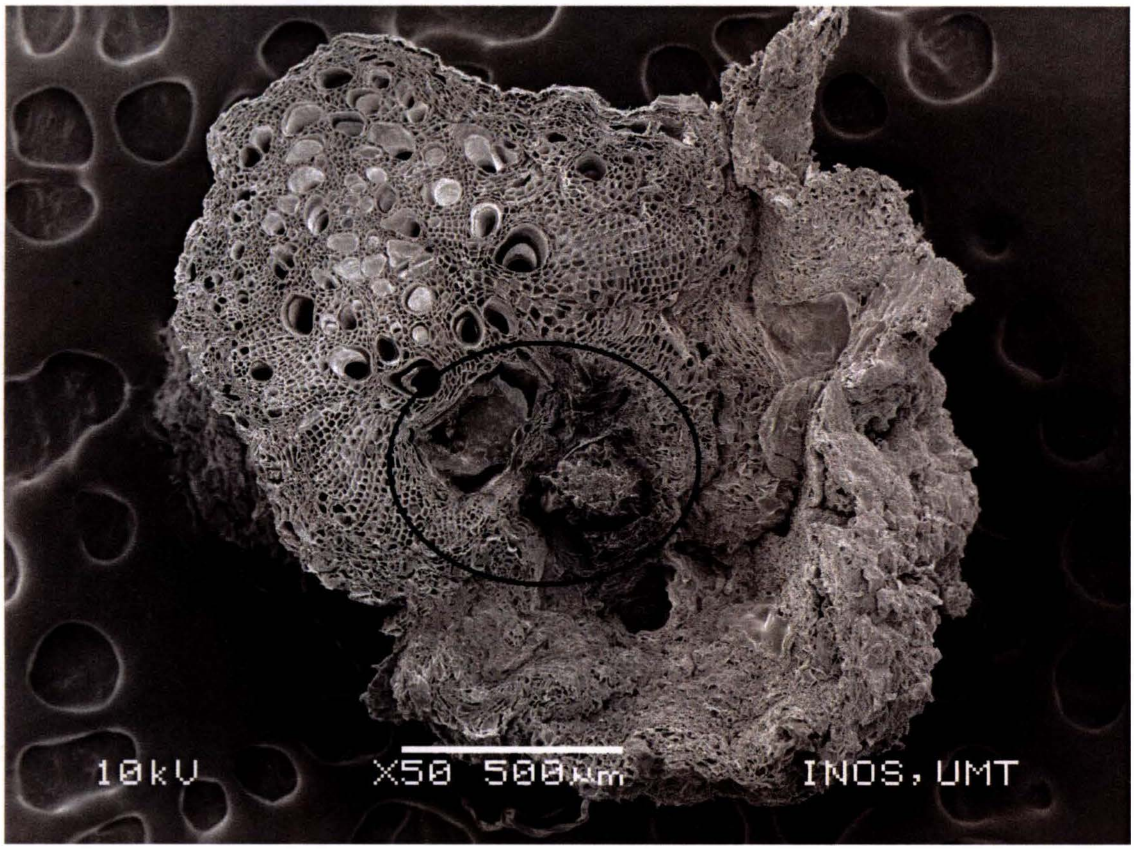

Figure 4.7: Cross section of root; The giant cells formed can easily be seen just above the circled area; the root-knot nematode captured in the circled area.

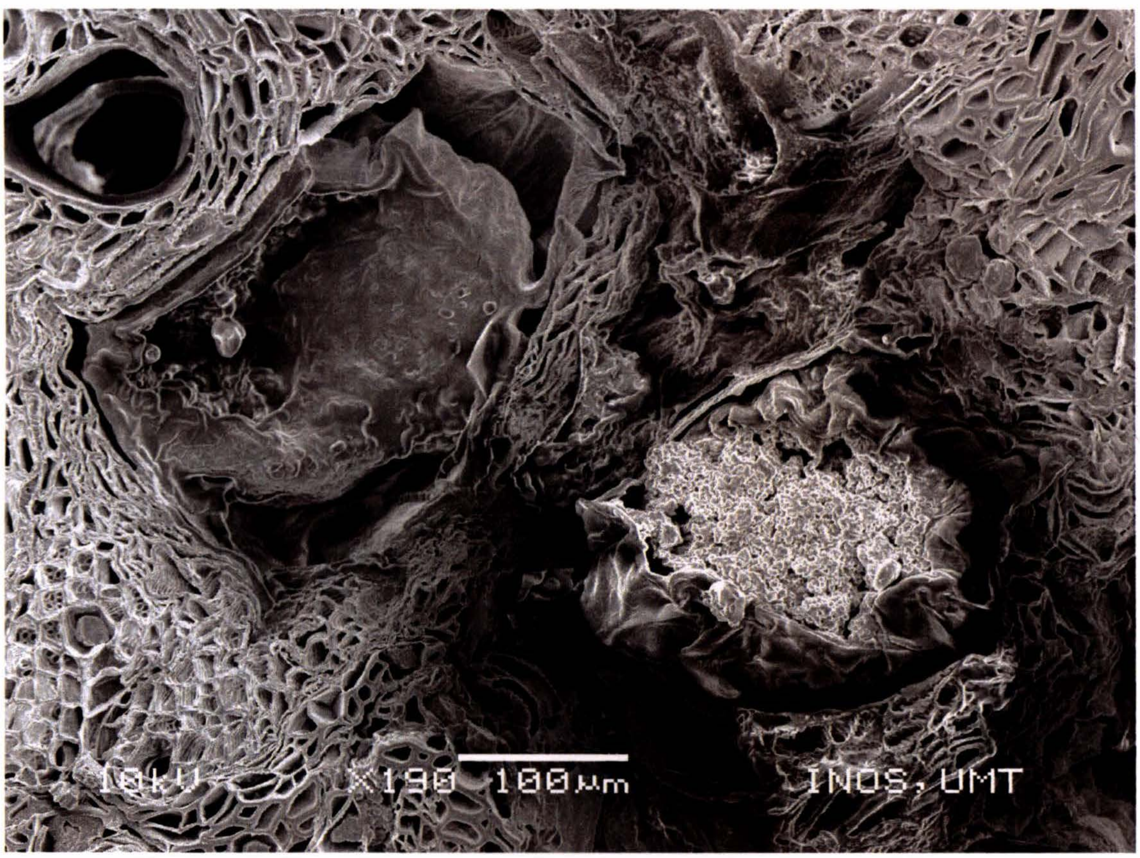

Figure 4.8: Root-knot nematode in the vascular tissues of the root.

4.4 Statistical Analysis

The experimental design used in this study is T-test to analyse all the statistical readings. The t-value for maize height and bioassay of kenaf and tomato data is smaller than 0.05 ($p < 0.05$), hence, there is no significant difference between the two groups mean. For bioassay of nematodes in kenaf and tomato, the data for first bioassay is smaller than 0.05 ($p < 0.05$), so, there is no significant difference between the two group means while data for second bioassay cannot be calculated because the standard deviation value is 0.

CHAPTER 5

CONCLUSION

This study has proven that the existence of nematodes population in Telaga Papan, Kuala Terengganu soil can effect the post harvest quality of maize. It is discovered that nematodes can cause great yield loss of maize and degradation of maize post harvest quality.

For future study, it is recommended to determine the type of nematode and proper control of other disease should be made for a better and accurate results.

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APPENDICES

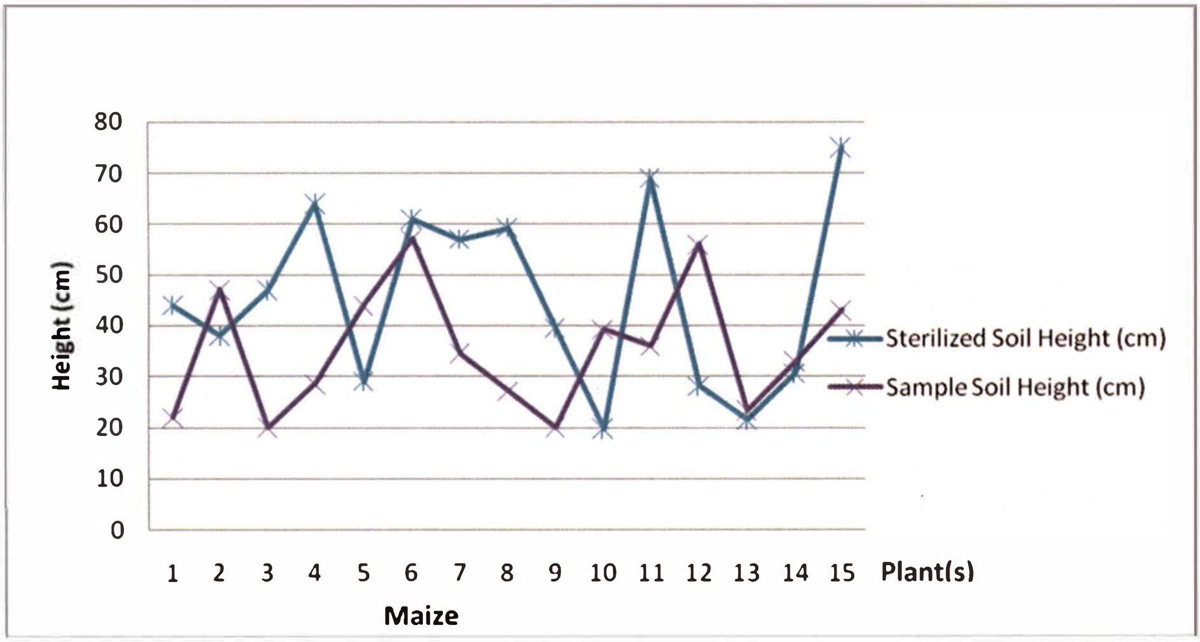
APPENDIX A

List of Equipments

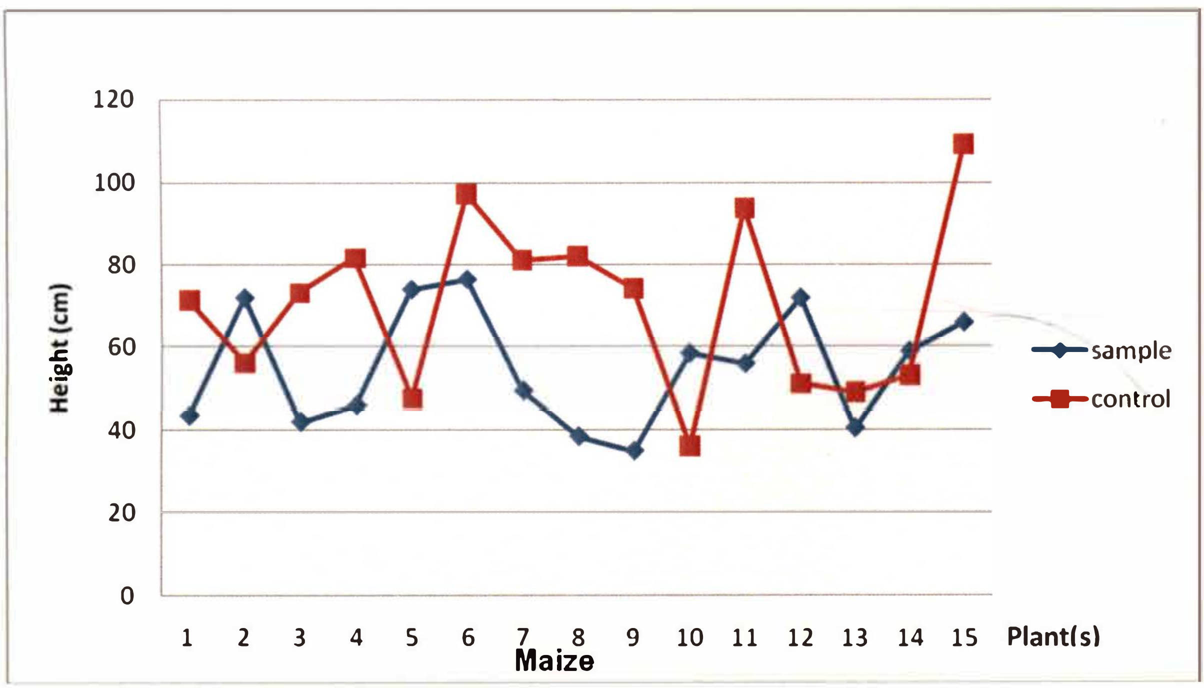
Scanning Electron Microscope (SEM), Critical Point Drying(CPD), Tissue Paper, Pots (small and big), Petri Dish, Tray, Paper Boat, Aluminum / Brass Stub , Phloxine B, Acid Fuschin , Lactic acid (Clear), Formalin Acetic Acid, Sodium Cacodylate Buffer, Alcohol, 0.1% Osmium Tetroxide, Ethanol 30%, 50%, 70%, 95% and 100%, Maize Maturity Index Chart, Glass slide, Cover slide.

APPENDIX B

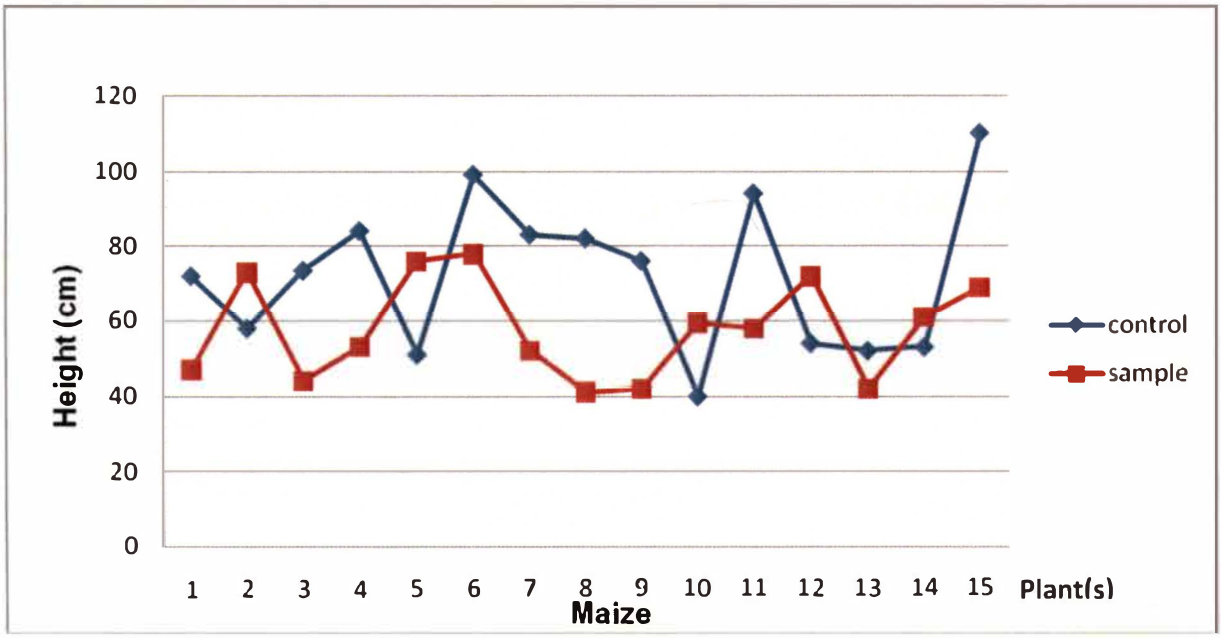
Growth Performance Of Maize



Growth performance of maize after 30 days planted in culvert.



Growth performance of maize after 60 days planted in culvert.



Growth performance of maize after 80 days (harvest) planted in culvert.

APPENDIX C

First Bioassay Data for Gall and Egg Mass Count in Kenaf and Tomato Roots After 3 Weeks

	Replicate	Roots observation	
		Gall	Egg Mass
Tomato	1	3	2
	2	2	0
	3	4	1
	4	3	1
	5	4	2
	6	5	2
	7	2	1
	8	5	4
	9	9	3
	10	0	0
	Average	3.7	2
Kenaf	1	3	2
	2	6	4
	3	15	5
	4	12	7
	5	24	13
	6	14	5
	7	12	6
	8	43	21
	9	10	5
	10	7	2
	Average	14.6	7

APPENDIX D

Comparation of First and Second Bioassay Data for Gall(S) Count in Kenaf and Tomato Roots After 3 Weeks

	Replicate	1st	2nd
		Roots observation	
		Gall(s)	Gall(s)
Tomato	1	3	0
	2	2	0
	3	4	0
	4	3	0
	5	4	0
	6	5	0
	7	2	0
	8	5	0
	9	9	0
	10	0	0
	Average	**4**	**0**
Kenaf	1	3	0
	2	6	0
	3	15	0
	4	12	0
	5	24	0
	6	14	0
	7	12	0
	8	43	0
	9	10	0
	10	7	0
	Average	**15**	**0**

APPENDIX E

Statistical Analysis for the Height of Maize; 30 Days (First), 60 Days (Second) and 80 Days (Harvest)

Group Statistics

	ID	N	Mean	Std. Deviation	Std. Error Mean
FIRST	1.00	2	33.0000	15.55635	11.00000
	2.00	2	42.5000	6.36396	4.50000
SECOND	1.00	2	57.4000	19.65757	13.90000
	2.00	2	64.0000	11.31371	8.00000
HARVEST	1.00	2	59.5000	17.67767	12.50000
	2.00	2	65.5000	10.60660	7.50000

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
FIRST	Equal variances assumed	.	.	-.799	2	.508	-9.50000	11.88486	-60.63644	41.63644
	Equal variances not assumed			-.799	1.326	.542	-9.50000	11.88486	-95.79134	76.79134
SECOND	Equal variances assumed	.	.	-.412	2	.721	-6.60000	16.03777	-75.60495	62.40495
	Equal variances not assumed			-.412	1.597	.729	-6.60000	16.03777	-95.29932	82.09932
HARVEST	Equal variances assumed	.	.	-.412	2	.721	-6.00000	14.57738	-68.72140	56.72140
	Equal variances not assumed			-.412	1.637	.728	-6.00000	14.57738	-84.10695	72.10695

APPENDIX F

Statistical Analysis for The First Bioassay and Second Bioassay of Gall(s) Count for Kenaf and Tomato Plant

Group Statistics

	VAR00001	N	Mean	Std. Deviation	Std. Error Mean
before	1	2	3.0000	.00000	.00000
	2	2	4.0000	2.82843	2.00000
after	1	2	.0000	.00000[a]	.00000
	2	2	.0000	.00000[a]	.00000

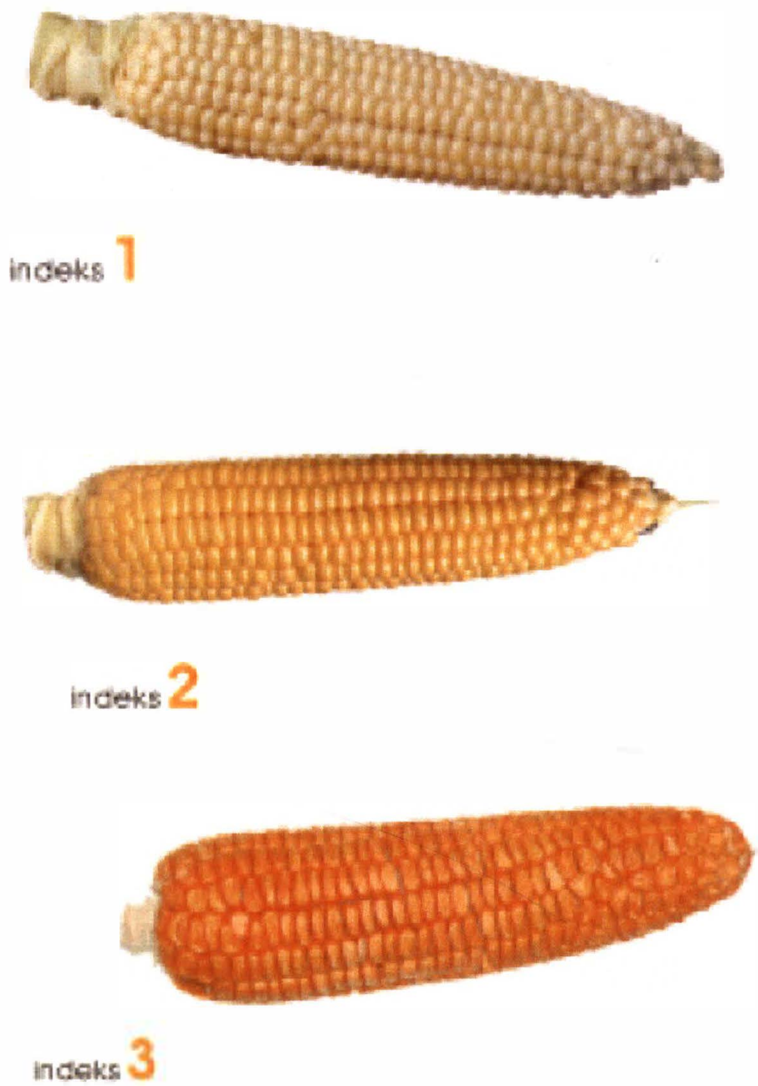
a. t cannot be computed because the standard deviations of both groups are 0.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
before	Equal variances assumed	.	.	-.500	2	.667	-1.00000	2.00000	-9.60531	7.60531
	Equal variances not assumed			-.500	1.000	.705	-1.00000	2.00000	-26.41241	24.41241

APPENDIX G

Maturity Index Chart of Maize



The maize from control soil have index 2, while maize from sample soil have index 1.
The maturity index chart of maize by FAMA.

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Semester July 2008/2009

THE STUDY OF THE INFLUENCE OF PLANT PARASITIC NEMATODES IN KENAF FIELD ON MAIZE (ZEA MAYS L.) POST-HARVEST QUALITY - AINA MARYAM ZAKARIA