DEVELOPMENT OF AUTOMOTIVE BRAKE PAD FROM COMPOSITES OF SHEA NUT (*VITELLARIA PARADOXA)* SHELL AND COW HOOF (*BAUHINIA UNGULATA)*

This research work used shea nut (*vitellaria paradoxa)* shell and cow hoof (*bauhinia ungulata)* as the reinforcement materials in the production of automotive brake pads. Taguchi method of experimental design and grey relational analysis were used to determine the optimal values of the manufacturing parameters. Other constituents combined together to produce the brake pad samples were epoxy resin, graphite, calcium carbonate and aluminium oxide. The optimal values obtained for SNS-reinforced samples were moulding pressure (15MPa), moulding temperature (90^0C), moulding time (9mins) and post curing time (1hour) while the values for CH-reinforced samples were 13MPa, 90^0C, 11mins and 2hours respectively. The optimized samples for each reinforcement were produced and subjected to water absorption, oil absorption, compression, hardness, wear rate and coefficient of friction tests. Other examinations carried out were thermo-gravimetric analysis, thermal conductivity test and morphological structure analysis. The results of the tests obtained for SNS-reinforced sample are 0.0591%, 0.0661%, 88.5MPa, 42.5HV, 0.216mg/m and 0.7103 respectively while that of the CH-reinforced sample are 0.0739%, 0.105%, 84MPa, 43HV, 0.1972mg/m and 0.781 respectively. The thermo-gravimetric analysis showed that the SNS-reinforced sample was more stable thermally than the CH-reinforced sample. However, the two samples have their maximum decomposition at a higher temperature range of 300^0C – 400^0C which falls within the range of average brake temperature. Thermal conductivity test gave 0.02154$Wm^{-1}K^{-1}$ and 0.0248 $Wm^{-1}K^{-1}$ for SNS-reinforced and CH-reinforced samples respectively. The morphological structure analysis showed that there was uniform distribution between the resin and the two reinforcement materials. These results obtained showed that SNS and CH are promising replacements for asbestos in automotive brake pad production.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Eggplant (*Solanum melongena* L.) is a warm-weather crop mostly cultivated in tropical and subtropical regions of the world (Daunay and Hazra, 2012). Vegetables (leafy and fruits) are widely grown in most parts of sub-Saharan Africa, especially, in the urban areas, and they constitute the most affordable and sustainable source of micronutrients in diets (Lucier and Jerardo, 2006). The name eggplant (*Solanum melongena* L.), also known as *aubergine* or *brinjal*, has been cultivated for centuries in Asia, Africa, Europe, and the Near East and is currently a crop species of global importance. Ninety (90) percent of the eggplant production came from five countries, including China, India, Iran, Egypt, and Turkey (FAO, 2012). The cultivated areas exceed more than 1,600,000 ha and the total yields was 43,573,139 tons yearly (FAO, 2012). The global production of eggplant increased to 50 million tons annually, with a net value of more than US$10 billion a year, which makes it the fifth most economically important *solanaceous* crop after potato, tomato, pepper, and tobacco (FAO, 2014). It is an economic flowering plant belonging to the family *Solanaceae*, of which members of about 1,400 species found throughout the temperate and tropical regions of the world are mostly herbaceous plants.

The fruit of the plant comes in a wide array of shapes and colours, some are yellow and small with green stripes. There are the big yellow ones with white colour and flat ribbed green types among others (Plazas *et al*., 2014). Regarding nutritional value, eggplant has a very low caloric value and is considered among the healthiest vegetables for its high content of vitamins, minerals and bioactive compounds for human health (Docimo *et al*., 2016).

Nutritionally, Eggplant contains water (92.5 %), protein (1 %), fat (0.3 %), and carbohydrates (6 %). They contain between 30 and 50 % of iron (Fe), fiber, potassium (K), manganese (Mn), copper (Cu) and vitamins; thiamin (vitamin B1), B6, folate, magnesium and niacin. Eggplant also contains phyto-nutrients such as nasunin and chlorogenic acid (Sabo and Dia, 2009). It is a valuable vegetable for canning industries for eggplant paste, *sautéed* Eggplant and other products. The fruits are fried, stewed, marinated and prepared in other ways. Eggplant with its bitter taste and spongy texture could really make an amazing pot of stew with a nice aroma. When eaten with boiled yam or rice. It is a delicacy that is well cherished by the people (Raigón *et al*., 2008).

The bioactive properties of eggplant are mostly associated with high content in phenolic compounds (Plazas *et al.*, 2013). Which are mostly phenolic acids, particularly chlorogenic acid in the fruit flesh (Stommel *et al.*, 2015) Both phenolic acids and anthocyanins have multiple properties beneficial for human health (Plazas *et al.*, 2013; Braga *et al.*, 2016). The plant can be regarded as a brain food because it houses the anthocyanin phyto-nutrient found in its skin, nasunin, a potent antioxidant and free radical scavenger that has been shown to protect cell membranes from damage. Studies have shown that nasunin protects the fats in brain cell membranes. Nasunin is not only a potent free radical scavenger, but is also an iron chelator (Stommel *et al.*, 2015). Iron is an essential nutrient, necessary for oxygen transport, normal immune function and collagen synthesis, but when it becomes too much in the blood stream; it becomes a major concern. Excess iron increases free radical production and is associated with an increased risk of heart disease and cancer (Stommel *et al.*, 2015).

The predominant phenolic compound found in eggplant is chlorogenic acid, which is one of the most potent free radical scavengers found in plant tissues. The chlorogenic acid performs antimutagenic (anticancer) activities in the body. It also performs anti- LDL (bad cholesterol) activities by increasing the levels of HDL (good cholesterol) in the body and at the same time has antiviral and antimicrobial properties. Consuming high amounts of eggplant have been found to be beneficial for people with glaucoma because it lowers the eye pressure (Harish *et al.*, 2008). Egg plant is low in calories and high in fiber. The eggplant is good for carbohydrate counters and dieters can actually snack on garden eggs in-between meals. In Nigeria, eggplant is a very important vegetable crop grown on commercial scale in some parts of the country. However, the small scale growers account for at least 86% of the total production. In the South -East of Nigeria, specifically, in Abia State, garden-egg popularly called “mikimiki“ (big sized green fruit with very deep and sweet “endocarp”) is grown commercially while in the savannah zone of Nigeria; the yellow, white and thick green skinned varieties are grown on large scale (FAO, 2009).

The production and economy of crops is affected in a variety of ways by nematodes particularly in terms of quality and quantity. Various types of pests are responsible for low yield. The vegetables are attacked by many pests including root-knot nematodes especially *M. incognita*. *Meloidogyne incognita* stood out as the dominant group of plant parasites. More than 300 plant species are attacked by *M. incognita* resulting in severe damage and losses (Kayani *et al*., 2013).

Root-knot nematodes (*Meloidogyne* species) are microscopic and parasitic nematodes which can be found in the roots of infected plants. Under *Meloidogyne* genus, there are about 98 species and common species encountered by farmers are *M. incognita*, *M. javanica*, *M. hapla*, and *M. arenaria* (Jones *et al.,* 2013). They can exist either in hot climates or short winters around the world. In a report by Gill and Mcsorley (2011), root-knot nematode is one of the most damaging groups of plant-parasitic nematodes and these nematodes are pests of almost all major crops. In addition, Karajeh (2008) stated that about 5% of the world crop production is destroyed by *Meloidogyne* species every year. Damage caused by the nematodes can be determined by measuring reductions in growth and yields of annual crops. Eggplant suffers from a number of diseases caused by fungi, bacteria, nematodes and phyto-plasma (Banglapedia, 2006).

1.2 Statement of the Research Problem

Eggplant (*Solanum* spps.) is one of the commonly grown crops in Nigeria, but the yield has been very low as a result of some associated problems like insect pest and disease caused by nematodes (FAO, 2008). Nematodes are distributed worldwide and are obligate parasite of the roots of thousands of plant species. The increasing demand of eggplants has increased along with the rapid growth of population. This is due to the increasing awareness toward the benefit of vegetables in fulfilling the nutrient of the family (Jumini and Marliah, 2009).

1.3 Justification of the Study

Meloidogyne species are microscopic and parasitic nematodes which can be found in the roots of infected plants. Root-knot nematodes survive well in appropriate hosts. Nematode populations increase to the maximum level in susceptible plants resulting in death before maturity. Eggplant and other vegetables are attacked by many pests including root-knot nematodes especially *M. incognita*. *M. incognita* stood out as one of the most dominant group of plant parasites. More than 300 plant species are attacked by *M. incognita* resulting in severe damage and losses including eggplant and the nematode continues to damage eggplant at higher inoculums levels. (Hussain *et al*., 2012; Kayani *et al*., 2013). In view of these, the research work was carried out to evaluate the effects of *M. incognita* on the growth and yield of *Solanum* spp. in Minna.

1.4 Aim and Objectives of the Study

The aim of the study was to evaluate the effect of *Meloidogyne incognita* on the growth and yield of some varieties of eggplant (*Solanum* spp) in Minna, Southern Guinea Savanna of Nigeria. The objectives were to:

i. determine the effect of *Meloidogyne incognita* on the growth of four varieties of eggplants.

ii. determine the effect of *Meloidogyne incognita* on the yield of four varieties of eggplants.

iii. determine the reaction of *Solanum spp* to *Meloidogyne incognita* on host status.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Morphological Description of Eggplant

Eggplant (*Solanum melongena* L.) is a diploid species (2n = 24), and is cultivated as a vegetable that yields immature edible fruits (FAO, 2008). It is perennial but is warm-season annual. Eggplants flowers are perfect, purple or on rare occasion white, with a spiny calyx, five-lobed corolla and yellow stamens. Their fruits are sometimes white or green in colour, but the most popular fruits exhibit deferent intensities of purple. Similarly, fruits can be whitish to dark purple, even black or combinations of these colours in stripes. Physiologically ripe fruits are brown or yellow. The Shapes of their fruits range includes spherical, oblong, ovoid, oval, long and many intermediate types. Fruits ranged from 4–45 cm in height, and 2–25 cm diameter. Mean fruit weight is in the range of 200–300 g. Newer Asian types have weights of 20–40 g (Hassan *et al.*, 2016).

In its primitive form, eggplant is a tall, woody perennial plant with large leaves. Prickles on the stem, leaves and calyx are typical. Andromonoecious flowers with five connate sepals, five connate petals and five stamens fused to the corolla are produced in small cymes (one to five flowers inflorescence). Flowers are generally self-pollinating although cross-pollination may occur in nature as a result of heterostyly and insect visitation. The fruit berries are small and thick-skinned, green and hard at maturity and unpalatable because they are bitter and seedy. Wild eggplants are distributed in tropical regions of Africa and Asia. Domestication, the cultivation and breeding have resulted in a smaller plant that is grown as an annual crop worldwide. Eggplant is a field crop in the Middle East and much of Asia, but greenhouse production is on the rise, especially in Europe and Japan (Daunay, 2008).

Cultivated forms usually lack prickles and produce perfect flowers that are often solitary. Fruits have thin skin, soft flesh and are larger, less seedy and less bitter than wild types. A diversity of fruit shapes exists among cultivars, with round, ovate, oblong, elongate and serpentine forms. Fruit size varies widely along with shape. Fruit length ranges from 4 to 45 cm and diameter from 2 to 25 cm. A 100-fold difference in fruit weight (15 g to1.5 kg) is seen among varieties. Fruit colors are linked to the variable presence of chlorophyll (green) and anthocyanin (red and purple) pigments in the developing fruit. White, green, violet, purple and almost black varieties have been selected, some with contrasting stripes or streaks (Swarup, 1995; Fraryet *et al.*, 2007). Eggplant's genome consists of approximately 956 Mbp (Bennett and Leitch, 2010); it is a diploid with a base chromosome number of 12.

2.2 Distribution of Eggplant

Eggplant, is a popular vegetable crop grown in the subtropics and tropics. It is called *brinjal* in India and *aubergine* in Europe. The name "eggplant" derives from the shape of the fruit of some varieties, which are white and shaped similarly to chicken eggs (Bliss and Elstein, 2004). The top five producing countries are China (28.4 million tons; 57% of world's total), India (13.4 million tons; 27% of world's total), Egypt (1.2 million tons), Turkey (0.82 million tons), and Iran (0.75 million tons). In Asia and the Mediterranean, eggplant ranked among the top five most important vegetable crops (Frary *et al.*, 2007). A rough estimate for a few countries indicates an annual production of 8,000 tones in Senegal, 60,000 tones in Cote d' Ivoire and 4,500 tones in Burkina Faso. (FAO, 2014).

2.3 Nutritional Benefits Eggplant

Interest in eggplant is growing rapidly because it is a good source of antioxidants (anthocyanins and phenolic acids), which are beneficial to human health (Gajewski, Katarzyna, and Bajer, 2009).

2.4 Uses of Eggplant

Medicinally, they are processed and used in the preparation of condiments and products used in treating different diseases and health problems (FAO, 2008) Eggplant has also been used in traditional medicine to treat many diseases. For example, in parts of Asia, vegetative aerial parts were traditionally used for treatment of skin problems and as a purgative, to ease urination, and to increase sex drive (Meyer *et al.*, 2014). In the same study, 77 medicinal properties were recorded for eggplant which indicates the importance of this plant in local medicine and its promise as a functional food and in the natural products industry. A meal of garden egg is proven to be of benefits to patients suffering from raised intraocular pressure (glaucoma) and convergence insufficiency, as well as in heart diseases and Arteriosccerosis (Harish *et al.*, 2008).

2.5 Insect Pests and Diseases of Eggplant

The complex of pests and diseases problems constitutes a major biotic factor militating against increased production of the crop especially during the dry season when it commands high prices. Schivalingaswamy and Satpathy, (2007) reported that a great diversity of species of insects from different orders and families with their characteristic damages based on mode of feeding have been recorded on the eggplant. The insect species which inflict damages on the crop through biting and chewing of the plant parts include Orthoptera (grasshoppers, locusts, crickets), larvae of Lepidoptera (fruit and shoot borer, leaf roller, caterpillar), adults and larvae of many beetles (Coleoptera) and other dipteran larvae. The other insect species which also inflict damage on the crop by the plant sap from the phloem (or xylem) system or from general tissues of foliage, roots and fruits include hemiptera (bugs), homoptera (leafhoppers, whiteflies, aphids) and the Thysanoptera (thrips) (Shivalingaswamy and Satpathy, 2007). Onekutu *et al.*, (2010) reported that insect pests account for reduced yield and losses of as much as 80 % of the crop.

Verticillium wilt is a destructive disease in eggplant production, which is mainly caused by the infection of *Verticillium dahliae* through root surface to vascular system (Garibaldi *et al.,* 2005; Wang *et al.,* 2005). *Verticillium dahliae* can survive in soil for more than six years, and infect many plant varieties, while chemical fungicides have no direct effects on infected plants, so the disease is hard to control all over the world (Pegg and Brady, 2002；Ligoxigakis *et al.,* 2002; Korolev *et al.,* 2008; Berbegal *et al.,* 2010).

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2.6 Soil and Climatic Requirements

Eggplant is a warm-season crop and does not tolerate frost. A long growing season of 80 days and 20 °C nights. Plant growth slowed pollination problems occur at temperatures below 17 °C or above 35 °C. Flowering is not affected by day length. Cooler temperatures can reduce fruit set. Higher temperatures and high humidity levels also reduce yields. Eggplant can tolerate drought and excessive rainfall. It will not tolerate extended periods of saturated soil owing to the build-up of root-rotting pathogens **(**Bliss and Elstein, 2004). Eggplant does well in a variety of soil textures. Previous crop residue must be stubble-disked to improve soil aeration and to adequately bury organic matter for decomposition. Eggplant grows best with a soil pH of 5.5 to 6.5. It is usually grown in light or sandy loam soils that provide good drainage and favorable soil temperatures. The crop will root to a depth of 90 to 120 cm, therefore, sandy loam or silt loam soils free of physical barriers are better for proper plant growth and development **(**Bliss and Elstein, 2004).

2.7 Cultural Practices

2.7.1 Land preparation

Well-drained, sandy loam soils are ideal for eggplant production. Poorly drained soils usually result in reduced functional root area, poor plant growth and low yields. Site selection is important if early eggplant production is required. For early production, select sites with a southern to southwestern exposure are most ideal. Soil with a southern exposure received more sunlight in the spring and therefore, warms up more quickly. Rotation is necessary so that eggplant is not planted after eggplant or other *solanaceous* crops such as tomato or pepper (Chen *et al.*, 2002). Good land preparation is important for optimum eggplant production. If large quantities of plant debris are present, disc the land several weeks before transplanting, then plough land, using a mould board plough. This will loosen the soil and bury old crop residue. The soils should be turned at least 20 cm deep. Eggplant is intolerant of poorly drained soil, so it is usually helpful (especially on heavier soils or in low areas) to transplant eggplant on raised bed (Bliss and Elstein, 2004).

2.7.2 Transplanting of eggplant

Eggplant crop is usually started by raising seedlings in plastic containers in greenhouses filled with peat; these seedlings are then transplanted into the field (Sękara, 2010). Seedling stage is a critical consideration in the vegetable production chain, and seedling quality and vigour are fundamental requisites for future plant performance in the field. Commercially produced eggplant seedlings should be genetically and morphologically uniform, visually attractive and healthy, with high physiological potential and resistance to stressful storage, transport and transplanting conditions (Costa *et al.*, 2013). Eggplant crops are normally grown from transplants; however, a few growers use direct seeding. In-row spacing of eggplant is 30 to 60 cm. The crop can be grown, using row width depending on the space needed by harvest workers. Growers usually plant eight rows and skip two rows to make roadways for harvest operations. Growers have also experimented with a bed spacing of 45 to 70 cm in an effort to maximise sunlight penetration onto the fruit, improving fruit colour (Potop *et al.*, 2014).

2.7.3 Fertilizer requirements

The crop showed different reactions to fertilizer applications of 75– 300 kg/ha nitrogen, 30–224 kg/ha phosphorus, and up to 80 kg/ha potassium, depending on the agro-climatic conditions (Sharma, and Brar 2008). Prabhu *et al*., (2006) studied the effects of different nitrogen and phosphorus application rates on eggplant cultivation and found that the crop yield per hectare was raised significantly by increasing nitrogen and phosphorus doses to 200 and 100 kg/ha of nitrogen and phosphorus, respectively.

2.7.4 Irrigation

Eggplant can be grown with furrow or drip irrigation. A crop of furrow irrigated eggplant uses approximately 1, 850 m^3 of water. Some growers use black plastic mulch and drip tape to control weeds, moisture and soil temperature in spring plantings. Critical watering periods are at flowering, fruit set and enlargement. The volume of water applied, depends on the time of the year and stage of plant growth. Most of the water and nutrient to absorbing roots are in the top 45 cm of the soil. Irrigation should be managed to maintain good soil moisture in this root zone. (Bliss and Elstein, 2004).

2.7.5 Weed control

Eggplant is slow to become established and cannot compete with aggressive weeds (Bliss, and Elstein, 2004). Weeds also harboured damaging insects and diseases. Weeds are controlled either by physical methods or chemical control. Physical methods such as hand weeding, cultivation and mulching, are quite frequently used on small vegetable farms. Only shallow cultivations necessary. Natural organic mulches, such as rice straw, will conserve moisture and add organic matter to the soil. Chemical weed control is especially popular in places where labour is expensive. Suitable herbicides include Lasso and Sencor (metribuzin). (Bliss and Elstein, 2004).

2.7.6 Pest and disease control

Many insect pests are attracted to eggplant. Spider mites (*Tetranychus*spp.), green peach aphids (*Myzuspersicae*), lygus (*Lygus* spp.), fleabeetles (Chrysomelidae) and wireworms (Elateridae) can be destructive to eggplant (Hussain *et al.,* 2011). Spider mites are especially harmful and should be treated as temperatures become warmer. Flea beetles are usually a problem only in young plants. Fields should be closely monitored during the flowering period as lygus will feed on flowers and cause flower drop. Root-knot nematodes (*Meloidogyne* spp.) can cause plants to wilt and leaves to yellow (Kayani *et al,* 2012). Herbicides, insecticides and fungicides should always be used in compliance with the label instructions. Mukhtar *et al.*, 2013d.

2.7.7 Harvesting and handling of eggplant

The fruit should be glossy, free of surface scalds, and wounds and have an intact and dark green calyx (Cantwell and Suslow, 2013). High-quality eggplants must have good sanitary conditions, be free of damage and off-flavors. The flesh should be white or creamy and with no browning. The seed coats should not be fully developed. Fruit is usually picked manually and mainly based on size. Late harvests are undesirable since they will lead to seedy and bitter fruit. Harvest of eggplant usually starts 75 to 90 days after transplanting or 15 to 35 days after flowering expansion Given the rapid fruit growth during the summer season pickings are usually required every 3–5days. In the last years, there has been increased interest in the commercialization of eggplants. Miniature eggplants have high visual appeal and are richer in antioxidants (Cantwell and Suslow, 2013).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of Study Area

The study was carried out in the screenhouse of the Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Gidan–Kwano Campus, Minna (Latitude 9^0 31' N and Longitude 6^0 29' E), in May, 2019. Niger state experiences distinct dry and wet seasons with an annual rainfall ranging from 1100 mm in the northern part to 1600 mm in the south with a mean of 1350 mm. The rainfall which peaks in September normally begins in April and ends in October. The temperature ranges between 35 ^{0}C and 37.5 ^{0}C with relative humidity between 60 and 80 %. The vegetation of the area is mainly short grasses and shrubs with scattered trees. Soils in Minna were found to have originated from basement complex rocks and generally are classified as Alfisols (Adeboye *et al.*, 2011).

3.2 Soil Collection and Sterilization

The top soil (0-15 cm depth) was collected from the old Teaching and Research Farms of the Federal University of Technology, Gidan Kwno Campus, Minna. The soil collected was cleared of all debris, gently crushed, thoroughly mixed, heat-sterilized for six hours and filled into each perforated black polyethylene bag, with each polyethylene containing (6 kg) of soil. Each pots has a depth of 38 cm and a diameter of 27 cm. A nursery was raised in plastic pots that contained heat-sterilized soil.

3.3 Source of Eggplant Seeds

The Eggplant seeds were sourced from National Horticulture Research Institute (NIHORT) Ibadan, Oyo State, Nigeria.

3.4 Inoculation

Egg masses of *Meloidogyne incognita* were obtained from the roots of infested tomato (*Solanum lycopersicum*) plants cultured in the screenhouse of School of Agriculture and Agricultural

Technology, Minna for the research work. The cultured tomato (*Solanum lycopersicum*) was carefully lifted and washed under running tap water and taken to the laboratory for onward extraction of *Meloidogyne incognita* egg masses. The roots were diced into smaller pieces of 1-2 cm and placed in an extraction dish. The egg masses were picked carefully into another Petri dish before inoculation. Inoculation was done by applying egg masses to the soil for the inoculations at 2 cm away from the plant base by making a groove around the plant.

3.5 Screenhouse Experiment

Seeds of eggplants planted raised in Polyethylene bags that contain heat-sterilized soil to raise seedlings. The experiment was laid out in a Completely Randomized Design. One eggplant seedling each of the variety was transplanted at four week old into Polyethylene bags, which contained heat-sterilized soil. One week after the establishment of the seedlings, the plant were inoculated with I_0 (control, no egg mass applied), I_{10}(10 egg masses), I_{20}(20 egg masses), I_{30}(30 egg masses), and I_{40}(40 egg masses) of the nematode inoculum. The experiment included four (4) species of eggplants namely; *Solanum eathiopicum* L. (Bello), *Solanum gilo* L. (Green), *Solanum macrocarpon* L. (White) and *Solanum melongena* L. (Yalo). These were sown in Polyethylene bags containing sterilized soil in the screenhouse at 25± 34 °C. The plants were watered daily and weeds hand-pulled when necessary.

3.6 Experimental Design

Four (4) species of eggplant were inoculated with (I_0 (Control), I_{10}, I_{20}, I_{30}, and I_{40}) egg masses per seedling. Four (4) blocks of pots, each group having a species was arranged. This group of four (4) species was one replication which was replicated three times. The Experimental Design used was a 4 x 5 factorial arranged in a completely randomised design with three (3) replications.

3.7 Data Collection

The following parameters were recorded:

Plant height (cm): Plant height was taken using a metre rule placed at the base of the plant to the apical tip of the plant at one-week intervals for twelve weeks after inoculation (WAI).

Collar girth (cm): The stem diameter was taken by placing a Vernier caliper around the stem which was also measured in centimeter using a graduated rule at one-week intervals for twelve weeks after inoculation (WAI).

Number of leaves per plant: The leaves were counted at one-week intervals for twelve weeks after inoculation (WAI) by counting the number of leaves per treatment.

Numbers of branches per plant: The branches were counted at one-week intervals for twelve weeks after inoculation (WAI) by counting the number of branches per treatment.

Number of flowers: The number of flowers were counted at one-week intervals for twelve weeks after inoculation (WAI) by counting the number of flowers per treatment.

Number of fruits at emergence: These was taken by counting the number of fruits per treatment at one-week intervals for twelve weeks.

Root length (cm): Thes**e** was measured using a metre rule placed at the base of the root to the tip of the root after harvest.

Fresh weight of plant (g): Fresh weight of plant was obtained using a sensitive weighing balance on each plant per treatment (Electronic scale, Model Hc-D Golden-mettler, USA).

Dry weight of plant (g): Dry weight of plant was obtained using a sensitive weighing balance to determine the weight of each plant per treatment (Electronic scale, Model Hc-D Golden-mettler, USA)..

Fruit weight (g): The fruit weight was determined using an sensitive weighing balance to determine the weight of the harvested fruits per treatment (Electronic scale, Model Hc-D Golden-mettler, USA)..

Percentage moisture content: was determined using.

Fresh weight of plant – Dry weight of plant = Water loss in plant

$$\text{Percentage moisture content} = \frac{\text{Water loss in plant}}{\text{Fresh weight of plant}} \times 100 \qquad \text{….. Equation 1}$$

recommended by Luis, *et al.,* (2001)

Total fruit yield per variety: was determine by

$$\text{Yield (Kg/ha)} = \frac{\text{Weight of Eggplant Fruit}}{\text{Area of Polyethylene bag}} \times 10{,}000 \qquad \text{….. Equation 2}$$

recommended by Aujla, *et al.,* (2007)

Root-knot/gall scoring:

The formation of galls on eggplant were counted in the laboratory after harvesting the plant using the method as reviewed by Otipa, *et al.,* (2003).

Scale for Scoring

0 = No Knot on roots

1 = Small knots difficult to see

2 = Small knots only but clearly visible, main roots clean

3 = Few large knots visible, but main roots clean

4 = Large knots predominate but main root clean

5 = 50 % of root knotted; knotting on parts of main root system

6 = Knotting on some of main roots

7 = Majority of main roots knotted

8 = All roots knotted; few clean roots visible

9 = All roots severely knotted; plant usually dying

10 = All roots severely knotted; no root System; plant usually dead

3.8 Data Analysis

The data collected were subjected to Analysis of Variance using SAS version 9.1. Treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

4.1.1 Effect of number of galls of (*Meloidogyne incognita*) on eggplant varieties after twelve weeks of inoculation.

Effect of number of galls of (*Meloidogyne incognita*) on eggplant varieties is presented in Table 4.1.1 The Result showed that there were high ($P \leq 0.001$) significant differences on Inoculum levels throughout the period of the study. Inoculum I_{40} has the highest $P \leq 0.001$ number of galls of 8.17, followed by I_{20} having 7.00 galls, I_{30} with 6.67 galls. I_{10} having 5.25 galls and I_{10} with 0.00 respectively.

Similarly, Table 4.1.1 also showed the effect of number of galls on eggplant varieties. The result indicated that there were no significant ($P \geq 0.05$) difference between the varieties after harvest. *S. gilo* recorded the highest number of galls of 5.86 while *S. macrocarpon* had the lowest number of galls 4.60. However there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) throughout the period under study (Table 4.1.1).

4.1.2 Effect of plant heights (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita.*

The effect of plant heights (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.2 The Results showed that there were no significant ($P \geq 0.05$) differences in inoculums levels (egg masses) throughout the period under study. Table 4.1.2 also shows the varietal responses to *Meloidogyne incognita* infection on the plant height of eggplant. There were high ($P \leq 0.001$) varietal differences on plant heights throughout the period of the study.

Table 4.1.1: Effect of number of galls of (*Meloidogyne incognita*) **on eggplant varieties after twelve weeks of inoculation**

Treatments	Number of Galls
Inoculum	
I_0	0.00[a]
I_{10}	5.25[b]
I_{20}	7.00[bc]
I_{30}	6.67[bc]
I_{40}	8.17[c]
SE$\pm$	0.9
CV%	40.34
LSD (0.05)	***
Varieties (V)	
Solanum eathiopicum	5.67
Solanum gilo	5.87
Solanum macrocarpon	4.60
Solanum melongena	5.53
SE$\pm$	0.80
CV%	24.84
LSD (0.05)	NS
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability

At first Week After Inoculation (WAI), *S. gilo* and *S. macrocarpon* were statistically similar having the highest (P≤0.001) plant height of 37.96 cm and 36.83 cm, respectively, while *S. eathiopicum* had the lowest value in height of 11.59 cm. At 2 WAI, *S. gilo* recorded the highest plant height of 42.27 cm which not different from 36.38 cm in S. *macrocarpon,* while *S. eathiopicum* recorded the lowest plant height of 13.88 cm. At 3 WAI, *S. gilo* had the highest plant height (P≤0.001) of 47.77 cm while *S. eathiopicum* recorded lowest plant height of 16.97 cm. It was also observed at 4 WAI, *S. gilo* had the highest (P≤0.001) plant height of 49.13 cm while *S. eathiopicum* had the least value in height of 19.88 cm. At 5 WAI, *S. gilo* recorded the highest plant height of 50.00 cm while *S. eathiopicum* had the lowest plant height of 23.13 cm respectively. Similarly, at 6 WAI, *S. gilo* and *S. macrocarpon* were statistically similar having the highest (P≤0.001) plant height of 56.99 cm and 55.51 cm respectively while *S. eathiopicum* had the lowest plant height of 31.16 cm.

At 7 WAI, *S. gilo* recorded the highest plant height of 58.11 cm while *S. eathiopicum* had the lowest plant height of 30.45 cm. At 8 WAI, *S. gilo* and *S. macrocarpon* were statistically similar having the highest (P≤0.001) plant height of 59.91 cm and 58.09 cm respectively, while *S. eathiopicum* had the least plant height of 32.26 cm. Also at 9 WAI, *S. macrocarpon* recorded the highest plant height of 63.90 cm while *S. gilo* had the lowest value of 34.13 cm respectively. At 10 WAI, *S. gilo* had the highest value in height of 65.66 cm while *S. aethiopicum* had the lowest plant height of 35.96 cm. At 11 WAI, *S. gilo* recorded the highest plant height of 68.45 cm while *S. aethiopicum* had the least plant height of 39.10 cm. Similarly, at 12 WAI, *S. gilo* recorded the highest plant height of 49.93 cm while *S. aethiopicum* had the lowest value in height of 22.87 cm respectively. However there was no significant (P ≥ 0.05) difference in interaction between Inoculums and Varieties (I X V) throughout the period under study (Table 4.1.2).

Table 4.1.2: Effect of plant heights (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_0	28.17	31.867	34.28	35.30	37.07	45.39	43.28	45.53	47.05	48.73	52.33	41.67
I_{10}	26.32	31.16	37.95	42.27	44.39	53.15	53.34	55.12	57.30	57.51	56.10	43.08
1_{20}	29.47	33.62	38.97	39.90	42.23	47.98	47.56	48.93	56.21	54.95	58.13	38.50
1_{30}	27.43	31.70	35.99	37.43	39.73	51.19	52.58	54.12	59.49	59.97	60.86	38.67
1_{40}	30.28	29.92	37.47	39.17	40.78	49.31	50.13	51.93	52.53	50.89	59.01	38.83
SE±	2.62	3.27	5.06	5.23	5.61	6.08	6.11	6.34	7.14	8.06	8.00	5.88
CV%	43.80	42.52	44.96	43.35	41.38	35.68	37.05	36.38	36.76	39.43	36.57	43.47
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	11.59^{c}	13.88^{c}	16.97^{c}	19.88^{b}	23.13^{b}	31.16^{b}	30.45^{b}	32.26^{b}	34.13^{b}	35.96^{b}	39.10^{b}	22.87^{b}
Solanum gilo	37.96^{a}	42.27^{a}	47.77^{a}	49.13^{a}	50.00^{a}	56.99^{a}	58.11^{a}	59.91^{a}	60.27^{a}	65.66^{a}	68.45^{a}	49.93^{a}
Solanum macrocarpon	36.83^{a}	38.38^{a}	44.94^{ab}	46.49^{a}	47.47^{a}	55.51^{a}	56.46^{a}	58.09^{a}	59.76^{a}	60.25^{a}	63.57^{a}	43.00^{a}
Solanum melongena	26.95^{b}	32.07^{b}	38.12^{b}	39.75^{a}	42.71^{a}	53.96^{a}	52.49^{a}	54.25^{a}	63.90^{a}	55.77^{a}	57.88^{a}	44.80^{a}
SE±	2.34	2.93	4.53	4.68	5.02	5.43	5.47	5.68	6.36	7.21	7.15	5.26
CV%	43.77	43.26	42.75	41.58	39.26	33.45	33.67	33.11	33.49	37.92	32.77	43.35
LSD (0.05)	***	***	***	***	***	***	***	***	***	***	***	***
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$

4.1.3 Effect of collar girth (cm) of eggplant varieties to the different inoculum levels of *Meloidogyne incognita*

The effect of collar girth of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.3 The Result (Table 4.1.3) showed that there were no significant ($P \geq 0.05$) difference in inoculum levels throughout the period under study. There was a very high varietal ($P \leq 0.001$) differences on collar girth from 1 WAI to 6 WAI. However at 1 WAI, *S. gilo* and *S. macrocarpon* are statistically similar having the highest ($P \leq 0.001$) collar girth value of 3.95 cm and 3.85 cm respectively while *S. aethiopicum* has the lowest collar girth value of 1.21 cm.

Similarly, at 2 WAI, *S. gilo* recorded the highest collar girth value of 4.08 cm while *S. aethiopicum* had the lowest collar girth value of 1.44 cm. Also at 3 WAI, *S. gilo* recorded the highest ($P \leq 0.001$) collar girth value of 4.23 cm while *S. aethiopicum* had 1.92 cm which has the lowest value. At 4 WAI, *S. gilo* had the highest ($P \leq 0.001$) value of 4.37 cm while *S. aethiopicum* recorded the least collar girth value of 2.09 cm. At 5 WAI, *S. gilo* recorded the highest ($P \leq 0.001$) collar girth value of 4.46 cm while *S. aethiopicum* had the lowest value of 2.21 cm respectively. Also at 6 WAI, *S. gilo* recorded the highest collar girth value of 4.5 cm while *S. aethiopicum* had the lowest value of 2.74 cm respectively. However, at 7 WAI, Significant ($P \leq 0.05$) difference was recorded were *S. gilo* had the highest collar girth value 3.79 cm while *S. aethiopicum* recorded the lowest value of 2.40 cm. At 8 WAI, no Significant ($P \geq 0.05$) difference was recorded while *S. gilo* had the highest collar girth value of 3.79 cm while *S. aethiopicum* recorded the lowest collar girth value of 2.40 cm.

Also, at 9 WAI, Significant ($P \leq 0.01$) differences was recorded, were *S. gilo* had the highest collar girth value of 4.48 cm while *S. aethiopicum* which is the lowest had 3.01 cm respectively. However at 10 WAI, no Significant ($P \geq 0.05$) difference was recorded while *S. aethiopicum* had the highest collar girth value of 6.39 cm while *S. melongena* has the lowest collar girth value of 3.93 cm. At 11 and 12 WAI, Significant (P≤ 0.01) difference was recorded. *S. gilo* had the highest collar girth value of 5.28 cm while *S. aethiopicum* had the lowest collar girth value of 3.55 cm respectively. However there was no significant (P≥ 0.05) difference in interaction between Inoculums and Varieties (I X V) throughout the period under study (4.1.3).

4.1.4 Effect of number of leaf of eggplant varieties to different inoculums levels of *Meloidogyne incognita*

The effect of number of leaf of eggplant varieties to different inoculums levels of *Meloidogyne incognita* is presented in Table 4.1.4. Result showed that there were no significant (P≥ 0.05) difference in inoculum levels throughout the period under study. There were, however, very high varietal (P≤0.001) differences in number of leaves throughout the period under study. Similarly, at 1 WAI, *S. macrocarpon* recorded (10.00) leaves which is the highest number of leaf while *S. eathiopicum* had the lowest number of leaves (4.00). Similarly, at 2 WAI, *S. gilo* had the highest number of leaves (22.00) while *S. eathiopicum* had the lowest number of leaves (6.00). Also, at 3 WAI, *S. gilo* recorded the highest number of leaves of (31.00) while *S. eathiopicum* had (5.00) which has the lowest number of leaves value. At 4 WAI, *S. gilo* had the highest number of leaves of (34.00) while *S. eathiopicum* recorded the least number of leaves (6.00). At 5 WAI, *S. gilo* recorded the highest number of leaves (36.53) while *S. eathiopicum* had the lowest number of leaves (7.00) respectively. Also, at 6 WAI, *S. gilo* recorded the highest number of leaves (42.00) while *S. eathiopicum* had the lowest number of leaves (15.00). Also, 7 WAI, *S. gilo* has the highest number of leaves (37.00) while *S. eathiopicum* has the lowest number of leaves (17.00). At 8 WAI, *S. gilo* has the highest number of leaves (40.00) while *S. eathiopicum* recorded the lowest

Table 4.1.3: Effect of collar girth of eggplant varieties to different inoculums levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_{0}	3.22	3.24	3.27	3.48	3.62	3.88	3.13	3.47	3.57	3.83	4.30	4.11
I_{10}	2.94	3.23	3.67	3.83	3.97	4.22	3.69	3.76	4.03	4.47	4.78	4.65
1_{20}	2.89	3.03	3.22	3.28	3.28	3.51	2.58	2.77	3.23	3.60	4.00	3.75
1_{30}	2.77	2.98	3.31	3.40	3.68	3.93	3.58	3.70	3.80	8.31	4.823	4.39
1_{40}	2.91	2.96	3.13	3.07	3.29	3.84	3.36	3.62	3.51	3.89	4.54	4.35
SE$\pm$	0.25	0.25	0.30	0.31	0.35	0.41	0.42	0.46	0.51	2.63	0.56	0.47
CV%	43.04	39.59	34.91	33.75	33.55	30.51	38.16	37.41	35.70	35.30	31.46	28.63
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	1.21^{c}	1.44^{c}	1.92^{c}	2.09^{c}	2.21^{c}	2.74b	2.40^{b}	2.61^{b}	3.01^{b}	6.39	3.55^{b}	3.55^{b}
Solanum gilo	3.95^{a}	4.08^{a}	4.23^{a}	4.37^{a}	4.46^{a}	4.54a	3.79^{a}	4.10^{a}	4.48^{a}	4.81	5.28^{a}	4.96^{a}
Solanum macrocarpon	3.85^{a}	3.92^{a}	3.91^{a}	3.92^{a}	4.08^{ab}	4.17a	3.57^{a}	3.75^{a}	3.75^{ab}	4.15	4.71^{a}	4.30^{ab}
Solanum melongena	2.77^{b}	2.91^{b}	3.21^{b}	3.26^{b}	3.52^{b}	4.06a	3.31^{a}	3.39^{ab}	3.26^{b}	3.93	4.41^{ab}	4.17^{ab}
SE$\pm$	0.22	0.22	0.27	0.28	0.31	0.36	0.38	0.42	0.46	2.34	0.50	0.42
CV%	40.41	38.74	36.37	35.27	32.54	28.32	36.16	36.22	36.50	41.12	28.24	30.15
LSD (0.05)	***	***	***	***	***	***	*	NS	**	NS	**	**
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability, ** = Significant at $P \leq 0.01$, Level of probability, * = Significant at $P \leq 0.05$ Level of probability.

number of leaves (16.00). Also, at 9 WAI, *S. gilo* had the highest number of leaves (40.00) while *S. eathiopicum* had the lowest number of leaves (17.00) respectively.

At 10 WAI, *S. gilo* had the highest number of leaves (39.00) while *S. eathiopicum* had the lowest number of leaves (16.00). At 11 WAI, *S. gilo* had the highest number of leaves (39.00) while *S. eathiopicum* had the lowest number of leaves (16.00). Similarly, at 12 WAI, *S. gilo* had the highest number of leaves (50.00) while *S. eathiopicum* had the lowest number of leaves (22.00) respectively. However, there was no significant (P≥ 0.05) difference in interaction between inoculum and Varieties (I X V) throughout the period under study (Table 4.1.4).

4.1.5 Effect of number of branches of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

The effect of number of branches of eggplant varieties to different **i**noculum levels of *Meloidogyne incognita* is presented in Table 4.1.5. Results showed that there were no significant (P ≥ 0.05) difference in inoculum levels on eggplant and their interactions throughout the period under study. Very high (P ≤ 0.001) varietal differences existed in number of branches produced by eggplants throughout the period under study.

Specifically, at 1 WAI, *S. gilo* recorded (8.00) which is the highest (P ≤ 0.001) number of branches while *S. eathiopicum* had the lowest number of branches of (0.00) respectively. Similarly, at two Weeks After Inoculation (WAI), *S. melongena* had the highest number of branches of (9.00) while *S. eathiopicum* recorded the lowest number of branches (0.00). Also at 3 WAI, *S. gilo* and *S. melongena* are statistically similar which have the highest number of branches (9.00) while *S. eathiopicum* had (1.00) which is the lowest number of branches. At 4 WAI, *S. gilo* recorded the highest (P ≤ 0.001) value (8.00) while *S. eathiopicum* had the least value of (1.00). At 5 WAI, *S. gilo* had the highest (P ≤ 0.001) number of branches (11.00) while *S. eathiopicum* had the lowest number of branches (2.00) respectively.

Table 4.1.4: Effect of number of leaf of eggplant varieties to different inoculums levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_0	9.25	15.92	23.33	23.75	26.08	30.83	28.75	29.25	30.83	30.12	30.42	41.67
I_{10}	9.42	16.08	20.92	23.83	26.58	34.75	32.00	34.42	35.42	33.00	33.58	42.42
I_{20}	8.33	15.75	20.25	22.67	22.92	30.58	27.00	27.75	30.33	28.75	29.17	38.50
I_{30}	9.08	13.17	18.33	20.67	23.83	32.08	32.42	33.75	34.17	31.25	31.67	38.92
I_{40}	8.67	16.42	21.50	22.50	25.67	34.00	31.42	30.50	30.42	30.75	31.33	38.83
SE±	1.08	2.05	3.06	3.59	3.81	3.90	5.21	4.87	5.06	4.95	4.94	5.88
CV%	45.93	44.43	48.20	47.06	44.96	41.48	45.58	45.53	45.66	45.65	45.15	43.90
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	4.33^{d}	4.60^{c}	5.40^{c}	6.07^{c}	7.40^{c}	15.47^{b}	16.73^{b}	15.67^{b}	15.80^{b}	15.67^{b}	15.87^{b}	22.33^{b}
Solanum gilo	13.40^{a}	21.93^{a}	30.80^{a}	34.00^{a}	36.53^{a}	42.33^{a}	37.33^{a}	39.47^{a}	40.07^{a}	39.20^{a}	39.67^{a}	49.93^{a}
Solanum macrocarpon	10.20^{b}	18.00^{b}	23.40^{b}	24.73^{b}	28.07^{b}	35.00^{a}	32.27^{a}	32.80^{a}	34.00^{a}	32.80^{a}	33.33^{a}	43.00^{a}
Solanum melongena	7.87^{c}	17.33^{b}	23.87^{b}	25.93^{b}	28.07^{b}	37.00^{a}	34.93^{a}	36.60^{a}	39.07^{a}	35.47^{a}	36.07^{a}	45.00^{a}
SE±	0.96	1.84	2.74	3.21	3.41	3.49	4.66	4.36	4.53	4.43	4.42	5.26
CV%	42.59	42.15	47.02	45.49	41.65	36.30	42.03	42.61	42.84	43.24	42.13	43.03
LSD (0.05)	***	***	***	***	***	***	***	***	***	***	***	***
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), *** = Significant at P≤0.001, Level of probability.

Also, at 6 WAI, *S. gilo* had the highest (P ≤ 0.001) number of branches (24.00) while *S. eathiopicum* had the lowest number of branches 7.00.

Also, at 7 WAI, *S. gilo* had the highest (P ≤ 0.001) number of branches (24.00) while *S. eathiopicum* recorded the lowest number of branches (5.00). At 8 WAI, *S. gilo* recorded the highest (P ≤ 0.001) number of branches (26.00) while *S. eathiopicum* had the lowest number of branches (6.00). At 9 WAI, *S. gilo* had the highest number of branches (22.00) while *S. eathiopicum* had the lowest number of branches (7.00). At 10 WAI, *S. gilo* recorded the highest number of branches (29.40) while *S. eathiopicum* had the lowest number of branches (8.00). At 11 WAI, *S. gilo* recorded the highest number of branches (31.00) while *S. eathiopicum* had the lowest number of branches (8.00). Similarly, at 12 WAI, *S. melongena* recorded the highest (P ≤ 0.001) number of branches (14.00) while *S. eathiopicum* had the lowest number of branches (5.00) respectively. However, there was no significant (P≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) throughout the period under study (Table 4.1.5).

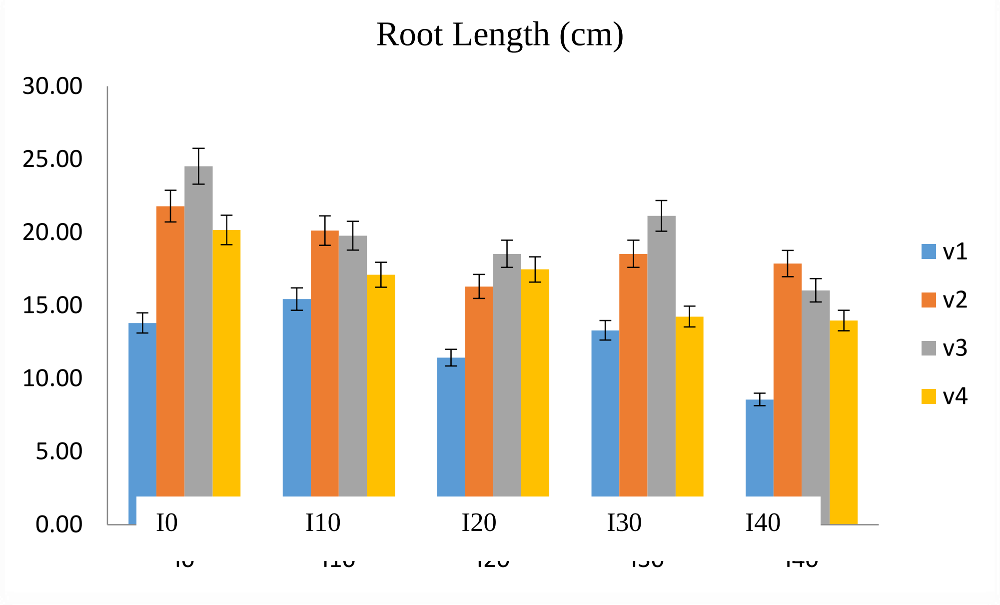
4.1.6 Effect of root length (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Effect of root length (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Figure 4.1. Results showed that there were high varietal (P≤ 0.01) differences on root length of the eggplant investifated. After harvest, *S. macrocarpon* had the highest mean root length of 24.53 cm while *S. eathiopicum* recorded the lowest mean root length of 8.57 cm. However there was no significant (P ≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Figure 4.1).

Table 4.1.5: Effect of number of branches of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_0	5.67	6.42	7.67	7.00	8.17	17.75	15.00	18.92	19.33	22.17	23.92	9.47
I_{10}	5.50	6.00	6.75	7.50	8.08	16.08	15.00	16.58	18.25	19.75	19.92	10.92
I_{20}	6.33	6.67	6.83	6.67	7.42	12.75	12.47	14.58	17.42	19.00	20.75	8.83
I_{30}	5.50	7.08	7.33	7.83	8.42	16.08	16.50	17.92	16.83	19.67	20.50	8.75
I_{40}	5.75	6.00	6.08	6.42	7.08	16.08	14.00	16.00	15.58	18.33	21.25	7.75
SE±	0.85	0.93	1.00	1.06	1.17	2.89	3.07	3.21	4.13	3.55	3.74	1.73
CV%	45.36	42.07	48.77	48.72	49.38	42.03	46.21	42.63	44.06	47.42	46.45	49.10
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	0.33^{b}	0.73^{b}	1.33^{b}	1.47^{b}	1.53^{b}	5.73^{c}	5.40^{c}	6.33^{c}	6.60^{b}	7.67^{c}	7.87^{c}	4.93^{c}
Solanum gilo	7.60^{a}	8.20^{a}	9.20^{a}	9.67^{a}	10.80^{a}	24.40^{a}	23.73^{a}	25.93^{a}	22.47^{a}	29.40^{a}	31.27^{a}	7.87^{bc}
Solanum macrocarpon	7.33^{a}	7.73^{a}	8.00^{a}	8.47^{a}	9.07^{a}	18.07^{b}	17.13^{b}	19.13^{b}	18.67^{a}	21.87^{b}	23.53^{b}	9.73^{b}
Solanum melongena	7.73^{a}	9.07^{a}	9.20^{a}	8.73^{a}	9.93^{a}	14.80^{b}	14.07^{b}	15.80^{b}	22.20^{a}	20.20^{b}	22.40^{b}	14.00^{a}
SE±	0.72	0.83	0.90	0.95	1.05	2.58	2.75	2.87	3.69	3.18	3.34	1.55
CV%	49.14	47.77	43.81	43.85	45.21	40.19	42.96	48.81	49.17	43.97	43.12	49.66
LSD (0.05)	***	***	***	***	***	***	***	***	***	***	***	***
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety,, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability.



Levels of inoculations

Figure 4.1: Root length (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita*.

V1= *Solanum eathiopicum* L. (Bello) V2= *Solanum gilo* L. (Green)

V3= *Solanum macrocarpon* L. (White) V4= *Solanum melongena* L. (Yalo)

4.1.7 Effect of number of flowers of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

The effect of number of flowers of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.6. The result showed that there were no significant (P≥ 0.05) difference in inoculums levels on number of flowers throughout the period under study. Table 4.1.6 also showed the varietal difference on the number of flowers of eggplant.

Similarly the result indicates high Significant (P≤0.001) differences between the varieties at (2WAI, 3WAI, 7WAI, 8WAI, 9WAI, and 12WAI) during the period under study. However, at 2 WAI, *S. gilo* had the highest (P≤0.001) number of flowers 4.47 while *S. eathiopicum* had the lowest number of flowers 0.00. Similarly, at 3 WAI, *S. gilo* recorded the (P≤0.001) highest number of flowers 12.13 while *S. eathiopicum* had the lowest number of flowers 0.00. Also, at 4 WAI, Significant (P≤ 0.01) difference was recorded, were *S. gilo* had the highest number of flowers 10.00 while *S. eathiopicum* had 2.07 which is the least number of flowers. At 5 WAI, Significant (P≤ 0.01) difference was recorded were *S. gilo* had the highest number of flowers 7.20 while *S. eathiopicum* had the least value of 2.53. At 6 WAI, Significant (P≤ 0.05) difference was recorded were *S. gilo* had the highest number of flowers 42.73 while *S. eathiopicum* recorded the lowest number of flowers 8.27 respectively. Also, at 7 WAI, *S. gilo* had the highest number of flowers 43.87 while *S. eathiopicum* had the lowest number of flowers 7.67 respectively. However, at 8 WAI, *S. gilo* had the highest number of flowers 47.00 while *S. eathiopicum* had the lowest number of flowers 8.67. At 9 WAI, *S. melongena* recorded the highest number of flowers 56.93 while *S. eathiopicum* recorded the lowest number of flowers 11.33.

Also, at 10 WAI, Significant ($P \leq 0.01$) differences was recorded, were *S. gilo* had the highest number of flower 42.53 while *S. eathiopicum* which is the lowest recorded 10.53 respectively. However, at 11 WAI, Significant ($P \leq 0.01$) difference was recorded were *S. gilo* had the highest number of flowers 41.20 and *S. eathiopicum* had the lowest number of flowers 9.80. At 12 WAI, *S. melongena* recorded the highest number of flowers 22.67 while *S. aethiopicum* had the lowest number of flowers 4.33 respectively. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) throughout the period under study (Table 4.1.6).

4.1.8 Effect of number of fruits of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

The effect of number of fruits of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.7. Similarly, Result showed very high Significant ($P \leq 0.001$) difference in inoculum levels throughout the period under study. However, at 5 WAI, I_0 recorded the highest ($P \leq 0.001$) number of mean fruits 3.92 while I_{30} had the least number of fruits 0.25. Also, at 6 WAI, I_0 had the highest ($P \leq 0.001$) number of fruits 4.25 while I_{30} had the lowest number of fruits 0.17 respectively. Also, at 7 WAI, I_0 recorded the highest number of fruits of 4.25 while I_{10} and I_{40} had the least number of fruits 1.00.

Similarly, at 8 WAI, I_0 had highest number of fruits 5.42 while I_{40}, I_{10}, I_{20}, I_{30} had 0.92, 0.83, 0.50, and 0.17 which are statistically similar and they have the lowest number of fruits. Also, at 9 WAI, I_0 had 5.83 which had the highest number of fruits while I_{30} had the lowest number of fruits 0.17 respectively. Similarly, at 10 WAI, I_0 recorded the highest number of fruits 5.92 while I_{30} had the lowest number of fruits 0.17. Also, at 11 WAI, I_0 had 5.92 which is the highest number of fruits while I_{30} had the lowest number of fruits 0.17 respectively.

Table 4.1.6: Effect of number of flowers of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum											
I_0	2.83	7.08	8.00	6.33	25.50	25.50	29.83	26.83	26.42	28.25	10.50
I_{10}	2.92	7.08	6.92	6.42	20.67	23.08	23.50	29.33	30.42	22.50	11.75
I_{20}	1.83	5.50	6.75	5.92	18.50	18.25	18.25	28.25	26.67	24.83	12.33
I_{30}	2.42	5.67	6.08	5.42	24.33	27.33	26.92	29.00	26.58	24.25	13.83
I_{40}	2.83	7.33	4.92	5.42	23.25	21.25	24.50	24.00	22.25	29.58	7.67
SE±	1.14	3.57	2.61	1.85	10.43	9.68	10.13	9.12	11.34	11.08	4.36
CV%	21.81	18.76	12.83	49.85	42.19	44.86	43.92	45.35	50.45	41.65	44.96
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)											
Solanum eathiopicum	0.00^{c}	0.00^{c}	2.07^{b}	2.53^{b}	8.27^{b}	7.67^{b}	8.67^{b}	11.33^{b}	10.53^{c}	9.80^{b}	4.33^{b}
Solanum gilo	4.47^{a}	11.60^{a}	9.53^{a}	7.20^{a}	42.73^{a}	43.87^{a}	47.00^{a}	20.40^{b}	42.53^{a}	41.20^{a}	9.60^{b}
Solanum macrocarpon	3.67^{ab}	9.27^{ab}	8.40^{a}	7.93^{a}	16.27^{b}	19.40^{b}	19.80^{b}	21.27^{b}	20.47^{bc}	20.60^{ab}	8.27^{b}
Solanum melongena	2.13^{b}	5.27^{b}	6.13^{ab}	5.93^{a}	22.53^{b}	21.40^{b}	22.93^{b}	56.93^{a}	32.33^{ab}	31.93^{a}	22.67^{a}
SE±	1.02	2.26	2.33	1.66	9.33	8.66	9.06	8.16	10.14	9.91	3.90
CV%	45.88	46.24	47.84	43.22	45.21	41.17	43.12	42.63	42.67	44.37	42.72
LSD (0.05)	***	***	**	**	*	***	***	***	**	**	***
Interaction											
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability, ** = Significant at $P \leq 0.01$, Level of probability, * = Significant at $P \leq 0.05$ Level of probability.

Similarly, at 12 WAI, I_0 had the highest number of fruits 5.92 while I_{30} recorded the lowest number of fruits 0.17 respectively. Table 4.1.7 also shows the varietal differences on number of fruits of eggplants. Similarly, the result indicates high varietal (P≤0.001) differences on number of fruits at (5WAI, 6WAI, 7WAI, while at 8WAI) Significant (P≤ 0.01) differences were recorded during the period under study. However, at 5 WAI, *S. melongena* gave the highest average number of fruits 2.73 while *S. eathiopicum* had the lowest number of fruits 0.00. Similarly, at 6 WAI, *S. melongena* had the highest number of fruits of 2.60 while *S. eathiopicum* had the lowest number of fruits 0.00.

Also, at 7 WAI, *S. melongena* had the highest number of fruits 2.60 while *S. eathiopicum* had the least number of fruits of 0.00. At 8 WAI, Significant (P≤ 0.01) difference was recorded were *S. melongena* recorded the highest number of fruits 2.33 while *S. eathiopicum* had the lowest number of fruits 0.73 respectively. Also, at 9, 10, 11, and 12 WAI, There was no Significant (P≥ 0.05) difference. At 9 WAI, *S. gilo* had the highest number of fruits 1.87 while *S. eathiopicum* had the lowest number of fruits of 0.93. Also at 10 WAI, *S. melongena* had the highest number of fruits 2.20 while *S. eathiopicum* had the lowest number of fruits 1.00. At 11 WAI, *S. melongena* had the highest number of fruits 2.20 while *S. eathiopicum* had the lowest number of fruits 1.00 respectively.

However, at 12 WAI, *S. melongena* recorded the highest number of fruits 2.20 while *S. eathiopicum* had the lowest number of fruits 1.00. However, there was significant (P≤ 0.01) difference in interaction between Inoculums and Varieties (I X V) at 5 WAI, 6 WAI, and 7 WAI, while significant (P≤ 0.05) difference was recorded at 8 WAI during the period under study (Table 4.1.7).

Table 4.1.7: Effect of number of fruits of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	**5 WAI**	**6 WAI**	**7 WAI**	**8 WAI**	**9 WAI**	**10 WAI**	**11 WAI**	**12 WAI**
Inoculum								
I_0	3.92[a]	4.25[a]	4.25[a]	5.42[a]	5.83[a]	5.92[a]	5.92[a]	5.92[a]
I_{10}	1.25[b]	1.00[b]	1.00[b]	0.83[b]	0.50[b]	1.17[b]	1.17[b]	1.17[b]
I_{20}	0.36[b]	0.75[b]	0.75[b]	0.50[b]	1.00[b]	0.92[b]	0.92[b]	0.92[b]
I_{30}	0.25[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]
I_{40}	1.18[b]	1.00[b]	1.00[b]	0.92[b]	0.08[b]	0.67[b]	0.67[b]	0.42[b]
SE±	0.63	0.63	0.63	0.48	0.43	0.57	0.57	0.55
CV%	41.47	41.45	48.15	49.75	40.36	41.12	41.12	45.52
LSD (0.05)	***	***	***	***	***	***	***	***
Varieties (V)								
Solanum eathiopicum	0.00[c]	0.00[b]	0.00[b]	0.73[b]	0.93[b]	1.00[b]	1.00[b]	1.00[b]
Solanum gilo	1.53[b]	1.47[a]	1.47[a]	1.60[ab]	1.87[a]	2.13[a]	2.13[a]	2.13[a]
Solanum macrocarpon	1.20[b]	1.67[a]	1.67[a]	1.60[ab]	1.53[ab]	1.73[b]	1.73[ab]	1.53[ab]
Solanum melongena	2.73[a]	2.60[a]	2.60[a]	2.33a	1.73[ab]	2.20[b]	2.20[a]	2.20[a]
SE±	0.58	0.56	0.56	0.43	0.39	0.51	0.51	0.49
CV%	28.32	28.31	25.79	36.14	24.65	23.08	23.08	25.75
LSD (0.05)	***	***	***	**	NS	NS	NS	NS
Interaction								
I X V	**	**	**	**	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), *** = Significant at P≤0.001, Level of probability, ** = Significant at P≤0.01, Level of probability.

4.1.9 Effect of *Meloidogyne incognita* on fresh weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on the fresh weight of Eggplant varieties is presented in Table 4.1.8. Similarly, the result indicates that there were varietal ($P \leq 0.05$) differences between the Varieties after harvest, *S. gilo* had the highest fresh weight of 117.47 g $plant^{-1}$while *S. eathiopicum* recorded the lowest fresh weight of 69.86 g $plant^{-1}$. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) on mean fresh weight during the period under study (Table 4.1.8).

4.1.10 Effect of *Meloidogyne incognita* on the dry weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on the dry weight of Eggplant varieties is presented in Table 4.1.9. The result indicates that there were varietal ($P \leq 0.01$) differences between the varieties after harvest. *S. gilo* had the highest dry weight of 104.31g $plant^{-1}$ while *S. eathiopicum* had the lowest dry weight of 658.85g $plant^{-1}$. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) on mean dry weight during the period under study (Table 4.1.9).

4.1.11 Effect of *Meloidogyne incognita* on the root biomass of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on fresh weight (g) of root of Eggplant varieties is presented in Table 4.1.10. However, Results indicated that there were no significant ($P \geq 0.05$) difference in inoculum levels on fresh weight of root of eggplant varieties. Similarly, I_0 had the highest fresh weight of root 40.84 while I_{30} had the lowest fresh weight of root 23.12 respectively.

Table 4.1.8: Effect of *Meloidogyne incognita* on fresh weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

Treatments	Fresh Weight at Harvest (g plant^{-1})
Inoculum	
I_0	116.82
I_{10}	86.01
I_{20}	75.50
I_{30}	94.27
I_{40}	101.55
SE$\pm$	17.96
CV%	43.69
LSD (0.05)	NS
Varieties (V)	
Solanum eathiopicum	69.86^{b}
Solanum gilo	117.47^{a}
Solanum macrocarpon	104.05^{a}
Solanum melongena	87.94^{ab}
SE$\pm$	16.06
CV%	48.28
LSD (0.05)	*
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), * = Significant at $P \leq 0.05$ Level of probability.

Table 4.1.9: Effect of *Meloidogyne incognita* on dry weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

Treatments	Dry weight at harvest ($g\ plant^{-1}$)
Inoculum	
I_0	99.56
I_{10}	75.06
I_{20}	64.41
I_{30}	82.83
I_{40}	91.04
SE±	16.52
CV%	50.03
LSD (0.05)	NS
Varieties (V)	
Solanum eathiopicum	58.85^{b}
Solanum gilo	104.31^{a}
Solanum macrocarpon	93.19^{a}
Solanum melongena	73.97^{ab}
SE±	14.78
CV%	50.65
LSD (0.05)	**
Interaction	
I XV	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), ** = Significant at $P \leq 0.01$, Level of probability.

Also, Table 4.1.10 showed the varietal differences on the fresh weight root of eggplants. Results indicates that there were varietal ($P \leq 0.01$) differences on fresh weight root of eggplant. *S. gilo* has the highest fresh weight root value of 48.35 g plant^{-1}while *S. aethiopicum* had the lowest fresh weight root value of 19.70 g plant^{-1}. However, there was no significant (P≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Table 4.1.10).

Similarly, Table 4.1.10 also showed the effect of *Meloidogyne incognita* on the dry weight (g) of root of eggplant varieties. Results indicated that there were no Significant (P≥ 0.05) difference in inoculum levels on dry weight (g) of root of eggplant varieties, I_0 had the heights dry weight root value of 37.10 while I_{20} had the lowest dry weight root value of 21.87 respectively.

Also, there were Significant (P≤ 0.01) differences on dry weight root of eggplant varieties. *S. gilo* recorded the highest dry weight root value of 40.03 g plant^{-1} while *S. eathiopicum* had the lowest dry weight root value of 17.94 g plant^{-1}. However, there was no significant (P≥ 0.05) difference in interaction between inoculum and Varieties (I X V) during the period under study (Table 4.1.10.).

4.1.12 Effect of *Meloidogyne incognita* on the weight (g) of fruit of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on the weight of fruit of eggplant varieties is presented in Figure 4.2. The result indicated that there were no varietal (P≥ 0.05) differences on mean weight between the verities. Similarly, *S. melongena* recorded the highest mean weight of 44.67 g plant^{-1} while *S. eathiopicum* had the lowest mean weight of 18.61 g plant^{-1}.

Table 4.1.10: Effect of *Meloidogyne incognita* on root biomass of eggplant varieties after twelve weeks of inoculation

Treatments	Fresh Weight of Root (g plant^{-1})	Dry Weight of Root (g Plant^{-1})
Inoculum		
I_0	40.84	37.10
I_{10}	35.58	33.54
I_{20}	35.58	21.87
I_{30}	23.12	24.03
I_{40}	30.38	28.95
SE$\pm$	10.09	12.84
CV%	42.21	43.85
LSD (0.05)	NS	NS
Varieties (V)		
Solanum eathiopicum	19.70^{c}	17.94^{b}
Solanum gilo.	48.35^{a}	40.03^{a}
Solanum macrocarpon	41.15^{ab}	38.73^{a}
Solanum melongena	23.20^{bc}	19.69^{b}
SE$\pm$	9.02	8.12
CV%	49.96	42.69
LSD(0.05)	**	**
Interaction		
I X V	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), ** = Significant at $P \leq 0.01$, Level of probability.

However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Figure 4.2).

4.1.13 Effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties is presented in Table 4.1.11. The result showed that there were significant (P≤ 0.05) difference in inoculums levels on the percentage moisture content of eggplant varieties. Similarly, after harvest, I_0 had the highest percentage moisture content value of 10.43 while I_{40} recorded the lowest percentage moisture content value of 5.00.

Table 4.1.11 also showed the effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties. The result indicated that there were no significant (P≥ 0.05) differences between the varieties after harvest. *S. melongena* recorded the highest percentage moisture content of 9.21% while *S. gilo* had the lowest percentage moisture content value of 5.81%. However there was no significant (P≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Table 4.1.11).

4.1.14 Effect of *Meloidogyne incognita* on yield kg ha $^{-1}$ of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on yield kg ha $^{-1}$of eggplant varieties is presented in Table 4.12.12 However the result showed that there were a high significant (P≤ 0.001) difference in inoculum levels on the yield of eggplant varieties. Similarly after harvest, I_0 recorded the heights yield value of 988.97 followed by I_{10} having 226.36, while I_{20} recorded 191.36 and I_{30} had the lowest yield value of 32.87 respectively.

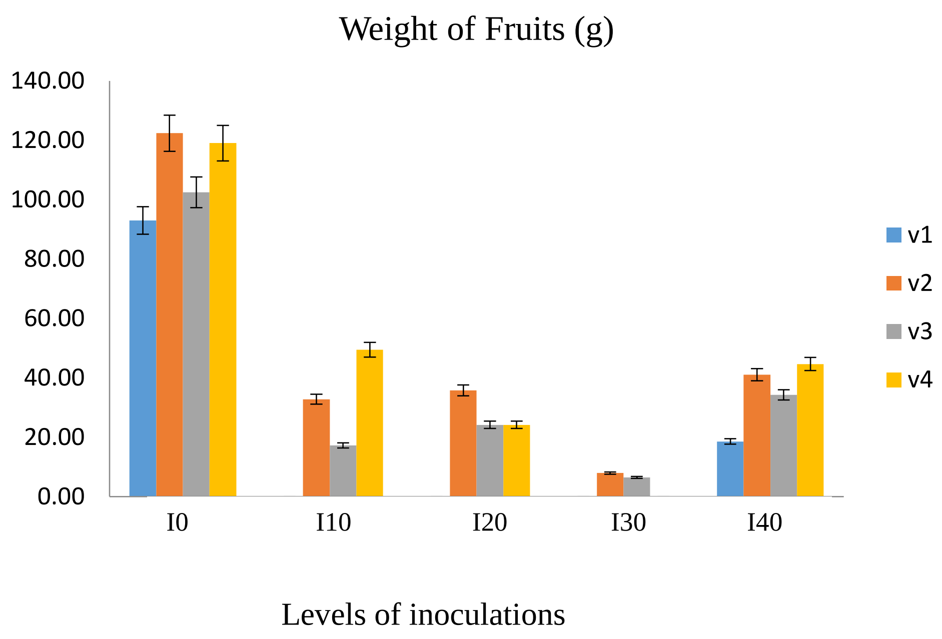


Figure 4.2: Weight of fruit (g) eggplant varieties after twelve weeks of inoculation.

V1= *Solanum eathiopicum* L. (Bello) V2= *Solanum gilo* L. (Green)

V3= *Solanum macrocarpon* L. (White) V4= *Solanum melongena* L. (Yalo)

Table 4.1.11: Effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties after twelve weeks of inoculation

Treatments	Percentage Moisture Content
Inoculum	
I_0	10.43[a]
I_{10}	6.72[ab]
I_{20}	6.94[ab]
I_{30}	6.97[ab]
I_{40}	5.00[b]
SE±	2.12
CV%	49.43
LSD (0.05)	*
Varieties (V)	
Solanum eathiopicum	6.35
Solanum gilo	5.81
Solanum macrocarpon	7.48
Solanum melongena	9.21
SE±	1.90
CV%	41.83
LSD (0.05)	NS
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), * = Significant at P≤0.05, Level of probability.

Table 4.12.12 also showed the varietal difference on yield of eggplant varieties. The result indicates that there were no varietal (P≥ 0.05) differences between the varieties after harvest. However, *S.*

melongena L. recorded the highest yield of 403.03 kg ha $^{-1}$, followed by *S. gilo* L. with 373.1503 kg ha $^{-1}$ while *S. eathiopicum* L. gave the least yield value of 168.82 kg ha $^{-1}$ respectively. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) during the period under study (Table 4.12.12).

Table 4.1.12: Effect of *Meloidogyne incognita* on yield kg ha $^{-1}$of eggplant varieties after twelve weeks of inoculation

Treatments	Yield kg ha $^{-1}$
Inoculum	
I_0	988.97^{a}
I_{10}	226.36^{b}
I_{20}	191.36^{b}
I_{30}	32.87^{b}
I_{40}	131.36^{b}
SE$\pm$	113.7
CV%	37.73
LSD (0.05)	***
Varieties (V)	
Solanum eathiopicum	168.82^{b}
Solanum gilo	373.15^{ab}
Solanum macrocarpon	311.76^{ab}
Solanum melongena	403.03^{a}
SE$\pm$	101.73
CV%	44.08
LSD (0.05)	NS
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability.

4.2 Discussion

The experiment showed a very high significant ($P \leq 0.001$) differences between inoculums levels on number of galls after harvest during the period of the study. *Solanum gilo* L. gave the highest number of galls of 5.87, The results confirm the findings Abdel-Momen *et al.* (1998); Vovlas *et al.* (2005) report that the size of galls as well as the number of galls is related to the number of nematodes infecting roots, although the inoculum concentration may have less effect at later evaluation stages. Similarly, Haider *et al.* (2003) reported that the inoculum level of 1000J2 of *M. incognita* per plant caused significant reduction in growth characters of French bean and pea. Akhtar *et al.* (2005) pathogenic to mung bean. Presence of galls on roots is a primary symptom associated with *M. incognita*. The increasing level of nematode inoculums has been attributed to gall formation and secondary root proliferation (Abrao and Mazzafera, 2001). Similar results were reported in different genotypes of tomato (Maleita *et al.*, 2012) and inoculum levels on tomato. Similarly, there was no significant ($P \geq 0.001$) differences between varieties on number of galls and interaction between inoculum and variety after harvest during the period of the study.

There were no Significant ($P \geq 0.05$) differences between inoculums levels on plant height, collar girth, number of leaves, number of branches, number of flowers, throughout the period of the study. These results are in conformity with the findings of Karssen and Moens (2006), who observed that length of plants decreased in the nematode infected plants, this was likely due to damage caused by the increasing numbers of nematodes that invaded plant roots, and probably ceasing the nutrient and water uptake. According to Sikora and Fernandez (2005), increase in the nematode populations and the subsequent reduction in the growth and yield of crops are

directly influenced by the initial density of the nematodes in the soil. The results confirm the findings of Maleita *et al.* (2012); who reported that plants heavily infested with root knot nematodes exhibited stunted growth and poor yield, in some cases plants die even before reaching maturity (Singh and Khurma, 2007).

However, there were a very high varietal ($P \leq 0.001$) differences on plant height, collar girth, number of leaf, number of branches, number of flowers, number of fruits, fresh weight, dry weight, fresh weight of root, dry weight of fruit throughout the period of the study. Similarly, *Solanum gilo* L. gave the highest plant height of 68.45 cm, *Solanum gilo* L. gave the highest collar girth of 5.28 cm, *Solanum gilo* L. gave the highest number of leafs 40.07, *Solanum gilo* L. gave the highest number of branches of 31.27, *Solanum melongena* L. gave the highest number of flowers 56.93, *Solanum melongena* L. gave the highest number of fruits at emergence of 2.20, *Solanum gilo* L. gave the highest number of fresh weight of 117.47 g plant^{-1}, *Solanum gilo* L. gave the highest number of dry weight of 104.31 g plant^{-1} , *Solanum* gilo L. gave the highest fresh weight of root 48.35 g plant^{-1} , *Solanum gilo* L. gave the highest dry weight of root 40.03 g plant^{-1}, *Solanum melongena* L. gave the highest weight of fruit 44.67 g plant^{-1} ,*Solanum gilo* L. gave the highest number of galls of 5.87, *Solanum melongena* L. gave the highest percentage moisture content of 9.21%, *Solanum melongena* L. gave the highest yield value of 403.03 kg ha $^{-1}$ These result agrees with the findings of Akpan *et al.* (2016) that Genetic variation in gene pool is vital for successful selection and yield improvement in each crop species. Genetic divergent population provides vast desirable traits from which selection can be made for crop improvement. The significant differences observed among the parents at the vegetative growth stage are indication of their genetic diversity. An earlier study on these parents showed

similar diversity. This report agrees with the findings of Kumar *et al.* (2015), Nyadanu *et al.* (2014) where the presence of genetic diversity in eggplant had been reported. Similarly, there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) on plant height, collar girth, number of leaf, number of branches, number of flowers, throughout the period under study. These agree with the report of Sikora and Fernandez (2005), increase in the nematode populations and the subsequent reduction in the growth and yield of crops are directly influenced by the initial density of the nematodes in the soil.

However, there was a very high varietal ($P \leq 0.001$) differences between inoculum levels on number of fruits at emergence and weight of fruit during the period of the study. *Solanum melongena* L. gave the highest number of fruits at emergence of 2.20 also, *S. melongena* L. gave the highest weight of fruit 44.67 g plant^{-1} The results confirm the findings of Maleita *et al.* (2012); they reported that plants heavily infested with root knot nematodes exhibited stunted growth and poor yield, The number of fruits per plant observed in this study agreed with earlier report of Thangamani, and Jansirani, (2012) on the same traits in eggplant. However there was significant ($P \leq 0.01$) difference in interaction between Inoculum and Varieties (I X V) on number of fruits at (5 WAI) to (7 WAI) while there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) at (8 WAI) to (12 WAI) during the period under study.

Also, there were a no Significant ($P \geq 0.05$) difference between inoculums levels on fresh weight, dry weight, fresh weight of root, dry weight, shoot length, root length of root after harvest. These agree with the findings of Kayani *et al*. 2017 that the stunted and reduced growth of foliar parts subsequently results in reduced biomass and productivity. Due to extensive

disruption of xylem vessels, the upward uptake of water and nutrients is greatly reduced. The root-knot infection also greatly affects permeability of roots to water. Due to the induction of nurse cell systems by females of root-knot nematodes for incessant feeding in infected roots, there is greater translocation of photosynthesis towards these infection sites, while the aboveground parts experience acute deficiency of nutrients (Wyss 2002, Di Vito *et al.*, 2004). As the infected plants face insufficient supply of nutrients, photosynthesis, energy, water etc., therefore, development and growth of leaf tissues and their essential constituents particularly chlorophyll pigments, are greatly hampered (Khan and Khan, 1997).

However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) on fresh weight, dry weight, fresh weight of root, dry weight, shoot length, root length of root after harvest. However, there were significant ($P \leq 0.05$) difference in inoculum levels on the percentage moisture content of eggplant varieties. These agree with the report of Di Vito *et al*. 2004 that maximum decreases in growth and yield variables of susceptible cultivars can be ascribed to severe root damage owing to nematode entry and/or feeding which resulted in impairment and disruption of water absorption by the infected root systems. After entry into roots, the root-knot females induce gall formation and giant cells in the stellar region and cause severe disruption of xylem tissues. Wyss (2002), Due to extensive disruption of xylem vessels, the upward uptake of water and nutrients is greatly reduced. The root-knot infection also greatly affects permeability of roots to water.

Similarly, there were no varietal ($P \geq 0.05$) differences between the varieties after harvest, and also there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) during the period under study.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From this study, it can, therefore, be concluded that large variations in growth and yield variables of some varieties of Eggplant were found in response to *M. incognita* infection. *Solanum melongena* L and *Solanum* gilo L. significantly produce the highest growth components (plant height, number of branches, number of leaves, collar girth, fresh weight of root, dry weight of root, shoot length, root length). *S. melongena* and *S. gilo* significantly produce the highest yield components (number of flowers, number of fruits, fresh and dry weight of plant, number of galls, and percentage moisture content). Among the eggplant varieties used, *Solanum melongena* L. performed best because it gave the highest mean yield of 403.02 kg ha^{-1} followed by *Solanum* gilo L. which gave 373.15 kg ha^{-1} respectively. In the same vein, I_{10} significantly produce the highest growth components (plant height, number of branches, number of leaves, collar girth, fresh weight of root, dry weight of root, shoot length, root length). Also, I_0 significantly produce the highest yield components (number of flowers, number of fruits, fresh and dry weight of plant, and percentage moisture content). Similarly, I_{40} significantly gave the highest number of galls, of (8.17) followed by I_{20} which recorded (7.00) while I_0 recorded no galls (0.00).

5.2 Recommendations

i. Based on the results of the study, it is recommended that famers should grow more of *Solanum melongena*, followed by *Solanum gilo* and *Solanum macrocarpon* because these varieties produce better yield in nematode infested soils.

ii. *Solanum melongena* L. is recommended to be used by farmers because it produces the best yield as a result of its tolerance to *Meloidogyne incognita*.

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APPENDIX A

Characteristics of the Eggplant Varieties used

Variety	**Characteristics**
Solanum eathiopicum L. (Bello)	Maturity (90-120 days), erect growth habit, multiple disease resistance especially Fusarium wilt, drought tolerance, fruits are edible with, sweet flavor, green stripes, fruit diameter 2-10 cm, prickliness non to slight, bitterness is non to moderate.
. *Solanum gilo* L. (Green)	Maturity (90-120 days), erect growth habit, drought tolerance, fruits are edible with, Spherical to elliptic in outline, fruit diameter 2-10 cm, oval in shape, prickliness non to slight, bitterness is non to moderate.
Solanum macrocarpon L. (White)	Maturity (100-120 days), erect growth habit, drought tolerance, very good vigor in growth, Ivory whitish in color, very sweet flavor, High Productivity, both fruits and leaves are edible

	with, fruit diameter 5-12 cm, prickliness non to slight, bitterness is non to moderate.
Solanum melongena L. (Yalo)	Maturity (100-120 days), erect growth habit, drought tolerance, good resistant to insect pest, hairy leaves and stem, sweet flavor, both fruits and leaves are edible with, fruit diameter 3-4 cm, prickliness non to slight, bitterness is; non to moderate.

Source: www.seedportal.org.ng (2015)

APPENDIX B

A

B

C

D

E F

Plate 1: Showing arrangements of eggplants varieties growing in the screenhouse of the Department of Crop Production School of Agriculture and Agricultural Technology, Federal University of Technology Gidan–Kwano Campus, Minna.

A = Two weeks old, B = Three weeks old, C = Four weeks old, D = Six weeks old

E = Flowering, and F= Fruiting

A B

C D

Plate 2: Showing harvested fruits of eggplants varieties grown in the screenhouse of the Department of Crop Production School of Agriculture and Agricultural Technology, Federal University of Technology Gidan–Kwano Campus, Minna..

Variety A is *Solanum eathiopicum* L. (Bello), Variety B is *Solanum gilo* L. (Green), Variety C is *Solanum macrocarpon* L. (White), and Variety D is *Solanum Melongena* L. (Yalo).

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Eggplant (*Solanum melongena* L.) is a warm-weather crop mostly cultivated in tropical and subtropical regions of the world (Daunay and Hazra, 2012). Vegetables (leafy and fruits) are widely grown in most parts of sub-Saharan Africa, especially, in the urban areas, and they constitute the most affordable and sustainable source of micronutrients in diets (Lucier and Jerardo, 2006). The name eggplant (*Solanum melongena* L.), also known as *aubergine* or *brinjal,* has been cultivated for centuries in Asia, Africa, Europe, and the Near East and is currently a crop species of global importance. Ninety (90) percent of the eggplant production came from five countries, including China, India, Iran, Egypt, and Turkey (FAO, 2012). The cultivated areas exceed more than 1,600,000 ha and the total yields was 43,573,139 tons yearly (FAO, 2012). The global production of eggplant increased to 50 million tons annually, with a net value of more than US$10 billion a year, which makes it the fifth most economically important *solanaceous* crop after potato, tomato, pepper, and tobacco (FAO, 2014). It is an economic flowering plant belonging to the family *Solanaceae*, of which members of about 1,400 species found throughout the temperate and tropical regions of the world are mostly herbaceous plants.

The fruit of the plant comes in a wide array of shapes and colours, some are yellow and small with green stripes. There are the big yellow ones with white colour and flat ribbed green types among others (Plazas *et al*., 2014). Regarding nutritional value, eggplant has a very low caloric value and is considered among the healthiest vegetables for its high content of vitamins, minerals and bioactive compounds for human health (Docimo *et al*., 2016).

Nutritionally, Eggplant contains water (92.5 %), protein (1 %), fat (0.3 %), and carbohydrates (6 %). They contain between 30 and 50 % of iron (Fe), fiber, potassium (K), manganese (Mn), copper (Cu) and vitamins; thiamin (vitamin B1), B6, folate, magnesium and niacin. Eggplant also contains phyto-nutrients such as nasunin and chlorogenic acid (Sabo and Dia, 2009). It is a valuable vegetable for canning industries for eggplant paste, *sautéed* Eggplant and other products. The fruits are fried, stewed, marinated and prepared in other ways. Eggplant with its bitter taste and spongy texture could really make an amazing pot of stew with a nice aroma. When eaten with boiled yam or rice. It is a delicacy that is well cherished by the people (Raigón *et al*., 2008).

The bioactive properties of eggplant are mostly associated with high content in phenolic compounds (Plazas *et al.,* 2013). Which are mostly phenolic acids, particularly chlorogenic acid in the fruit flesh (Stommel *et al.,* 2015) Both phenolic acids and anthocyanins have multiple properties beneficial for human health (Plazas *et al*., 2013; Braga *et al.*, 2016). The plant can be regarded as a brain food because it houses the anthocyanin phyto-nutrient found in its skin, nasunin, a potent antioxidant and free radical scavenger that has been shown to protect cell membranes from damage. Studies have shown that nasunin protects the fats in brain cell membranes. Nasunin is not only a potent free radical scavenger, but is also an iron chelator (Stommel *et al.*, 2015). Iron is an essential nutrient, necessary for oxygen transport, normal immune function and collagen synthesis, but when it becomes too much in the blood stream; it becomes a major concern. Excess iron increases free radical production and is associated with an increased risk of heart disease and cancer (Stommel *et al.*, 2015).

The predominant phenolic compound found in eggplant is chlorogenic acid, which is one of the most potent free radical scavengers found in plant tissues. The chlorogenic acid performs antimutagenic (anticancer) activities in the body. It also performs anti- LDL (bad cholesterol) activities by increasing the levels of HDL (good cholesterol) in the body and at the same time has antiviral and antimicrobial properties. Consuming high amounts of eggplant have been found to be beneficial for people with glaucoma because it lowers the eye pressure (Harish *et al.,* 2008). Egg plant is low in calories and high in fiber. The eggplant is good for carbohydrate counters and dieters can actually snack on garden eggs in-between meals. In Nigeria, eggplant is a very important vegetable crop grown on commercial scale in some parts of the country. However, the small scale growers account for at least 86% of the total production. In the South -East of Nigeria, specifically, in Abia State, garden-egg popularly called "mikimiki" (big sized green fruit with very deep and sweet "endocarp") is grown commercially while in the savannah zone of Nigeria; the yellow, white and thick green skinned varieties are grown on large scale (FAO, 2009).

The production and economy of crops is affected in a variety of ways by nematodes particularly in terms of quality and quantity. Various types of pests are responsible for low yield. The vegetables are attacked by many pests including root-knot nematodes especially *M. incognita*. *Meloidogyne incognita* stood out as the dominant group of plant parasites. More than 300 plant species are attacked by *M. incognita* resulting in severe damage and losses (Kayani *et al*., 2013).

Root-knot nematodes (*Meloidogyne* species) are microscopic and parasitic nematodes which can be found in the roots of infected plants. Under *Meloidogyne* genus, there are about 98 species and common species encountered by farmers are *M. incognita*, *M. javanica*, *M. hapla*, and *M. arenaria* (Jones *et al.,* 2013). They can exist either in hot climates or short winters around the world. In a report by Gill and Mcsorley (2011), root-knot nematode is one of the most damaging groups of plant-parasitic nematodes and these nematodes are pests of almost all major crops. In addition, Karajeh (2008) stated that about 5% of the world crop production is destroyed by *Meloidogyne* species every year. Damage caused by the nematodes can be determined by measuring reductions in growth and yields of annual crops. Eggplant suffers from a number of diseases caused by fungi, bacteria, nematodes and phyto-plasma (Banglapedia, 2006).

1.2 Statement of the Research Problem

Eggplant (*Solanum* spps.) is one of the commonly grown crops in Nigeria, but the yield has been very low as a result of some associated problems like insect pest and disease caused by nematodes (FAO, 2008). Nematodes are distributed worldwide and are obligate parasite of the roots of thousands of plant species. The increasing demand of eggplants has increased along with the rapid growth of population. This is due to the increasing awareness toward the benefit of vegetables in fulfilling the nutrient of the family (Jumini and Marliah, 2009).

1.3 Justification of the Study

Meloidogyne species are microscopic and parasitic nematodes which can be found in the roots of infected plants. Root-knot nematodes survive well in appropriate hosts. Nematode populations increase to the maximum level in susceptible plants resulting in death before maturity. Eggplant and other vegetables are attacked by many pests including root-knot nematodes especially *M. incognita*. *M. incognita* stood out as one of the most dominant group of plant parasites. More than 300 plant species are attacked by *M. incognita* resulting in severe damage and losses including eggplant and the nematode continues to damage eggplant at higher inoculums levels. (Hussain *et al*., 2012; Kayani *et al*., 2013). In view of these, the research work was carried out to evaluate the effects of *M. incognita* on the growth and yield of *Solanum* spp. in Minna.

1.4 Aim and Objectives of the Study

The aim of the study was to evaluate the effect of *Meloidogyne incognita* on the growth and yield of some varieties of eggplant (*Solanum* spp) in Minna, Southern Guinea Savanna of Nigeria. The objectives were to:

iv. determine the effect of *Meloidogyne incognita* on the growth of four varieties of eggplants.

v. determine the effect of *Meloidogyne incognita* on the yield of four varieties of eggplants.

vi. determine the reaction of *Solanum spp* to *Meloidogyne incognita* on host status.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Morphological Description of Eggplant

Eggplant (*Solanum melongena* L.) is a diploid species (2n = 24), and is cultivated as a vegetable that yields immature edible fruits (FAO, 2008). It is perennial but is warm-season annual. Eggplants flowers are perfect, purple or on rare occasion white, with a spiny calyx, five-lobed corolla and yellow stamens. Their fruits are sometimes white or green in colour, but the most popular fruits exhibit deferent intensities of purple. Similarly, fruits can be whitish to dark purple, even black or combinations of these colours in stripes. Physiologically ripe fruits are brown or yellow. The Shapes of their fruits range includes spherical, oblong, ovoid, oval, long and many intermediate types. Fruits ranged from 4–45 cm in height, and 2–25 cm diameter. Mean fruit weight is in the range of 200–300 g. Newer Asian types have weights of 20–40 g (Hassan *et al.*, 2016).

In its primitive form, eggplant is a tall, woody perennial plant with large leaves. Prickles on the stem, leaves and calyx are typical. Andromonoecious flowers with five connate sepals, five connate petals and five stamens fused to the corolla are produced in small cymes (one to five flowers inflorescence). Flowers are generally self-pollinating although cross-pollination may occur in nature as a result of heterostyly and insect visitation. The fruit berries are small and thick-skinned, green and hard at maturity and unpalatable because they are bitter and seedy. Wild eggplants are distributed in tropical regions of Africa and Asia. Domestication, the cultivation and breeding have resulted in a smaller plant that is grown as an annual crop worldwide. Eggplant is a field crop in the Middle East and much of Asia, but greenhouse production is on the rise, especially in Europe and Japan (Daunay, 2008).

Cultivated forms usually lack prickles and produce perfect flowers that are often solitary. Fruits have thin skin, soft flesh and are larger, less seedy and less bitter than wild types. A diversity of fruit shapes exists among cultivars, with round, ovate, oblong, elongate and serpentine forms. Fruit size varies widely along with shape. Fruit length ranges from 4 to 45 cm and diameter from 2 to 25 cm. A 100-fold difference in fruit weight (15 g to1.5 kg) is seen among varieties. Fruit colors are linked to the variable presence of chlorophyll (green) and anthocyanin (red and purple) pigments in the developing fruit. White, green, violet, purple and almost black varieties have been selected, some with contrasting stripes or streaks (Swarup, 1995; Fraryet *et al.*, 2007). Eggplant's genome consists of approximately 956 Mbp (Bennett and Leitch, 2010); it is a diploid with a base chromosome number of 12.

2.2 Distribution of Eggplant

Eggplant, is a popular vegetable crop grown in the subtropics and tropics. It is called *brinjal* in India and *aubergine* in Europe. The name "eggplant" derives from the shape of the fruit of some varieties, which are white and shaped similarly to chicken eggs (Bliss and Elstein, 2004). The top five producing countries are China (28.4 million tons; 57% of world's total), India (13.4 million tons; 27% of world's total), Egypt (1.2 million tons), Turkey (0.82 million tons), and Iran (0.75 million tons). In Asia and the Mediterranean, eggplant ranked among the top five most important vegetable crops (Frary *et al.*, 2007). A rough estimate for a few countries indicates an annual production of 8,000 tones in Senegal, 60,000 tones in Cote d' Ivoire and 4,500 tones in Burkina Faso. (FAO, 2014).

2.3 Nutritional Benefits Eggplant

Interest in eggplant is growing rapidly because it is a good source of antioxidants (anthocyanins and phenolic acids), which are beneficial to human health (Gajewski, Katarzyna, and Bajer, 2009).

2.4 Uses of Eggplant

Medicinally, they are processed and used in the preparation of condiments and products used in treating different diseases and health problems (FAO, 2008) Eggplant has also been used in traditional medicine to treat many diseases. For example, in parts of Asia, vegetative aerial parts were traditionally used for treatment of skin problems and as a purgative, to ease urination, and to increase sex drive (Meyer *et al.,* 2014). In the same study, 77 medicinal properties were recorded for eggplant which indicates the importance of this plant in local medicine and its promise as a functional food and in the natural products industry. A meal of garden egg is proven to be of benefits to patients suffering from raised intraocular pressure (glaucoma) and convergence insufficiency, as well as in heart diseases and Arteriosccerosis (Harish *et al.,* 2008).

2.5 Insect Pests and Diseases of Eggplant

The complex of pests and diseases problems constitutes a major biotic factor militating against increased production of the crop especially during the dry season when it commands high prices. Schivalingaswamy and Satpathy, (2007) reported that a great diversity of species of insects from different orders and families with their characteristic damages based on mode of feeding have been recorded on the eggplant. The insect species which inflict damages on the crop through biting and chewing of the plant parts include Orthoptera (grasshoppers, locusts, crickets), larvae of Lepidoptera (fruit and shoot borer, leaf roller, caterpillar), adults and larvae of many beetles (Coleoptera) and other dipteran larvae. The other insect species which also inflict damage on the crop by the plant sap from the phloem (or xylem) system or from general tissues of foliage, roots and fruits include hemiptera (bugs), homoptera (leafhoppers, whiteflies, aphids) and the

Thysanoptera (thrips) (Shivalingaswamy and Satpathy, 2007). Onekutu *et al.*, (2010) reported that insect pests account for reduced yield and losses of as much as 80 % of the crop.

Verticillium wilt is a destructive disease in eggplant production, which is mainly caused by the infection of *Verticillium dahliae* through root surface to vascular system (Garibaldi *et al.*, 2005; Wang *et al.*, 2005). *Verticillium dahliae* can survive in soil for more than six years, and infect many plant varieties, while chemical fungicides have no direct effects on infected plants, so the disease is hard to control all over the world (Pegg and Brady, 2002；Ligoxigakis *et al.*, 2002; Korolev *et al.*, 2008; Berbegal *et al.*, 2010).

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2.6 Soil and Climatic Requirements

Eggplant is a warm-season crop and does not tolerate frost. A long growing season of 80 days and 20 °C nights. Plant growth slowed pollination problems occur at temperatures below 17 °C or above 35 °C. Flowering is not affected by day length. Cooler temperatures can reduce fruit set. Higher temperatures and high humidity levels also reduce yields. Eggplant can tolerate drought and excessive rainfall. It will not tolerate extended periods of saturated soil owing to the build-up of root-rotting pathogens **(**Bliss and Elstein, 2004). Eggplant does well in a variety of soil textures. Previous crop residue must be stubble-disked to improve soil aeration and to adequately bury organic matter for decomposition. Eggplant grows best with a soil pH of 5.5 to 6.5. It is usually grown in light or sandy loam soils that provide good drainage and favorable soil temperatures. The crop will root to a depth of 90 to 120 cm, therefore, sandy loam or silt loam soils free of physical barriers are better for proper plant growth and development **(**Bliss and Elstein, 2004).

2.7 Cultural Practices

2.7.1 Land preparation

Well-drained, sandy loam soils are ideal for eggplant production. Poorly drained soils usually result in reduced functional root area, poor plant growth and low yields. Site selection is important if early eggplant production is required. For early production, select sites with a southern to southwestern exposure are most ideal. Soil with a southern exposure received more sunlight in the spring and therefore, warms up more quickly. Rotation is necessary so that eggplant is not planted after eggplant or other *solanaceous* crops such as tomato or pepper (Chen *et al.,* 2002). Good land preparation is important for optimum eggplant production. If large quantities of plant debris are present, disc the land several weeks before transplanting, then plough land, using a mould board plough. This will loosen the soil and bury old crop residue. The soils should be turned at least 20 cm deep. Eggplant is intolerant of poorly drained soil, so it is usually helpful (especially on heavier soils or in low areas) to transplant eggplant on raised bed (Bliss and Elstein, 2004).

2.7.2 Transplanting of eggplant

Eggplant crop is usually started by raising seedlings in plastic containers in greenhouses filled with peat; these seedlings are then transplanted into the field (Sękara, 2010). Seedling stage is a critical consideration in the vegetable production chain, and seedling quality and vigour are fundamental requisites for future plant performance in the field. Commercially produced eggplant seedlings should be genetically and morphologically uniform, visually attractive and healthy, with high physiological potential and resistance to stressful storage, transport and transplanting conditions (Costa *et al.,* 2013). Eggplant crops are normally grown from transplants; however, a few growers use direct seeding. In-row spacing of eggplant is 30 to 60 cm. The crop can be grown, using row width depending on the space needed by harvest workers. Growers usually plant eight rows and skip two rows to make roadways for harvest operations.

Growers have also experimented with a bed spacing of 45 to 70 cm in an effort to maximise sunlight penetration onto the fruit, improving fruit colour (Potop *et al.*, 2014).

2.7.3 Fertilizer requirements

The crop showed different reactions to fertilizer applications of 75– 300 kg/ha nitrogen, 30–224 kg/ha phosphorus, and up to 80 kg/ha potassium, depending on the agro-climatic conditions (Sharma, and Brar 2008). Prabhu *et al*., (2006) studied the effects of different nitrogen and phosphorus application rates on eggplant cultivation and found that the crop yield per hectare was raised significantly by increasing nitrogen and phosphorus doses to 200 and 100 kg/ha of nitrogen and phosphorus, respectively.

2.7.4 Irrigation

Eggplant can be grown with furrow or drip irrigation. A crop of furrow irrigated eggplant uses approximately 1, 850 m^3 of water. Some growers use black plastic mulch and drip tape to control weeds, moisture and soil temperature in spring plantings. Critical watering periods are at flowering, fruit set and enlargement. The volume of water applied, depends on the time of the year and stage of plant growth. Most of the water and nutrient to absorbing roots are in the top 45 cm of the soil. Irrigation should be managed to maintain good soil moisture in this root zone. (Bliss and Elstein, 2004).

2.7.5 Weed control

Eggplant is slow to become established and cannot compete with aggressive weeds (Bliss, and Elstein, 2004). Weeds also harboured damaging insects and diseases. Weeds are controlled either by physical methods or chemical control. Physical methods such as hand weeding, cultivation and mulching, are quite frequently used on small vegetable farms. Only shallow cultivations necessary. Natural organic mulches, such as rice straw, will conserve moisture and add organic matter to the soil. Chemical weed control is especially popular in places where labour is expensive. Suitable herbicides include Lasso and Sencor (metribuzin). (Bliss and Elstein, 2004).

2.7.6 Pest and disease control

Many insect pests are attracted to eggplant. Spider mites (*Tetranychus*spp.), green peach aphids (*Myzuspersicae*), lygus (*Lygus* spp.), fleabeetles (Chrysomelidae) and wireworms (Elateridae) can be destructive to eggplant (Hussain *et al.,* 2011). Spider mites are especially harmful and should be treated as temperatures become warmer. Flea beetles are usually a problem only in young plants. Fields should be closely monitored during the flowering period as lygus will feed on flowers and cause flower drop. Root-knot nematodes (*Meloidogyne* spp.) can cause plants to wilt and leaves to yellow (Kayani *et al,* 2012). Herbicides, insecticides and fungicides should always be used in compliance with the label instructions. Mukhtar *et al.,* 2013d.

2.7.7 Harvesting and handling of eggplant

The fruit should be glossy, free of surface scalds, and wounds and have an intact and dark green calyx (Cantwell and Suslow, 2013). High-quality eggplants must have good sanitary conditions, be free of damage and off-flavors. The flesh should be white or creamy and with no browning. The seed coats should not be fully developed. Fruit is usually picked manually and mainly based on size. Late harvests are undesirable since they will lead to seedy and bitter fruit. Harvest of eggplant usually starts 75 to 90 days after transplanting or 15 to 35 days after flowering expansion Given the rapid fruit growth during the summer season pickings are usually required every 3–5days. In the last years, there has been increased interest in the commercialization of eggplants. Miniature eggplants have high visual appeal and are richer in antioxidants (Cantwell and Suslow, 2013).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of Study Area

The study was carried out in the screenhouse of the Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Gidan–Kwano Campus, Minna (Latitude 9^0 31' N and Longitude 6^0 29' E), in May, 2019. Niger state experiences distinct dry and wet seasons with an annual rainfall ranging from 1100 mm in the northern part to 1600 mm in the south with a mean of 1350 mm. The rainfall which peaks in September normally begins in April and ends in October. The temperature ranges between 35 ^{0}C and 37.5 ^{0}C with relative humidity between 60 and 80 %. The vegetation of the area is mainly short grasses and shrubs with scattered trees. Soils in Minna were found to have originated from basement complex rocks and generally are classified as Alfisols (Adeboye *et al.*, 2011).

3.2 Soil Collection and Sterilization

The top soil (0-15 cm depth) was collected from the old Teaching and Research Farms of the Federal University of Technology, Gidan Kwno Campus, Minna. The soil collected was cleared of all debris, gently crushed, thoroughly mixed, heat-sterilized for six hours and filled into each perforated black polyethylene bag, with each polyethylene containing (6 kg) of soil. Each pots has a depth of 38 cm and a diameter of 27 cm. A nursery was raised in plastic pots that contained heat-sterilized soil.

3.3 Source of Eggplant Seeds

The Eggplant seeds were sourced from National Horticulture Research Institute (NIHORT) Ibadan, Oyo State, Nigeria.

3.4 Inoculation

Egg masses of *Meloidogyne incognita* were obtained from the roots of infested tomato (*Solanum lycopersicum*) plants cultured in the screenhouse of School of Agriculture and Agricultural Technology, Minna for the research work. The cultured tomato (*Solanum lycopersicum*) was carefully lifted and washed under running tap water and taken to the laboratory for onward extraction of *Meloidogyne incognita* egg masses. The roots were diced into smaller pieces of 1-2 cm and placed in an extraction dish. The egg masses were picked carefully into another Petri dish before inoculation. Inoculation was done by applying egg masses to the soil for the inoculations at 2 cm away from the plant base by making a groove around the plant.

3.5 Screenhouse Experiment

Seeds of eggplants planted raised in Polyethylene bags that contain heat-sterilized soil to raise seedlings. The experiment was laid out in a Completely Randomized Design. One eggplant seedling each of the variety was transplanted at four week old into Polyethylene bags, which contained heat-sterilized soil. One week after the establishment of the seedlings, the plant were inoculated with I_0 (control, no egg mass applied), I_{10}(10 egg masses), I_{20}(20 egg masses), I_{30}(30 egg masses), and I_{40}(40 egg masses) of the nematode inoculum. The experiment included four (4) species of eggplants namely; *Solanum eathiopicum* L. (Bello), *Solanum gilo* L. (Green), *Solanum macrocarpon* L. (White) and *Solanum melongena* L. (Yalo). These were sown in Polyethylene bags containing sterilized soil in the screenhouse at 25± 34 °C. The plants were watered daily and weeds hand-pulled when necessary.

3.6 Experimental Design

Four (4) species of eggplant were inoculated with (I_0 (Control), I_{10}, I_{20}, I_{30}, and I_{40}) egg masses per seedling. Four (4) blocks of pots, each group having a species was arranged. This group of four (4) species was one replication which was replicated three times. The Experimental Design used was a 4 x 5 factorial arranged in a completely randomised design with three (3) replications.

3.7 Data Collection

The following parameters were recorded:

Plant height (cm): Plant height was taken using a metre rule placed at the base of the plant to the apical tip of the plant at one-week intervals for twelve weeks after inoculation (WAI).

Collar girth (cm): The stem diameter was taken by placing a Vernier caliper around the stem which was also measured in centimeter using a graduated rule at one-week intervals for twelve weeks after inoculation (WAI).

Number of leaves per plant: The leaves were counted at one-week intervals for twelve weeks after inoculation (WAI) by counting the number of leaves per treatment.

Numbers of branches per plant: The branches were counted at one-week intervals for twelve weeks after inoculation (WAI) by counting the number of branches per treatment.

Number of flowers: The number of flowers were counted at one-week intervals for twelve weeks after inoculation (WAI) by counting the number of flowers per treatment.

Number of fruits at emergence: These was taken by counting the number of fruits per treatment at one-week intervals for twelve weeks.

Root length (cm): Thes**e** was measured using a metre rule placed at the base of the root to the tip of the root after harvest.

Fresh weight of plant (g): Fresh weight of plant was obtained using a sensitive weighing balance on each plant per treatment (Electronic scale, Model Hc-D Golden-mettler, USA).

Dry weight of plant (g): Dry weight of plant was obtained using a sensitive weighing balance to determine the weight of each plant per treatment (Electronic scale, Model Hc-D Golden-mettler, USA)..

Fruit weight (g): The fruit weight was determined using an sensitive weighing balance to determine the weight of the harvested fruits per treatment (Electronic scale, Model Hc-D Golden-mettler, USA)..

Percentage moisture content: was determined using.

Fresh weight of plant – Dry weight of plant = Water loss in plant

$$\text{Percentage moisture content} = \frac{\text{Water loss in plant}}{\text{Fresh weight of plant}} \times 100 \quad \text{….. Equation 1}$$

recommended by Luis, *et al.,* (2001)

Total fruit yield per variety: was determine by

$$\text{Yield (Kg/ha)} = \frac{\text{Weight of Eggplant Fruit}}{\text{Area of Polyethylene bag}} \times 10{,}000 \quad \text{….. Equation 2}$$

recommended by Aujla, *et al.,* (2007)

Root-knot/gall scoring:

The formation of galls on eggplant were counted in the laboratory after harvesting the plant using the method as reviewed by Otipa, *et al.,* (2003).

Scale for Scoring

0 = No Knot on roots

1 = Small knots difficult to see

2 = Small knots only but clearly visible, main roots clean

3 = Few large knots visible, but main roots clean

4 = Large knots predominate but main root clean

5 = 50 % of root knotted; knotting on parts of main root system

6 = Knotting on some of main roots

7 = Majority of main roots knotted

8 = All roots knotted; few clean roots visible

9 = All roots severely knotted; plant usually dying

10 = All roots severely knotted; no root System; plant usually dead

3.8 Data Analysis

The data collected were subjected to Analysis of Variance using SAS version 9.1. Treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

4.1.1 Effect of number of galls of (*Meloidogyne incognita*) on eggplant varieties after twelve weeks of inoculation.

Effect of number of galls of (*Meloidogyne incognita*) on eggplant varieties is presented in Table 4.1.1 The Result showed that there were high ($P \leq 0.001$) significant differences on Inoculum levels throughout the period of the study. Inoculum I_{40} has the highest $P \leq 0.001$ number of galls of 8.17, followed by I_{20} having 7.00 galls, I_{30} with 6.67 galls. I_{10} having 5.25 galls and I_{10} with 0.00 respectively.

Similarly, Table 4.1.1 also showed the effect of number of galls on eggplant varieties. The result indicated that there were no significant ($P \geq 0.05$) difference between the varieties after harvest. *S. gilo* recorded the highest number of galls of 5.86 while *S. macrocarpon* had the lowest number of galls 4.60. However there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) throughout the period under study (Table 4.1.1).

4.1.2 Effect of plant heights (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita.*

The effect of plant heights (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.2 The Results showed that there were no significant ($P \geq 0.05$) differences in inoculums levels (egg masses) throughout the period under study. Table 4.1.2 also shows the varietal responses to *Meloidogyne incognita* infection on the plant height of eggplant. There were high ($P \leq 0.001$) varietal differences on plant heights throughout the period of the study.

Table 4.1.1: Effect of number of galls of (*Meloidogyne incognita*) on eggplant varieties after twelve weeks of inoculation

Treatments	Number of Galls
Inoculum	
I_0	0.00^a
I_{10}	5.25^b
I_{20}	7.00^{bc}
I_{30}	6.67^{bc}
I_{40}	8.17^c
SE$\pm$	0.9
CV%	40.34
LSD (0.05)	***
Varieties (V)	
Solanum eathiopicum	5.67
Solanum gilo	5.87
Solanum macrocarpon	4.60
Solanum melongena	5.53
SE$\pm$	0.80
CV%	24.84
LSD (0.05)	NS
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability

At first Week After Inoculation (WAI), *S. gilo* and *S. macrocarpon* were statistically similar having the highest ($P \leq 0.001$) plant height of 37.96 cm and 36.83 cm, respectively, while *S. eathiopicum* had the lowest value in height of 11.59 cm. At 2 WAI, *S. gilo* recorded the highest plant height of 42.27 cm which not different from 36.38 cm in S. *macrocarpon*, while *S. eathiopicum* recorded the lowest plant height of 13.88 cm. At 3 WAI, *S. gilo* had the highest plant height ($P \leq 0.001$) of 47.77 cm while *S. eathiopicum* recorded lowest plant height of 16.97 cm. It was also observed at 4 WAI, *S. gilo* had the highest ($P \leq 0.001$) plant height of 49.13 cm while *S. eathiopicum* had the least value in height of 19.88 cm. At 5 WAI, *S. gilo* recorded the highest plant height of 50.00 cm while *S. eathiopicum* had the lowest plant height of 23.13 cm respectively. Similarly, at 6 WAI, *S. gilo* and *S. macrocarpon* were statistically similar having the highest ($P \leq 0.001$) plant height of 56.99 cm and 55.51 cm respectively while *S. eathiopicum* had the lowest plant height of 31.16 cm.

At 7 WAI, *S. gilo* recorded the highest plant height of 58.11 cm while *S. eathiopicum* had the lowest plant height of 30.45 cm. At 8 WAI, *S. gilo* and *S. macrocarpon* were statistically similar having the highest ($P \leq 0.001$) plant height of 59.91 cm and 58.09 cm respectively, while *S. eathiopicum* had the least plant height of 32.26 cm. Also at 9 WAI, *S. macrocarpon* recorded the highest plant height of 63.90 cm while *S. gilo* had the lowest value of 34.13 cm respectively. At 10 WAI, *S. gilo* had the highest value in height of 65.66 cm while *S. aethiopicum* had the lowest plant height of 35.96 cm. At 11 WAI, *S. gilo* recorded the highest plant height of 68.45 cm while *S. aethiopicum* had the least plant height of 39.10 cm. Similarly, at 12 WAI, *S. gilo* recorded the highest plant height of 49.93 cm while *S. aethiopicum* had the lowest value in height of 22.87 cm respectively. However there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) throughout the period under study (Table 4.1.2).

Table 4.1.2: Effect of plant heights (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_0	28.17	31.867	34.28	35.30	37.07	45.39	43.28	45.53	47.05	48.73	52.33	41.67
I_{10}	26.32	31.16	37.95	42.27	44.39	53.15	53.34	55.12	57.30	57.51	56.10	43.08
1_{20}	29.47	33.62	38.97	39.90	42.23	47.98	47.56	48.93	56.21	54.95	58.13	38.50
1_{30}	27.43	31.70	35.99	37.43	39.73	51.19	52.58	54.12	59.49	59.97	60.86	38.67
1_{40}	30.28	29.92	37.47	39.17	40.78	49.31	50.13	51.93	52.53	50.89	59.01	38.83
SE±	2.62	3.27	5.06	5.23	5.61	6.08	6.11	6.34	7.14	8.06	8.00	5.88
CV%	43.80	42.52	44.96	43.35	41.38	35.68	37.05	36.38	36.76	39.43	36.57	43.47
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	11.59^c	13.88^c	16.97^c	19.88^b	23.13^b	31.16^b	30.45^b	32.26^b	34.13^b	35.96^b	39.10^b	22.87^b
Solanum gilo	37.96^a	42.27^a	47.77^a	49.13^a	50.00^a	56.99^a	58.11^a	59.91^a	60.27^a	65.66^a	68.45^a	49.93^a
Solanum macrocarpon	36.83^a	38.38^a	44.94^{ab}	46.49^a	47.47^a	55.51^a	56.46^a	58.09^a	59.76^a	60.25^a	63.57^a	43.00^a
Solanum melongena	26.95^b	32.07^b	38.12^b	39.75^a	42.71^a	53.96^a	52.49^a	54.25^a	63.90^a	55.77^a	57.88^a	44.80^a
SE±	2.34	2.93	4.53	4.68	5.02	5.43	5.47	5.68	6.36	7.21	7.15	5.26
CV%	43.77	43.26	42.75	41.58	39.26	33.45	33.67	33.11	33.49	37.92	32.77	43.35
LSD (0.05)	***	***	***	***	***	***	***	***	***	***	***	***
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$

4.1.3 Effect of collar girth (cm) of eggplant varieties to the different inoculum levels of *Meloidogyne incognita*

The effect of collar girth of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.3 The Result (Table 4.1.3) showed that there were no significant ($P \geq 0.05$) difference in inoculum levels throughout the period under study. There was a very high varietal ($P \leq 0.001$) differences on collar girth from 1 WAI to 6 WAI. However at 1 WAI, *S. gilo* and *S. macrocarpon* are statistically similar having the highest ($P \leq 0.001$) collar girth value of 3.95 cm and 3.85 cm respectively while *S. aethiopicum* has the lowest collar girth value of 1.21 cm.

Similarly, at 2 WAI, *S. gilo* recorded the highest collar girth value of 4.08 cm while *S. aethiopicum* had the lowest collar girth value of 1.44 cm. Also at 3 WAI, *S. gilo* recorded the highest ($P \leq 0.001$) collar girth value of 4.23 cm while *S. aethiopicum* had 1.92 cm which has the lowest value. At 4 WAI, *S. gilo* had the highest ($P \leq 0.001$) value of 4.37 cm while *S. aethiopicum* recorded the least collar girth value of 2.09 cm. At 5 WAI, *S. gilo* recorded the highest ($P \leq 0.001$) collar girth value of 4.46 cm while *S. aethiopicum* had the lowest value of 2.21 cm respectively. Also at 6 WAI, *S. gilo* recorded the highest collar girth value of 4.5 cm while *S. aethiopicum* had the lowest value of 2.74 cm respectively. However, at 7 WAI, Significant ($P \leq 0.05$) difference was recorded were *S. gilo* had the highest collar girth value 3.79 cm while *S. aethiopicum* recorded the lowest value of 2.40 cm. At 8 WAI, no Significant ($P \geq 0.05$) difference was recorded while *S. gilo* had the highest collar girth value of 3.79 cm while *S. aethiopicum* recorded the lowest collar girth value of 2.40 cm.

Also, at 9 WAI, Significant ($P \leq 0.01$) differences was recorded, were *S. gilo* had the highest collar girth value of 4.48 cm while *S. aethiopicum* which is the lowest had 3.01 cm respectively. However at 10 WAI, no Significant ($P \geq 0.05$) difference was recorded while *S. aethiopicum* had the highest collar girth value of 6.39 cm while *S. melongena* has the lowest collar girth value of 3.93 cm. At 11 and 12 WAI, Significant (P≤ 0.01) difference was recorded. *S. gilo* had the highest collar girth value of 5.28 cm while *S. aethiopicum* had the lowest collar girth value of 3.55 cm respectively. However there was no significant (P≥ 0.05) difference in interaction between Inoculums and Varieties (I X V) throughout the period under study (4.1.3).

4.1.4 Effect of number of leaf of eggplant varieties to different inoculums levels of *Meloidogyne incognita*

The effect of number of leaf of eggplant varieties to different inoculums levels of *Meloidogyne incognita* is presented in Table 4.1.4. Result showed that there were no significant (P≥ 0.05) difference in inoculum levels throughout the period under study. There were, however, very high varietal (P≤0.001) differences in number of leaves throughout the period under study. Similarly, at 1 WAI, *S. macrocarpon* recorded (10.00) leaves which is the highest number of leaf while *S. eathiopicum* had the lowest number of leaves (4.00). Similarly, at 2 WAI, *S. gilo* had the highest number of leaves (22.00) while *S. eathiopicum* had the lowest number of leaves (6.00). Also, at 3 WAI, *S. gilo* recorded the highest number of leaves of (31.00) while *S. eathiopicum* had (5.00) which has the lowest number of leaves value. At 4 WAI, *S. gilo* had the highest number of leaves of (34.00) while *S. eathiopicum* recorded the least number of leaves (6.00). At 5 WAI, *S. gilo* recorded the highest number of leaves (36.53) while *S. eathiopicum* had the lowest number of leaves (7.00) respectively. Also, at 6 WAI, *S. gilo* recorded the highest number of leaves (42.00) while *S. eathiopicum* had the lowest number of leaves (15.00). Also, 7 WAI, *S. gilo* has the highest number of leaves (37.00) while *S. eathiopicum* has the lowest number of leaves (17.00). At 8 WAI, *S. gilo* has the highest number of leaves (40.00) while *S. eathiopicum* recorded the lowest

Table 4.1.3: Effect of collar girth of eggplant varieties to different inoculums levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_0	3.22	3.24	3.27	3.48	3.62	3.88	3.13	3.47	3.57	3.83	4.30	4.11
I_{10}	2.94	3.23	3.67	3.83	3.97	4.22	3.69	3.76	4.03	4.47	4.78	4.65
1_{20}	2.89	3.03	3.22	3.28	3.28	3.51	2.58	2.77	3.23	3.60	4.00	3.75
1_{30}	2.77	2.98	3.31	3.40	3.68	3.93	3.58	3.70	3.80	8.31	4.823	4.39
1_{40}	2.91	2.96	3.13	3.07	3.29	3.84	3.36	3.62	3.51	3.89	4.54	4.35
SE$\pm$	0.25	0.25	0.30	0.31	0.35	0.41	0.42	0.46	0.51	2.63	0.56	0.47
CV%	43.04	39.59	34.91	33.75	33.55	30.51	38.16	37.41	35.70	35.30	31.46	28.63
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	1.21^{c}	1.44^{c}	1.92^{c}	2.09^{c}	2.21^{c}	2.74b	2.40^{b}	2.61^{b}	3.01^{b}	6.39	3.55^{b}	3.55^{b}
Solanum gilo	3.95^{a}	4.08^{a}	4.23^{a}	4.37^{a}	4.46^{a}	4.54a	3.79^{a}	4.10^{a}	4.48^{a}	4.81	5.28^{a}	4.96^{a}
Solanum macrocarpon	3.85^{a}	3.92^{a}	3.91^{a}	3.92^{a}	4.08^{ab}	4.17a	3.57^{a}	3.75^{a}	3.75^{ab}	4.15	4.71^{a}	4.30^{ab}
Solanum melongena	2.77^{b}	2.91^{b}	3.21^{b}	3.26^{b}	3.52^{b}	4.06a	3.31^{a}	3.39^{ab}	3.26^{b}	3.93	4.41^{ab}	4.17^{ab}
SE$\pm$	0.22	0.22	0.27	0.28	0.31	0.36	0.38	0.42	0.46	2.34	0.50	0.42
CV%	40.41	38.74	36.37	35.27	32.54	28.32	36.16	36.22	36.50	41.12	28.24	30.15
LSD (0.05)	***	***	***	***	***	***	*	NS	**	NS	**	**
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability, ** = Significant at $P \leq 0.01$, Level of probability, * = Significant at $P \leq 0.05$ Level of probability.

number of leaves (16.00). Also, at 9 WAI, *S. gilo* had the highest number of leaves (40.00) while *S. eathiopicum* had the lowest number of leaves (17.00) respectively.

At 10 WAI, *S. gilo* had the highest number of leaves (39.00) while *S. eathiopicum* had the lowest number of leaves (16.00). At 11 WAI, *S. gilo* had the highest number of leaves (39.00) while *S. eathiopicum* had the lowest number of leaves (16.00). Similarly, at 12 WAI, *S. gilo* had the highest number of leaves (50.00) while *S. eathiopicum* had the lowest number of leaves (22.00) respectively. However, there was no significant ($P \geq 0.05$) difference in interaction between inoculum and Varieties (I X V) throughout the period under study (Table 4.1.4).

4.1.5 Effect of number of branches of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

The effect of number of branches of eggplant varieties to different **i**noculum levels of *Meloidogyne incognita* is presented in Table 4.1.5. Results showed that there were no significant ($P \geq 0.05$) difference in inoculum levels on eggplant and their interactions throughout the period under study. Very high ($P \leq 0.001$) varietal differences existed in number of branches produced by eggplants throughout the period under study.

Specifically, at 1 WAI, *S. gilo* recorded (8.00) which is the highest ($P \leq 0.001$) number of branches while *S. eathiopicum* had the lowest number of branches of (0.00) respectively. Similarly, at two Weeks After Inoculation (WAI), *S. melongena* had the highest number of branches of (9.00) while *S. eathiopicum* recorded the lowest number of branches (0.00). Also at 3 WAI, *S. gilo* and *S. melongena* are statistically similar which have the highest number of branches (9.00) while *S. eathiopicum* had (1.00) which is the lowest number of branches. At 4 WAI, *S. gilo* recorded the highest ($P \leq 0.001$) value (8.00) while *S. eathiopicum* had the least value of (1.00). At 5 WAI, *S. gilo* had the highest ($P \leq 0.001$) number of branches (11.00) while *S. eathiopicum* had the lowest number of branches (2.00) respectively.

Table 4.1.4: Effect of number of leaf of eggplant varieties to different inoculums levels of *Meloidogyne incognita*

Treatments	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum												
I_0	9.25	15.92	23.33	23.75	26.08	30.83	28.75	29.25	30.83	30.12	30.42	41.67
I_{10}	9.42	16.08	20.92	23.83	26.58	34.75	32.00	34.42	35.42	33.00	33.58	42.42
I_{20}	8.33	15.75	20.25	22.67	22.92	30.58	27.00	27.75	30.33	28.75	29.17	38.50
I_{30}	9.08	13.17	18.33	20.67	23.83	32.08	32.42	33.75	34.17	31.25	31.67	38.92
I_{40}	8.67	16.42	21.50	22.50	25.67	34.00	31.42	30.50	30.42	30.75	31.33	38.83
SE±	1.08	2.05	3.06	3.59	3.81	3.90	5.21	4.87	5.06	4.95	4.94	5.88
CV%	45.93	44.43	48.20	47.06	44.96	41.48	45.58	45.53	45.66	45.65	45.15	43.90
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	4.33^{d}	4.60^{c}	5.40^{c}	6.07^{c}	7.40^{c}	15.47^{b}	16.73^{b}	15.67^{b}	15.80^{b}	15.67^{b}	15.87^{b}	22.33^{b}
Solanum gilo	13.40^{a}	21.93^{a}	30.80^{a}	34.00^{a}	36.53^{a}	42.33^{a}	37.33^{a}	39.47^{a}	40.07^{a}	39.20^{a}	39.67^{a}	49.93^{a}
Solanum macrocarpon	10.20^{b}	18.00^{b}	23.40^{b}	24.73^{b}	28.07^{b}	35.00^{a}	32.27^{a}	32.80^{a}	34.00^{a}	32.80^{a}	33.33^{a}	43.00^{a}
Solanum melongena	7.87^{c}	17.33^{b}	23.87^{b}	25.93^{b}	28.07^{b}	37.00^{a}	34.93^{a}	36.60^{a}	39.07^{a}	35.47^{a}	36.07^{a}	45.00^{a}
SE±	0.96	1.84	2.74	3.21	3.41	3.49	4.66	4.36	4.53	4.43	4.42	5.26
CV%	42.59	42.15	47.02	45.49	41.65	36.30	42.03	42.61	42.84	43.24	42.13	43.03
LSD (0.05)	***	***	***	***	***	***	***	***	***	***	***	***
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability.

Also, at 6 WAI, *S. gilo* had the highest (P ≤ 0.001) number of branches (24.00) while *S. eathiopicum* had the lowest number of branches 7.00.

Also, at 7 WAI, *S. gilo* had the highest (P ≤ 0.001) number of branches (24.00) while *S. eathiopicum* recorded the lowest number of branches (5.00). At 8 WAI, *S. gilo* recorded the highest (P ≤ 0.001) number of branches (26.00) while *S. eathiopicum* had the lowest number of branches (6.00). At 9 WAI, *S. gilo* had the highest number of branches (22.00) while *S. eathiopicum* had the lowest number of branches (7.00). At 10 WAI, *S. gilo* recorded the highest number of branches (29.40) while *S. eathiopicum* had the lowest number of branches (8.00). At 11 WAI, *S. gilo* recorded the highest number of branches (31.00) while *S. eathiopicum* had the lowest number of branches (8.00). Similarly, at 12 WAI, *S. melongena* recorded the highest (P ≤ 0.001) number of branches (14.00) while *S. eathiopicum* had the lowest number of branches (5.00) respectively. However, there was no significant (P≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) throughout the period under study (Table 4.1.5).

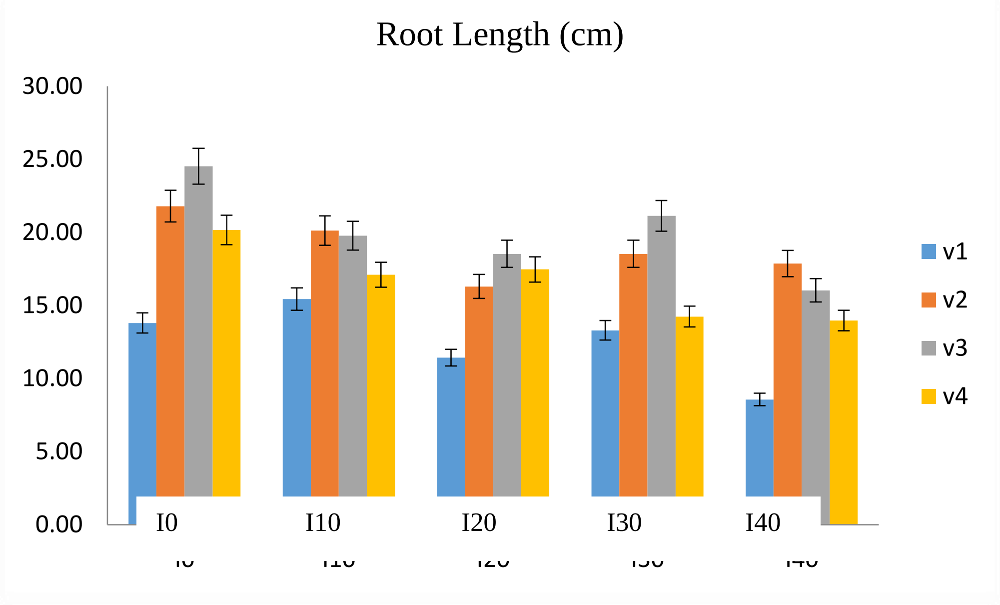
4.1.6 Effect of root length (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Effect of root length (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Figure 4.1. Results showed that there were high varietal (P≤ 0.01) differences on root length of the eggplant investifated. After harvest, *S. macrocarpon* had the highest mean root length of 24.53 cm while *S. eathiopicum* recorded the lowest mean root length of 8.57 cm. However there was no significant (P ≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Figure 4.1).

Table 4.1.5: Effect of number of branches of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	**1 WAI**	**2 WAI**	**3 WAI**	**4 WAI**	**5 WAI**	**6 WAI**	**7 WAI**	**8 WAI**	**9 WAI**	**10 WAI**	**11 WAI**	**12 WAI**
Inoculum												
I_0	5.67	6.42	7.67	7.00	8.17	17.75	15.00	18.92	19.33	22.17	23.92	9.47
I_{10}	5.50	6.00	6.75	7.50	8.08	16.08	15.00	16.58	18.25	19.75	19.92	10.92
I_{20}	6.33	6.67	6.83	6.67	7.42	12.75	12.47	14.58	17.42	19.00	20.75	8.83
I_{30}	5.50	7.08	7.33	7.83	8.42	16.08	16.50	17.92	16.83	19.67	20.50	8.75
I_{40}	5.75	6.00	6.08	6.42	7.08	16.08	14.00	16.00	15.58	18.33	21.25	7.75
SE±	0.85	0.93	1.00	1.06	1.17	2.89	3.07	3.21	4.13	3.55	3.74	1.73
CV%	45.36	42.07	48.77	48.72	49.38	42.03	46.21	42.63	44.06	47.42	46.45	49.10
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)												
Solanum eathiopicum	0.33^{b}	0.73^{b}	1.33^{b}	1.47^{b}	1.53^{b}	5.73^{c}	5.40^{c}	6.33^{c}	6.60^{b}	7.67^{c}	7.87^{c}	4.93^{c}
Solanum gilo	7.60^{a}	8.20^{a}	9.20^{a}	9.67^{a}	10.80^{a}	24.40^{a}	23.73^{a}	25.93^{a}	22.47^{a}	29.40^{a}	31.27^{a}	7.87^{bc}
Solanum macrocarpon	7.33^{a}	7.73^{a}	8.00^{a}	8.47^{a}	9.07^{a}	18.07^{b}	17.13^{b}	19.13^{b}	18.67^{a}	21.87^{b}	23.53^{b}	9.73^{b}
Solanum melongena	7.73^{a}	9.07^{a}	9.20^{a}	8.73^{a}	9.93^{a}	14.80^{b}	14.07^{b}	15.80^{b}	22.20^{a}	20.20^{b}	22.40^{b}	14.00^{a}
SE±	0.72	0.83	0.90	0.95	1.05	2.58	2.75	2.87	3.69	3.18	3.34	1.55
CV%	49.14	47.77	43.81	43.85	45.21	40.19	42.96	48.81	49.17	43.97	43.12	49.66
LSD (0.05)	***	***	***	***	***	***	***	***	***	***	***	***
Interaction												
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety,, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability.



Levels of inoculations

Figure 4.1: Root length (cm) of eggplant varieties to different inoculum levels of *Meloidogyne incognita.*

V1= *Solanum eathiopicum* L. (Bello)   V2= *Solanum gilo* L. (Green)

V3= *Solanum macrocarpon* L. (White)   V4= *Solanum melongena* L. (Yalo)

4.1.7 Effect of number of flowers of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

The effect of number of flowers of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.6. The result showed that there were no significant (P≥ 0.05) difference in inoculums levels on number of flowers throughout the period under study. Table 4.1.6 also showed the varietal difference on the number of flowers of eggplant.

Similarly the result indicates high Significant (P≤0.001) differences between the varieties at (2WAI, 3WAI, 7WAI, 8WAI, 9WAI, and 12WAI) during the period under study. However, at 2 WAI, *S. gilo* had the highest (P≤0.001) number of flowers 4.47 while *S. eathiopicum* had the lowest number of flowers 0.00. Similarly, at 3 WAI, *S. gilo* recorded the (P≤0.001) highest number of flowers 12.13 while *S. eathiopicum* had the lowest number of flowers 0.00. Also, at 4 WAI, Significant (P≤ 0.01) difference was recorded, were *S. gilo* had the highest number of flowers 10.00 while *S. eathiopicum* had 2.07 which is the least number of flowers. At 5 WAI, Significant (P≤ 0.01) difference was recorded were *S. gilo* had the highest number of flowers 7.20 while *S. eathiopicum* had the least value of 2.53. At 6 WAI, Significant (P≤ 0.05) difference was recorded were *S. gilo* had the highest number of flowers 42.73 while *S. eathiopicum* recorded the lowest number of flowers 8.27 respectively. Also, at 7 WAI, *S. gilo* had the highest number of flowers 43.87 while *S. eathiopicum* had the lowest number of flowers 7.67 respectively. However, at 8 WAI, *S. gilo* had the highest number of flowers 47.00 while *S. eathiopicum* had the lowest number of flowers 8.67. At 9 WAI, *S. melongena* recorded the highest number of flowers 56.93 while *S. eathiopicum* recorded the lowest number of flowers 11.33.

Also, at 10 WAI, Significant ($P \leq 0.01$) differences was recorded, were *S. gilo* had the highest number of flower 42.53 while *S. eathiopicum* which is the lowest recorded 10.53 respectively. However, at 11 WAI, Significant ($P \leq 0.01$) difference was recorded were *S. gilo* had the highest number of flowers 41.20 and *S. eathiopicum* had the lowest number of flowers 9.80. At 12 WAI, *S. melongena* recorded the highest number of flowers 22.67 while *S. aethiopicum* had the lowest number of flowers 4.33 respectively. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) throughout the period under study (Table 4.1.6).

4.1.8 Effect of number of fruits of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

The effect of number of fruits of eggplant varieties to different inoculum levels of *Meloidogyne incognita* is presented in Table 4.1.7. Similarly, Result showed very high Significant ($P \leq 0.001$) difference in inoculum levels throughout the period under study. However, at 5 WAI, I_0 recorded the highest ($P \leq 0.001$) number of mean fruits 3.92 while I_{30} had the least number of fruits 0.25. Also, at 6 WAI, I_0 had the highest ($P \leq 0.001$) number of fruits 4.25 while I_{30} had the lowest number of fruits 0.17 respectively. Also, at 7 WAI, I_0 recorded the highest number of fruits of 4.25 while I_{10} and I_{40} had the least number of fruits 1.00.

Similarly, at 8 WAI, I_0 had highest number of fruits 5.42 while I_{40}, I_{10}, I_{20}, I_{30} had 0.92, 0.83, 0.50, and 0.17 which are statistically similar and they have the lowest number of fruits. Also, at 9 WAI, I_0 had 5.83 which had the highest number of fruits while I_{30} had the lowest number of fruits 0.17 respectively. Similarly, at 10 WAI, I_0 recorded the highest number of fruits 5.92 while I_{30} had the lowest number of fruits 0.17. Also, at 11 WAI, I_0 had 5.92 which is the highest number of fruits while I_{30} had the lowest number of fruits 0.17 respectively.

Table 4.1.6: Effect of number of flowers of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	**2 WAI**	**3 WAI**	**4 WAI**	**5 WAI**	**6 WAI**	**7 WAI**	**8 WAI**	**9 WAI**	**10 WAI**	**11 WAI**	**12 WAI**
Inoculum											
I_0	2.83	7.08	8.00	6.33	25.50	25.50	29.83	26.83	26.42	28.25	10.50
I_{10}	2.92	7.08	6.92	6.42	20.67	23.08	23.50	29.33	30.42	22.50	11.75
I_{20}	1.83	5.50	6.75	5.92	18.50	18.25	18.25	28.25	26.67	24.83	12.33
I_{30}	2.42	5.67	6.08	5.42	24.33	27.33	26.92	29.00	26.58	24.25	13.83
I_{40}	2.83	7.33	4.92	5.42	23.25	21.25	24.50	24.00	22.25	29.58	7.67
SE±	1.14	3.57	2.61	1.85	10.43	9.68	10.13	9.12	11.34	11.08	4.36
CV%	21.81	18.76	12.83	49.85	42.19	44.86	43.92	45.35	50.45	41.65	44.96
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties (V)											
Solanum eathiopicum	0.00^{c}	0.00^{c}	2.07^{b}	2.53^{b}	8.27^{b}	7.67^{b}	8.67^{b}	11.33^{b}	10.53^{c}	9.80^{b}	4.33^{b}
Solanum gilo	4.47^{a}	11.60^{a}	9.53^{a}	7.20^{a}	42.73^{a}	43.87^{a}	47.00^{a}	20.40^{b}	42.53^{a}	41.20^{a}	9.60^{b}
Solanum macrocarpon	3.67^{ab}	9.27^{ab}	8.40^{a}	7.93^{a}	16.27^{b}	19.40^{b}	19.80^{b}	21.27^{b}	20.47^{bc}	20.60^{ab}	8.27^{b}
Solanum melongena	2.13^{b}	5.27^{b}	6.13^{ab}	5.93^{a}	22.53^{b}	21.40^{b}	22.93^{b}	56.93^{a}	32.33^{ab}	31.93^{a}	22.67^{a}
SE±	1.02	2.26	2.33	1.66	9.33	8.66	9.06	8.16	10.14	9.91	3.90
CV%	45.88	46.24	47.84	43.22	45.21	41.17	43.12	42.63	42.67	44.37	42.72
LSD (0.05)	***	***	**	**	*	***	***	***	**	**	***
Interaction											
I X V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), *** = Significant at P≤0.001, Level of probability, ** = Significant at P≤0.01, Level of probability, * = Significant at P≤0.05 Level of probability.

Similarly, at 12 WAI, I_0 had the highest number of fruits 5.92 while I_{30} recorded the lowest number of fruits 0.17 respectively. Table 4.1.7 also shows the varietal differences on number of fruits of eggplants. Similarly, the result indicates high varietal ($P \leq 0.001$) differences on number of fruits at (5WAI, 6WAI, 7WAI, while at 8WAI) Significant ($P \leq 0.01$) differences were recorded during the period under study. However, at 5 WAI, *S. melongena* gave the highest average number of fruits 2.73 while *S. eathiopicum* had the lowest number of fruits 0.00. Similarly, at 6 WAI, *S. melongena* had the highest number of fruits of 2.60 while *S. eathiopicum* had the lowest number of fruits 0.00.

Also, at 7 WAI, *S. melongena* had the highest number of fruits 2.60 while *S. eathiopicum* had the least number of fruits of 0.00. At 8 WAI, Significant ($P \leq 0.01$) difference was recorded were *S. melongena* recorded the highest number of fruits 2.33 while *S. eathiopicum* had the lowest number of fruits 0.73 respectively. Also, at 9, 10, 11, and 12 WAI, There was no Significant ($P \geq 0.05$) difference. At 9 WAI, *S. gilo* had the highest number of fruits 1.87 while *S. eathiopicum* had the lowest number of fruits of 0.93. Also at 10 WAI, *S. melongena* had the highest number of fruits 2.20 while *S. eathiopicum* had the lowest number of fruits 1.00. At 11 WAI, *S. melongena* had the highest number of fruits 2.20 while *S. eathiopicum* had the lowest number of fruits 1.00 respectively.

However, at 12 WAI, *S. melongena* recorded the highest number of fruits 2.20 while *S. eathiopicum* had the lowest number of fruits 1.00. However, there was significant ($P \leq 0.01$) difference in interaction between Inoculums and Varieties (I X V) at 5 WAI, 6 WAI, and 7 WAI, while significant ($P \leq 0.05$) difference was recorded at 8 WAI during the period under study (Table 4.1.7).

Table 4.1.7: Effect of number of fruits of eggplant varieties to different inoculum levels of *Meloidogyne incognita*

Treatments	5 WAI	6 WAI	7 WAI	8 WAI	9 WAI	10 WAI	11 WAI	12 WAI
Inoculum								
I_0	3.92[a]	4.25[a]	4.25[a]	5.42[a]	5.83[a]	5.92[a]	5.92[a]	5.92[a]
I_{10}	1.25[b]	1.00[b]	1.00[b]	0.83[b]	0.50[b]	1.17[b]	1.17[b]	1.17[b]
I_{20}	0.36[b]	0.75[b]	0.75[b]	0.50[b]	1.00[b]	0.92[b]	0.92[b]	0.92[b]
I_{30}	0.25[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]	0.17[b]
I_{40}	1.18[b]	1.00[b]	1.00[b]	0.92[b]	0.08[b]	0.67[b]	0.67[b]	0.42[b]
SE±	0.63	0.63	0.63	0.48	0.43	0.57	0.57	0.55
CV%	41.47	41.45	48.15	49.75	40.36	41.12	41.12	45.52
LSD (0.05)	***	***	***	***	***	***	***	***
Varieties (V)								
Solanum eathiopicum	0.00[c]	0.00[b]	0.00[b]	0.73[b]	0.93[b]	1.00[b]	1.00[b]	1.00[b]
Solanum gilo	1.53[b]	1.47[a]	1.47[a]	1.60[ab]	1.87[a]	2.13[a]	2.13[a]	2.13[a]
Solanum macrocarpon	1.20[b]	1.67[a]	1.67[a]	1.60[ab]	1.53[ab]	1.73[b]	1.73[ab]	1.53[ab]
Solanum melongena	2.73[a]	2.60[a]	2.60[a]	2.33a	1.73[ab]	2.20[b]	2.20[a]	2.20[a]
SE±	0.58	0.56	0.56	0.43	0.39	0.51	0.51	0.49
CV%	28.32	28.31	25.79	36.14	24.65	23.08	23.08	25.75
LSD (0.05)	***	***	***	**	NS	NS	NS	NS
Interaction								
I X V	**	**	**	**	NS	NS	NS	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), *** = Significant at P≤0.001, Level of probability, ** = Significant at P≤0.01, Level of probability.

4.1.9 Effect of *Meloidogyne incognita* on fresh weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on the fresh weight of Eggplant varieties is presented in Table 4.1.8. Similarly, the result indicates that there were varietal ($P \leq 0.05$) differences between the Varieties after harvest, *S. gilo* had the highest fresh weight of 117.47 g $plant^{-1}$while *S. eathiopicum* recorded the lowest fresh weight of 69.86 g $plant^{-1}$. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) on mean fresh weight during the period under study (Table 4.1.8).

4.1.10 Effect of *Meloidogyne incognita* on the dry weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on the dry weight of Eggplant varieties is presented in Table 4.1.9. The result indicates that there were varietal ($P \leq 0.01$) differences between the varieties after harvest. *S. gilo* had the highest dry weight of 104.31g $plant^{-1}$ while *S. eathiopicum* had the lowest dry weight of 658.85g $plant^{-1}$. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) on mean dry weight during the period under study (Table 4.1.9).

4.1.11 Effect of *Meloidogyne incognita* on the root biomass of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on fresh weight (g) of root of Eggplant varieties is presented in Table 4.1.10. However, Results indicated that there were no significant ($P \geq 0.05$) difference in inoculum levels on fresh weight of root of eggplant varieties. Similarly, I_0 had the highest fresh weight of root 40.84 while I_{30} had the lowest fresh weight of root 23.12 respectively.

Table 4.1.8: Effect of *Meloidogyne incognita* on fresh weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

Treatments	**Fresh Weight at Harvest (g $plant^{-1}$)**
Inoculum	
I_0	116.82
I_{10}	86.01
I_{20}	75.50
I_{30}	94.27
I_{40}	101.55
SE±	17.96
CV%	43.69
LSD (0.05)	NS
Varieties (V)	
Solanum eathiopicum	69.86^{b}
Solanum gilo	117.47^{a}
Solanum macrocarpon	104.05^{a}
Solanum melongena	87.94^{ab}
SE±	16.06
CV%	48.28
LSD (0.05)	*
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), * = Significant at $P \leq 0.05$ Level of probability.

Table 4.1.9: Effect of *Meloidogyne incognita* on dry weight (g) (whole plant) of eggplant varieties after twelve weeks of inoculation

Treatments	Dry weight at harvest ($g\ plant^{-1}$)
Inoculum	
I_0	99.56
I_{10}	75.06
I_{20}	64.41
I_{30}	82.83
I_{40}	91.04
SE±	16.52
CV%	50.03
LSD (0.05)	NS
Varieties (V)	
Solanum eathiopicum	58.85^{b}
Solanum gilo	104.31^{a}
Solanum macrocarpon	93.19^{a}
Solanum melongena	73.97^{ab}
SE±	14.78
CV%	50.65
LSD (0.05)	**
Interaction	
I XV	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), ** = Significant at $P \leq 0.01$, Level of probability.

Also, Table 4.1.10 showed the varietal differences on the fresh weight root of eggplants. Results indicates that there were varietal ($P \leq 0.01$) differences on fresh weight root of eggplant. *S. gilo* has the highest fresh weight root value of 48.35 g plant^{-1}while *S. aethiopicum* had the lowest fresh weight root value of 19.70 g plant^{-1}. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Table 4.1.10).

Similarly, Table 4.1.10 also showed the effect of *Meloidogyne incognita* on the dry weight (g) of root of eggplant varieties. Results indicated that there were no Significant ($P \geq 0.05$) difference in inoculum levels on dry weight (g) of root of eggplant varieties, I_0 had the heights dry weight root value of 37.10 while I_{20} had the lowest dry weight root value of 21.87 respectively.

Also, there were Significant ($P \leq 0.01$) differences on dry weight root of eggplant varieties. *S. gilo* recorded the highest dry weight root value of 40.03 g plant^{-1} while *S. eathiopicum* had the lowest dry weight root value of 17.94 g plant^{-1}. However, there was no significant ($P \geq 0.05$) difference in interaction between inoculum and Varieties (I X V) during the period under study (Table 4.1.10.).

4.1.12 Effect of *Meloidogyne incognita* on the weight (g) of fruit of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on the weight of fruit of eggplant varieties is presented in Figure 4.2. The result indicated that there were no varietal ($P \geq 0.05$) differences on mean weight between the verities. Similarly, *S. melongena* recorded the highest mean weight of 44.67 g plant^{-1} while *S. eathiopicum* had the lowest mean weight of 18.61 g plant^{-1}.

Treatments	Fresh Weight of Root (g plant^{-1})	Dry Weight of Root (g Plant^{-1})
Inoculum		
I_0	40.84	37.10
I_{10}	35.58	33.54
I_{20}	35.58	21.87
I_{30}	23.12	24.03
I_{40}	30.38	28.95
SE±	10.09	12.84
CV%	42.21	43.85
LSD (0.05)	NS	NS
Varieties (V)		
Solanum eathiopicum	19.70^{c}	17.94^{b}
Solanum gilo.	48.35^{a}	40.03^{a}
Solanum macrocarpon	41.15^{ab}	38.73^{a}
Solanum melongena	23.20^{bc}	19.69^{b}
SE±	9.02	8.12
CV%	49.96	42.69
LSD(0.05)	**	**
Interaction		
I X V	NS	NS

Table 4.1.10: Effect of *Meloidogyne incognita* on root biomass of eggplant varieties after twelve weeks of inoculation

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), ** = Significant at P≤0.01, Level of probability.

However, there was no significant (P≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Figure 4.2).

4.1.13 Effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties is presented in Table 4.1.11. The result showed that there were significant (P≤ 0.05) difference in inoculums levels on the percentage moisture content of eggplant varieties. Similarly, after harvest,

I_0 had the highest percentage moisture content value of 10.43 while I_{40} recorded the lowest percentage moisture content value of 5.00.

Table 4.1.11 also showed the effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties. The result indicated that there were no significant (P≥ 0.05) differences between the varieties after harvest. *S. melongena* recorded the highest percentage moisture content of 9.21% while *S. gilo* had the lowest percentage moisture content value of 5.81%. However there was no significant (P≥ 0.05) difference in interaction between Inoculum and Varieties (I X V) during the period under study (Table 4.1.11).

4.1.14 Effect of *Meloidogyne incognita* on yield kg ha $^{-1}$of eggplant varieties after twelve weeks of inoculation

The effect of *Meloidogyne incognita* on yield kg ha $^{-1}$of eggplant varieties is presented in Table 4.12.12 However the result showed that there were a high significant (P≤ 0.001) difference in inoculum levels on the yield of eggplant varieties. Similarly after harvest, I_0 recorded the heights yield value of 988.97 followed by I_{10} having 226.36, while I_{20} recorded 191.36 and I_{30} had the lowest yield value of 32.87 respectively.

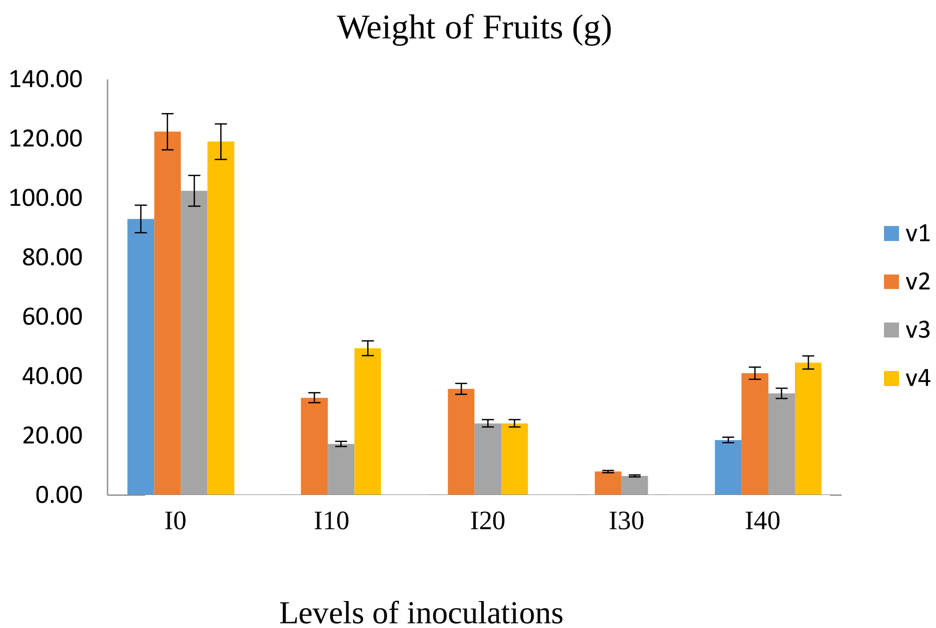


Figure 4.2: Weight of fruit (g) eggplant varieties after twelve weeks of inoculation.

V1= *Solanum eathiopicum* L. (Bello) V2= *Solanum gilo* L. (Green)

V3= *Solanum macrocarpon* L. (White) V4= *Solanum melongena* L. (Yalo)

Table 4.1.11: Effect of *Meloidogyne incognita* on percentage moisture content of eggplant varieties after twelve weeks of inoculation

Treatments	Percentage Moisture Content
Inoculum	
I_0	10.43[a]
I_{10}	6.72[ab]
I_{20}	6.94[ab]
I_{30}	6.97[ab]
I_{40}	5.00[b]
SE$\pm$	2.12
CV%	49.43
LSD (0.05)	*
Varieties (V)	
Solanum eathiopicum	6.35
Solanum gilo	5.81
Solanum macrocarpon	7.48
Solanum melongena	9.21
SE$\pm$	1.90
CV%	41.83
LSD (0.05)	NS
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant (P ≥ 0.05), * = Significant at P≤0.05, Level of probability.

Table 4.12.12 also showed the varietal difference on yield of eggplant varieties. The result indicates that there were no varietal ($P \geq 0.05$) differences between the varieties after harvest. However, *S. melongena* L. recorded the highest yield of 403.03 kg ha^{-1}, followed by *S. gilo* L. with 373.1503 kg ha^{-1} while *S. eathiopicum* L. gave the least yield value of 168.82 kg ha^{-1} respectively. However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) during the period under study (Table 4.12.12).

Table 4.1.12: Effect of *Meloidogyne incognita* on yield kg ha $^{-1}$ of eggplant varieties after twelve weeks of inoculation

Treatments	Yield kg ha $^{-1}$
Inoculum	
I_0	988.97[a]
I_{10}	226.36[b]
I_{20}	191.36[b]
I_{30}	32.87[b]
I_{40}	131.36[b]
SE±	113.7
CV%	37.73
LSD (0.05)	***
Varieties (V)	
Solanum eathiopicum	168.82[b]
Solanum gilo	373.15[ab]
Solanum macrocarpon	311.76[ab]
Solanum melongena	403.03[a]
SE±	101.73
CV%	44.08
LSD (0.05)	NS
Interaction	
I X V	NS

Means in a column of any set of treatment(s) followed by different letter(s) are significantly different, WAI = Weeks After Inoculation, I= Inoculum, V= Variety, SE = Standard Error, LSD= Least Significant Difference, NS = Not Significant ($P \geq 0.05$), *** = Significant at $P \leq 0.001$, Level of probability.

4.2 Discussion

The experiment showed a very high significant ($P \leq 0.001$) differences between inoculums levels on number of galls after harvest during the period of the study. *Solanum gilo* L. gave the highest number of galls of 5.87, The results confirm the findings Abdel-Momen *et al.* (1998); Vovlas *et al.* (2005) report that the size of galls as well as the number of galls is related to the number of nematodes infecting roots, although the inoculum concentration may have less effect at later evaluation stages. Similarly, Haider *et al.* (2003) reported that the inoculum level of 1000J2 of *M. incognita* per plant caused significant reduction in growth characters of French bean and pea. Akhtar *et al.* (2005) pathogenic to mung bean. Presence of galls on roots is a primary symptom associated with *M. incognita*. The increasing level of nematode inoculums has been attributed to gall formation and secondary root proliferation (Abrao and Mazzafera, 2001). Similar results were reported in different genotypes of tomato (Maleita *et al.*, 2012) and inoculum levels on tomato. Similarly, there was no significant ($P \geq 0.001$) differences between varieties on number of galls and interaction between inoculum and variety after harvest during the period of the study.

There were no Significant ($P \geq 0.05$) differences between inoculums levels on plant height, collar girth, number of leaves, number of branches, number of flowers, throughout the period of the study. These results are in conformity with the findings of Karssen and Moens (2006), who observed that length of plants decreased in the nematode infected plants, this was likely due to damage caused by the increasing numbers of nematodes that invaded plant roots, and probably ceasing the nutrient and water uptake. According to Sikora and Fernandez (2005), increase in the nematode populations and the subsequent reduction in the growth and yield of crops are directly influenced by the initial density of the nematodes in the soil. The results confirm the findings of Maleita *et al.* (2012); who reported that plants heavily infested with root knot nematodes exhibited stunted growth and poor yield, in some cases plants die even before reaching maturity (Singh and Khurma, 2007).

However, there were a very high varietal (P≤0.001) differences on plant height, collar girth, number of leaf, number of branches, number of flowers, number of fruits, fresh weight, dry weight, fresh weight of root, dry weight of fruit throughout the period of the study. Similarly, *Solanum gilo* L. gave the highest plant height of 68.45 cm, *Solanum gilo* L. gave the highest collar girth of 5.28 cm, *Solanum gilo* L. gave the highest number of leafs 40.07, *Solanum gilo* L. gave the highest number of branches of 31.27, *Solanum melongena* L. gave the highest number of flowers 56.93, *Solanum melongena* L. gave the highest number of fruits at emergence of 2.20, *Solanum gilo* L. gave the highest number of fresh weight of 117.47 g plant^{-1}, *Solanum gilo* L. gave the highest number of dry weight of 104.31 g plant^{-1} , *Solanum* gilo L. gave the highest fresh weight of root 48.35 g plant^{-1} , *Solanum gilo* L. gave the highest dry weight of root 40.03 g plant^{-1}, *Solanum melongena* L. gave the highest weight of fruit 44.67 g plant^{-1} ,*Solanum gilo* L. gave the highest number of galls of 5.87, *Solanum melongena* L. gave the highest percentage moisture content of 9.21%, *Solanum melongena* L. gave the highest yield value of 403.03 kg ha $^{-1}$ These result agrees with the findings of Akpan *et al.* (2016) that Genetic variation in gene pool is vital for successful selection and yield improvement in each crop species. Genetic divergent population provides vast desirable traits from which selection can be made for crop improvement. The significant differences observed among the parents at the vegetative growth stage are indication of their genetic diversity. An earlier study on these parents showed similar diversity. This report agrees with the findings of Kumar *et al.* (2015), Nyadanu *et al.* (2014) where the presence of genetic diversity in eggplant had been reported. Similarly, there was no significant ($P \geq 0.05$) difference in interaction between Inoculums and Varieties (I X V) on plant height, collar girth, number of leaf, number of branches, number of flowers, throughout the period under study. These agree with the report of Sikora and Fernandez (2005), increase in the nematode populations and the subsequent reduction in the growth and yield of crops are directly influenced by the initial density of the nematodes in the soil.

However, there was a very high varietal ($P \leq 0.001$) differences between inoculum levels on number of fruits at emergence and weight of fruit during the period of the study. *Solanum melongena* L. gave the highest number of fruits at emergence of 2.20 also, *S. melongena* L. gave the highest weight of fruit 44.67 g plant^{-1} The results confirm the findings of Maleita *et al.* (2012); they reported that plants heavily infested with root knot nematodes exhibited stunted growth and poor yield, The number of fruits per plant observed in this study agreed with earlier report of Thangamani, and Jansirani, (2012) on the same traits in eggplant. However there was significant ($P \leq 0.01$) difference in interaction between Inoculum and Varieties (I X V) on number of fruits at (5 WAI) to (7 WAI) while there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) at (8 WAI) to (12 WAI) during the period under study.

Also, there were a no Significant ($P \geq 0.05$) difference between inoculums levels on fresh weight, dry weight, fresh weight of root, dry weight, shoot length, root length of root after harvest. These agree with the findings of Kayani *et al*. 2017 that the stunted and reduced growth of foliar parts subsequently results in reduced biomass and productivity. Due to extensive disruption of xylem vessels, the upward uptake of water and nutrients is greatly reduced. The root-knot infection also greatly affects permeability of roots to water. Due to the induction of nurse cell systems by females of root-knot nematodes for incessant feeding in infected roots, there is greater translocation of photosynthesis towards these infection sites, while the aboveground parts experience acute deficiency of nutrients (Wyss 2002, Di Vito *et al.*, 2004). As the infected plants face insufficient supply of nutrients, photosynthesis, energy, water etc., therefore, development and growth of leaf tissues and their essential constituents particularly chlorophyll pigments, are greatly hampered (Khan and Khan, 1997).

However, there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) on fresh weight, dry weight, fresh weight of root, dry weight, shoot length, root length of root after harvest. However, there were significant ($P \leq 0.05$) difference in inoculum levels on the percentage moisture content of eggplant varieties. These agree with the report of Di Vito *et al*. 2004 that maximum decreases in growth and yield variables of susceptible cultivars can be ascribed to severe root damage owing to nematode entry and/or feeding which resulted in impairment and disruption of water absorption by the infected root systems. After entry into roots, the root-knot females induce gall formation and giant cells in the stellar region and cause severe disruption of xylem tissues. Wyss (2002), Due to extensive disruption of xylem vessels, the upward uptake of water and nutrients is greatly reduced. The root-knot infection also greatly affects permeability of roots to water.

Similarly, there were no varietal ($P \geq 0.05$) differences between the varieties after harvest, and also there was no significant ($P \geq 0.05$) difference in interaction between Inoculum and Varieties (I X V) during the period under study.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From this study, it can, therefore, be concluded that large variations in growth and yield variables of some varieties of Eggplant were found in response to *M. incognita* infection. *Solanum melongena* L and *Solanum* gilo L. significantly produce the highest growth components (plant height, number of branches, number of leaves, collar girth, fresh weight of root, dry weight of root, shoot length, root length). *S. melongena* and *S. gilo* significantly produce the highest yield components (number of flowers, number of fruits, fresh and dry weight of plant, number of galls, and percentage moisture content). Among the eggplant varieties used, *Solanum melongena* L. performed best because it gave the highest mean yield of 403.02 kg ha^{-1} followed by *Solanum* gilo L. which gave 373.15 kg ha^{-1} respectively. In the same vein, I_{10} significantly produce the highest growth components (plant height, number of branches, number of leaves, collar girth, fresh weight of root, dry weight of root, shoot length, root length). Also, I_0 significantly produce the highest yield components (number of flowers, number of fruits, fresh and dry weight of plant, and percentage moisture content). Similarly, I_{40} significantly gave the highest number of galls, of (8.17) followed by I_{20} which recorded (7.00) while I_0 recorded no galls (0.00).

5.2 Recommendations

i. Based on the results of the study, it is recommended that famers should grow more of *Solanum melongena*, followed by *Solanum gilo* and *Solanum macrocarpon* because these varieties produce better yield in nematode infested soils.

ii. *Solanum melongena* L. is recommended to be used by farmers because it produces the best yield as a result of its tolerance to *Meloidogyne incognita*.

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APPENDIX A

Characteristics of the Eggplant Varieties used

Variety	**Characteristics**
Solanum eathiopicum L. (Bello)	Maturity (90-120 days), erect growth habit, multiple disease resistance especially Fusarium wilt, drought tolerance, fruits are edible with, sweet flavor, green stripes, fruit diameter 2-10 cm, prickliness non to slight, bitterness is non to moderate.
. *Solanum gilo* L. (Green)	Maturity (90-120 days), erect growth habit, drought tolerance, fruits are edible with, Spherical to elliptic in outline, fruit diameter 2-10 cm, oval in shape, prickliness non to slight, bitterness is non to moderate.
Solanum macrocarpon L. (White)	Maturity (100-120 days), erect growth habit, drought tolerance, very good vigor in growth, Ivory whitish in color, very sweet flavor, High Productivity, both fruits and leaves are edible with, fruit diameter 5-12 cm, prickliness non to slight, bitterness is non to moderate.
Solanum melongena L. (Yalo)	Maturity (100-120 days), erect growth habit, drought tolerance, good resistant to insect pest, hairy leaves and stem, sweet flavor, both fruits and leaves are edible with, fruit

diameter 3-4 cm, prickliness non to slight, bitterness is; non to moderate.

Source: www.seedportal.org.ng (2015)

APPENDIX B

A

B

C

D

E F

Plate 1: Showing arrangements of eggplants varieties growing in the screenhouse of the Department of Crop Production School of Agriculture and Agricultural Technology, Federal University of Technology Gidan–Kwano Campus, Minna.

A = Two weeks old, B = Three weeks old, C = Four weeks old, D = Six weeks old

E = Flowering, and F= Fruiting

A B

C D

Plate 2: Showing harvested fruits of eggplants varieties grown in the screenhouse of the Department of Crop Production School of Agriculture and Agricultural Technology, Federal University of Technology Gidan–Kwano Campus, Minna..

Variety A is *Solanum eathiopicum* L. (Bello), Variety B is *Solanum gilo* L. (Green), Variety C is *Solanum macrocarpon* L. (White), and Variety D is *Solanum Melongena* L. (Yalo).