**INFLUENCE OF POST EMERGENCE HERBICIDES AND RATES ON THE GROWTH AND YIELD RESPONSE OF EGG PLANT (*Solanum melongena* L.)**

**A RESEARCH PROJECT**

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**SEPTEMBER, 2022**

**CHAPTER ONE**

**INTRODUCTION**

* 1. **Background of the Study**

Eggplant (*Solanum melongena* L.) is together with tomato among the most widely known vegetable of the Solanaceae family (Daunay, 2008). Eggplants (*Solanum melongena* L.) are thought to be derived from the wild African species, *Solanum incanum* (Daunay *et al.,* 2001).

Eggplants (*Solanum melongena* L.) were already domesticated in Southeast Asia, particularly in Northeast India and Southeast China more than 2000 years ago (Sekara *et al.,* 2007). Historical, morphological, and molecular evi­dence suggests that the Indochinese region is the primary center of diversity of *Solanum melongena* (Muñoz-Falcón *et al.,* 2009). The species was then introduced in Europe through Spain from where it spread to the other part of the World (Prohens *et al.,* 2005).

With an implanted surface of 1.8 million of ha, eggplant (*Solanum melongena* L.) world production is 46.6 million Ton (FAOSTAT, 2014). China and India are the major growing countries with 60% and 25% of the total volume respectively, followed by Iran (2.7%), Egypt (2.5%), Turkey (1.8%), Indonesia (1.1%), and Japan (0.7%) (FAO, 2016). Spain, Italy, and Greece concentrate most eggplant production in Europe. Eggplant world com­merce has shown a growing trend (FAO, 2016). In 2012, exports reached 440,000 Ton, the main contributors being Spain, Jordan, Mexico, the Netherlands and Syria, Germany, France, and the United Kingdom. U.S. production is not sufficient to cover the domestic demands and the country together with Russia, Canada, Iraq, and Italy accounts for 75% of global imports (FAOSTAT, 2014).

Eggplant (*Solanum melongena* L.) is identified as one of the most valuable vegetable packed with essential nutrients (Fukuoka *et al.,* 2010; Dar *et al.,* 2014). The eggplant is a delicate, tropical perennial often cultivated as a tender orhalf-hardy annual in temperate climates (Nunome *et al.,* 2001; Hirakawa *et al.,* 2014). It is being widely cultivated throughout the world in tropical and subtropical climates. Nutritionally, eggplant is low in fat, protein, and carbohydrates and also rich in dietary fiber, sugar, sodium and potassium (Fukuoka *et al.,* 2010). It also contains important vitamins like A, B6, C, D and calcium, iron and magnesium (Zhou *et al.,* 2012). Eggplant is used in the cuisine of many countries (Zhou *et al.,* 2012). It is also widely used in diets of West Africans (Nigeria) for making stew and sauce (Ubokudom *et al.,* 2010). Eggplant, due to its texture and bulk, can be used as a meat substitute in vegan and vegetarian cuisine. The juice of eggplant significantly reduces weight, plasma cholesterol levels, and aortic cholesterol content (Elanchezhyan *et al.,* 2008; Prabhu *et al.,* 2009; Chopra *et al.,* 2013; Hirakawa *et al.,* 2014).

Although, weeds pose most serious problem in eggplant (*Solanum melongena* L.) cultivation because of liberal use of farmyard manure, chemical fertilizers and frequent irrigations that help the weeds to grow vigorously (Sumeet *et al.,* 2017). It has been well established that losses from weeds accounts for 45 per cent more than when compared to insect, pest and diseases about 30 and 20 per cent, respectively (Rao, 1993).In most of the vegetables crops, the early growth period is the most critical stage at which stresses of any kind affects the economic yields. Weed competition is one such important stress during this period (Sumeet *et al.,* 2017). Besides, this period coincides with the season of peak labour activity leading to scarcity of labour for weeding. This adds to the already high costs of production (Sumeet *et al.,* 2017). So proper weed control method, therefore, is the prime need and very much essential to give herbicide usage its share to obtain maximum productivity in eggplant (*Solanum melongena* L.) production.

**1.2 Justification of the Study**

Where success of crop depends on many factors and effective weed management is one of most prior for a successful crop productivity. Favorable environmental conditions, proper spacing and liberal use of farmyard manure, chemical fertilizers and frequent irrigations encourage the weed in to grow vigorously and lead to severe weed competition particularly during early stages of eggplant (*Solanum melongena* L.) growth. It has been estimated that losses in yield due to weeds alone vary from 10 to 70% depending upon the extent of weed infestation (Mani *et al.,* 1968). It is difficult to control weed manually because of poor efficiency of the labour in summer and rainy season besides heavy cost of manual weeding. There seems to be good scope to make use of selective or post-emergence chemical (herbicides) control to attain season long control of weeds (Reddy *et al.,* 2000). The study is designed to investigate the feasibility of using different types of post-emergence herbicides and rates as a weed control approach considering the growth and yield response of eggplant (*Solanum melongena* L.).

* 1. **Objective of the Study**

The major objectives of this study are;

1. To determine the effect of Post Emergence Herbicides types on the yield and growth Response of Egg Plant
2. To determine the effect of Post Emergence Herbicides Rates on the yield and growth response of Egg Plant

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Origin and Distribution of Egg Plant (*Solanum melongena)***

Eggplant (*Solanum melongena L*.), also known as Aubergine, Brinjal or Guinea squash is one of the known vegetable and fruits in the world. The name ‘*eggplant’* currently refers to three crops belonging to the genus *Solanum*, sub-genus *Leptostemonum*, derived from the Old World: *Solanum melongena* L. (eggplant), *S. aethiopicum* L. (scarlet eggplant), and *S. macrocarpon* L. (Gboma eggplant). *Solanum aethiopicum* and *S. macrocarpon* are native to Africa, where they are grown locally for their edible fruits and young leaves (Macha 2005; Sękara *et al*. 2007; Caruso *et al*., 2017). The *Solanum melongena* complex exhibits a series of morphological intermediates, from small-fruited spiny plants to large fruited non-spiny plants. 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 (Raigón *et al*., 2008; Docimo *et al*., 2016).

Eggplant(*Solanum melongena* L.) is together with tomato among the most widely known edible fruits of the Solanaceae family (Daunay, 2008). Eggplants are thought to be derived from the wild African species, *Solanum incanum*. Eggplants were already domesticated in Southeast Asia, particularly in Northeast India and southeast China more than 2000 years ago (Sekara *et al.,* 2007). Historical, morphological, and molecular evi­dence suggests that the Indochinese region is the primary center of diversity of *S. melongena* (Muñoz-Falcón *et al.,* 2009). The species was then introduced in Europe through Spain from where it spread to the new World (Prohens *et al.,* 2005).

**2.2 Botany and Varieties of Egg Plant (*Solanum melongena)***

Eggplants have a strong and well-developed root system. The stem is 0.5–2 m tall and may often be spiny. Leaves are large (10–20 cm), lanceolate, and coarsely lobulated. Most varieties bloom in three to five flowers bunches. Flowers are large, white, or purple-white and have a five-lobed corolla and large anthers. Their long style difficult self-pollination, but the plant is mainly autogamous (Daunay *et al.,* 2001).

Some early cultivars having ovoid fruit are responsible for the name *“egg-plant.”* The berries require a period of 25–40 days to reach harvest maturity. In fully developed fruit, the calyx remains as accessory tissue. In contrast to other fruits in which growth and ripening are clearly delimited, eggplant expansion continues until advanced ripening stages (Daunay *et al.,* 2001). Remarkable variability in fruit color (white to green, yellow, purple, black, or striped), shape (ovoid, rounded, elongate, or pyri­form), and size (15–1500 g) is found among cultivars (Zaro *et al.*, 2014). The seeds are white or yellow and may keep their viability for 4–6 years (Sekara *et al.,* 2007). The edible portion includes the pulp placental tissue and seeds and in some preparations the peel (Zaro *et al.*, 2014). Different classifications have used to group eggplant varieties. Bradley (2017) identified three varietal groups: *S. m. var*. *esculentum* which comprises the commercially common forms with intermediate size, common aubergine, including white varieties, with many cultivars; *s. m. var.* *serpentinum* including varieties with very long fruit (snake aubergine), and *S. m. var.* *depressum* grouping genotypes with small fruit (dwarf aubergine). Other attributes used for classification eggplant are the pericarp color, the presence of spines in the calyx, and the fruit length covered by the calyx.

**2.3 Classification of Egg Plant (*Solanum melongena)***

Eggplant (*Solanum melongena)* is an Old World species, unlike other solanaceous crops which are native to the New World. However, like its Solanum relatives, tomato and pepper, eggplant is an autogamous diploid with 12 chromosomes. The fruit of the eggplant is botanically classified as a berry, and contains numerous edible soft seeds that are bitter because they contain nicotinoid alkaloids. Although the domestication history of eggplant has long been debated, according to the most accepted hypotheses, eggplants were first domesticated over 4000 years ago in South East Asia (Meyer *et al.,* 2012). The putative progenitor of eggplant, *S. insanum L.* is widespread in tropical Asia from Madagascar to the Philippines (Syfert *et al.,* 2016). India has been labelled the centre of diversity of varietal eggplant by some researchers (Fraikue, 2016). Cultivation of this crop then spread through Africa, the Near East and Europe.

Although there are several different eggplant species grown around the world, the one most commonly cultivated is *Solanum melongena.* Wild relatives of this eggplant species produce large spiny leaves and small, green, hard, egg-shaped fruits. *S. melongena* differs from its wild predecessors mostly in terms of fruit colour and shape. Ranging from dark purple to black, with some green and white varieties, the fruit of cultivated eggplant is larger than the wild type and more variable in shape. Some eggplant varieties have rounder (*S. melongena var. esculentum*) fruits whereas others have elongated *(S. melongena var. serpentinum*) fruits (Swarup, 1995). Two other agriculturally important species of eggplant are commonly grown and consumed in Africa: *Solanum aethiopicum* and *Solanum macrocarpon*. Unlike *S. melongena*, these species are grown for their nutritious leaves. *S. aethiopicum* is a shrub like plant with hairy or glabrous leaves. Based on leaf and fruit morphology and uses, *S. aethiopicum* is grouped into four accessions (Aculeatum, Gilo, Kumba, and Shum). The Gilo group is the most important group in the *S. aethiopicum* complex with its large and rounded edible fruits (Gramazio *et al.,* 2016). *S. macrocarpon* is grown solely for its large, glabrous leaves. It produces small yellow-orange fruits which are not edible (Macha, 2005).

Kingdom: *Plantae*

Order: *Solanales*

Family: *Solanaceae*

Genus: *Solanum*

Species: *Solanum melongena*

Binomial name: *Solanum melongena L.*

**2.4 Economic Importance of Egg Plant (*Solanum melongena)***

Eggplant is grown as an annual plant and is one of the most consumed fruit vegetables in tropical Africa; probably the third after tomato and onion, and before okra (Grubben and Denton, 2004). Although excessive rainfall affects both vegetative growth and flower formation, the plant is well adapted to both wet and dry season cultivation. In West Africa, the eggfruits are eaten when cooked or fried with spices in stews, or dried and pound as condiments (Fayemi, 1999). Eggplant is a highly valued delicacy in Nigerian society such that its importance cannot be overemphasized to consumers and farmers alike (Pessarakli *et al.,* 2003). The eggplant apart from being a source of vegetable also has numerous health benefits which are essential for the overall development of the human body. Its acceptability cuts across religion, tribal, cultural and ethnic groups in Nigeria, hence the wide usage of the garden eggplant (Ubokudom, *et al.,* 2010). Eggplant is grown during the dry and wet seasons and because of its relatively high yield, it is an important commodity in the local trade and a source of income to the farmers (Aliyu *et al.,* 1992).

Eggplant is a high-yielding crop and is well-adapted to hot and wet environments. Therefore it typically remains affordable while other vegetable crop prices increase. As a result, eggplant is an especially important source of nutrients in the diets of low-income consumers (Hanson *et al.,* 2006). Interest in this plant is growing rapidly because it is a good source of antioxidants (anthocyanins and phenolic acids), which are beneficial to human health (Gajewski *et al.,* 2009). Eggplant has also been used in traditional medicine to treat many diseases. For example, in parts of Asia, vegetative aerial parts of *S. americanum/nigrum* 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.

**2.5 Proximate and Nutritional Composition of Eggplant (*Solanum melongena)***

Eggplant is an important fruit and the fruit is rich in essential vitamins and minerals. Proximately, it contains 89.0g water, 1.4g protein, 1.0g fat, 8.0g carbohydrate, 1.5g cellulose, 130mg calcium, 105mg vitamin c and 1.6 mg Iron (Romain, 2001). Though the level of bioactive components in eggplant may depend on the cultivar (Zaro *et al.,* 2014), fruit proximate composition remains fairly constant across genotypes. Water is by far the most abundant components with more than 90% of the total fruit weight. Fiber is particularly abundant (3%) compared to other foods and even to other vegetable sources. Proteins and lipids are present at very low lev­els. The major sugars are glucose and fructose which range between 0.8% and 1.5%. Sucrose and maltose are present but in low concentration (Rodriguez *et al.,* 1999). Organic acids found at relatively low levels (*ca*. 0.1%) and are more abundant in the outer pulp (near to the peel) as opposed to sugars which are more prevalent in the inner flesh (Zaro *et al.,* 2014). As for other vegetables, eggplant has low energy density (25 and 19 calories per 100 g of raw and cooked fruit, respectively). The fruit has moderate levels of most vitamins and minerals but are relatively rich in potassium. The berries are low in sodium and have no cholesterol (Zaro *et al.,* 2014).

Similarly to other Solanaceous species, eggplants were at once believed to be poisonous due to the presence of steroidal glycoalkaloids. Recent studies have indicated that low intakes of some glycoal­kaloids may exert some potentially beneficial effects such as the inhibition of some types of cancerous cells and the formation of complexes with cholesterol (Mennella *et al.,* 2010; Sánchez-Mata *et al.,* 2010). Solasonine and solamargine, the main eggplants alkaloids are normally present at nontoxic concentra­tions (Mennella *et al.,* 2010), but may confer bitter taste (Sánchez-Mata *et al.,* 2010).

In the last years, eggplants have received higher interest due to their high levels of bioactive com­pounds. In a study evaluating the antioxidant capacity of different fresh vegetables, eggplants ranked within the top 10 (Derivi *et al.*, 2002). Eggplant extracts inhibited inflammation and radical-mediated pathogenesis, carcinogenesis, and atherosclerosis (Han *et al.,* 2003; Matsubara *et al.,* 2005). High egg­plant intake exerted hepatoprotective (Akanitapichat *et al.,* 2010) and hypolipidemic effects also reduced plasma glucose levels in rats (Derivi *et al.*, 2002).

**TABLE 2.1: Eggplant Nutritional Composition (per 100 g of Fresh and Raw Fruit)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Proximates** | | **Minerals (mg)** | | **Vitamins** | | **Lipids** | |
| Water (g) | 92.30 | Ca | 9.00 | Vitamin C (mg) | 2.20 | Saturated (g) | 0.03 |
| Energy (kcal) | 25.00 | Fe | 0.23 | Thiamin (mg) | 0.04 | Monounsaturated (g) | 0.02 |
| Protein (g) | 0.98 | Mg | 14.00 | Riboflavin (mg) | 0.04 | Polyunsaturated (g) | 0.08 |
| Total lipid (g) | 0.18 | P | 24.00 | Niacin (mg) | 0.65 | Cholesterol (mg) | 0.00 |
| Carbohydrate (g) | 5.88 | K | 229.00 | Vitamin B6 (mg) | 0.08 |
| Fiber (g) | 3.00 | Na | 2.00 | Folate (μg) | 22.00 |
| Total sugar (g) | 3.53 | Zn | 0.16 | Vitamin A (μg) | 1.00 |
|  | | | | Vitamin E (μg) | 0.30 |  | |
|  | | | | Vitamin K (μg) | 3.50 |  | |

*Source:* U.S. Department of Agriculture, Agricultural Research Service. (2013).

**2.6 Global Egg Plant Production Statistics**

With regards to the nutritional composition and health benefit of eggplant, it is deemed to receive global interest in terms of huge production capacity. With an implanted surface of 1.8 million of ha, eggplant world production is 46.6 million Ton (FAOSTAT, 2014). China and India are the major growing countries with 60% and 25% of the total volume respectively, followed by Iran (2.7%), Egypt (2.5%), Turkey (1.8%), Indonesia (1.1%), and Japan (0.7%). Spain, Italy, and Greece concentrate most eggplant production in Europe. Eggplant world com­merce has shown a growing trend. In 2012 exports reached 440,000 Ton, the main contributors being Spain, Jordan, Mexico, the Netherlands and Syria, Germany, France, and the United Kingdom. U.S. production is not sufficient to cover the domestic demands and the country together with Russia, Canada, Iraq, and Italy accounts for 75% of global imports (FAOSTAT, 2014).

According to FAO, 2016, 90% of eggplant production comes from only five countries. 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 ranks among the top five most important vegetable crops (Frary *et al*., 2007).

**2.7 Constraints of Eggplant Production in Nigeria**

The yield of eggplant in Nigeria is generally low due to the use of varieties that are of narrow genetic base which are grown on soils that are of inherent low fertility (Dauda *et al.*, 2003). The unimproved local cultivars commonly grown in the tropics with scanty plant stands, improper planting distance and lack of other improved agricultural inputs in the management of the crops has resulted in low yield (Law *et al.* 2009). However, in Nigeria, farmers get lower yield mainly due to the fact that eggplant is sensitive to a number of environmental stresses, especially extreme temperature, salinity, drought, excessive moisture and environmental pollution, improper planting distance, diseases and pests as well as weed infestation.

Under the climatic conditions in Nigeria, eggplant is infested by a number of insect pests, the most destructive of which is the eggplant shoot and fruit borer (ESFB, *Leucinodes orbonalis* Guen.). Despite heavy insecticide applications, significant yield losses occur on a regular basis (Ghosh *et al.,* 2003). Additionally, uncontrolled weed growth interferes with the growth eggplants and crop yields (Shivalingappa *et al.,* 2014).

**2.8 Ecological Requirement of Egg Plant (*Solanum melongena)***

Eggplant is a warm-season crop that requires 60–85 days for cycle completion. The plant needs a 10–12h photoperiod and performs best at relatively high temperatures (the optimum being around 23°C–26°C) (Sekara *et al.,* 2007). Thus, the crop is grown during the summer season. Eggplants are very sensitive to cool weather and do not perform well when exposed to low temperature. In cool seasons flowering, fer­tility, and fruit set are severely affected (Sekara *et al.,* 2007). At 10°C–12°C growth is arrested and flowering and fructification are markedly compromised (Sekara *et al.,* 2007). Well-drained sandy loam, loam, or clay loam soils having a good supply of organic matter and pH of 6.0–6.5 are best for growing eggplants. Plant spacing varies from 45 to 60 cm between plants, and 60 to 100 cm between rows depending on the cultivar and cultural practices (Sekara *et al.,* 2007).

**2.9 Agronomic Characteristics of Egg Plant (*Solanum melongena)***

Eggplant requires 60–85 days for cycle completion. Eggplants are planted in a variety of bed sizes that range from 40- to 60-inch centers. On narrower beds they are planted in one plant line per bed and on wider beds they are planted in one or two plant lines (Zaro *et al.,* 2014). Spacing is about 45 to 60 cm (18 to 24 in) between plants, depending on cultivar, and 60 to 90 cm (24 to 35 in) between rows, depending on the type of cultivation equipment being used (Mennella *et al.,* 2010). Mulching helps conserve moisture and prevent weeds and fungal diseases and the plants benefit from some shade during the hottest part of the day. Unfortunately, eggplant transplants are slow to establish and initially compete poorly with weeds. Weeds germinating during the first 6 to 8 weeks after transplanting can have serious consequences. After 8 to 10 weeks, the yield of eggplants is less affected by late-emerging weeds; however, weeds can interfere with harvest and produce weed seeds that can be troublesome in rotational crops (Sumeet *et al.,* 2017). Hand pollination by shaking the flowers improves the set of the first blossoms. Growers typically cut fruits from the vine just above the calyx owing to the somewhat woody stems. Flowers are complete, containing both female and male structures, and may be self- or cross-pollinated (Zaro *et al.,* 2014). Many of the pests and diseases that afflict other solanaceous plants, such as tomato, capsicum, and potato, are also troublesome to eggplants. For this reason, it should generally not be planted in areas previously occupied by its close relatives (Zaro *et al.,* 2014). However, since eggplants can be particularly susceptible to pests such as whiteflies, they are sometimes grown with slightly less susceptible plants, such as chili pepper, as a sacrificial trap crop. Four years should separate successive crops of eggplants to reduce pest pressure (Zaro *et al.,* 2014).

**2.9.1 Weed Management in Egg Plant**

Good weed control in eggplant begins the same as any other crop, before the crop is planted. Know the weeds that are a problem in the field. Control established perennials before planning to plant peppers in the field. Use cultural, mechanical, and chemical weed control techniques in a coordinated manor to reduce the risk of interference with the crop (Bradley, 2017). Choose herbicides that control the weeds in the field, apply the proper rate for the soil texture and organic matter in the field, and spray and incorporate herbicides to minimize the risk of crop injury and maximize weed control (Hembree, 2015). Several effective herbicides are registered for use in transplanted eggplant (Bradley, 2017). Each a slightly different spectrum of weeds, and has certain disadvantages.

Effective weed management in eggplants begins with proper field selection and identification of potential weed problems (Bradley, 2017). It involves pre-irrigation and cultivation, proper land and bed preparation, sanitation, and proper selection of herbicides (Hembree, 2015). When combined with good cultural practices, available herbicides can control many of the weed species that are found in eggplant fields. The choice of herbicide depends upon the weed species that are present and the cultural practices followed thereafter (Hembree, 2015).

***2.9.1.1 Pre-Emergence Herbicides***

Pre-emergence herbicides are applied to the soil and mechanically mixed with the soil or are irrigated into the soil before weeds emerge (Hembree, 2015). They are effective against germinating seeds before they germinate; these materials usually give some residual control of 3-6 months. Herbicides work best if they are applied when soil moisture is adequate for plant growth. Pre-emergence herbicides are effective against germinating seeds, not dry seeds (Bradley, 2017). Pre-emergence herbicides are not to be applied on wet soils, as compaction can occur (Hembree, 2015).

***2.9.1.2 Post-Emergence Herbicides***

Post-emergence herbicides are sprayed onto the foliage of the weeds after they have emerged (Hembree, 2015). Certain post-emergence herbicides are systemic, selective and are absorbed by the leaves and stems of the weeds and translocated in the plant. Other post-emergence herbicides are strictly contact and only kill the leaves/plants they come in contact with (Bradley, 2017). Post-emergence herbicides work best on non-stressed plants, which absorb and translocate the material more readily than stressed plants (Hembree, 2015). Some common examples of post-emergence and it trade name include:

* Sethoxydim - *Trade name: Poast®,*
* Clethodim - *Trade name: SelectMax®*
* Halosulfuron - *Trade name: Sandea®*
* Bentazon - *Trade name: Basagran®*

*Source; Greg and Beth (2019).*

**2.9.2 Effect of Post-Emergence Herbicides and Rates on Egg Plant Yield and Growth**

The productivity of any crop depends on many factors and effective weed management is one of most prior for a successful crop. Favorable environmental conditions, proper spacing and liberal use of farmyard manure, chemical fertilizers and frequent irrigations encourage the weeds to grow vigorously and lead to severe weed competition particularly during early stages of its growth (Hembree, 2015). It has been estimated that losses in yield due to weeds alone vary from 10 to 70% depending upon the extent of weed infestation (Mani *et al.,* 1968). It is difficult to control manually because of poor efficiency of the labour in summer and rainy season besides heavy cost of manual weeding. There seems to be good scope to make use of selective chemical and cultural control to attain season long control (Hembree, 2015).

According to Marque *et al.,* (2017), in his study with major weeds found in the eggplant cultivar were; *Eleusine indica*, *Portulaca oleracea,* and *Cyperus rotundus*. And he reported that coexistence between the weed community and the eggplant throughout the entire crop production cycle reduced eggplant fruit yield by 78%.

Sumeet *et al.,* (2017) reported that the treatment comprising with post-emergence application of paraquat @ 0.15 kg/ha at 45 days after transplanting (DAT) showed better result than other treatment (mulching) with yield of 96.72% and this findings was similar to Nadagouda, (1995).

Shivalingappa *et al.,* (2014) also revealed that pendimethalin @ 1.5 kg a.i. ha-1 had more significant effect among treatments which results less number of weeds, less dry weight (g), high weed control efficiency (WCE %), and increased in morphological, biochemical parameters, yield attributes while comparing with all the treatments at 30, 60, 90, 120 DAT followed by pendimethalin @ 1.0 kg a.i. ha-1

**CHAPTER THREE**

**MATERIALS AND METHODS**

**3.1 Study Area**

This study will be carried out at the teaching and research farm of faculty of agriculture, Akwa Ibom State University. Obio Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State. The area lies between latitude 4030’N and 50 00’N and longitudes 700 30’E and 800 00’E (SLUS-AK, 1989). It records annual rainfall of about 2500mm. the rainfall lasts between April and November usually with a break in august which last for about 2 weeks (termed august break). Temperature range is between 22.5-30.7OC. The relative humidity is about 78%. The soil is sandy loam (SLUS-AK, 1989).

**3.2 Experimental Design and Treatments**

The experiment will be laid out in a randomized complete block design (RCBD) with four treatments and two replications. Each sub-plot measured of 3m X 8m and consisted of 2 rows as shown in figure 1, having a net plot of 2m x 5m and maximum 4m x 15 m.

The herbicides types to be used will be; starforce and bentazon in the rates of 0.0, 1.0, 2.0, 3.0 kga.iha-1

**Bentazon Starforce**

**8m 8m**

**3m 0 1 2 3 1 0 3 2**

**Starforce Bentazon**

**3m**

**Bentazon Starforce**

**3m**

**Starforce Bentazon**

**3m**

**Figure 1: The Layout of the Experimental Treatments and Design**

**3.3 Soil Sampling**

Prior to planting the soil will be randomly sampled at the depth of 0.15cm at three different location or spots in the area. The soil samples will be bulked together to obtain a representative sample, the representative sample will be air dried and sieved with 2mm sieve before being taken to the laboratory for analysis.

**3.4 Agronomic Practices**

**3.4.1 Land Preparation**

The field will be cleared manually using cutlass and tilled with spade. Stumping (if any) and beds making will also done manually through the use of spade.

**3.4.2 Planting**

Planting material will be done using eggplant seeds.

**3.4.3 Fertilizer application**

Organic manure in the form of poultry dung will be used alongside Compound Fertilizer (N: P: K 15:15:20) will be applied at the rate of 50 g/vine (500 kg/ha) by ring application, 4 weeks after planting.

**3.4.4 Weeding**

Removal of unwanted plants or weed will be done by application of post-emergence herbicides (starforce and bentazon) at the rates of 0, 1.0, 2.0 and 3.0 kg a.i. ha-1

**3.4.5 Harvesting**

Harvesting will be done manually using sharp knife at 30, 45 and 60 days intervals.

**3.5 Data collection**

**3.5.1 Growth Parameters**

* **Plant height (cm)**

The plant height will be measured from the base of the plant to the terminal growing point of the main stem at 30, 60, 90, 120 days after transplant. The average plant height will be worked out and expressed in centimeters.

* **Number of leaves per plant**

The number of leaves per plant will be measured at 30, 60, 90, 120 days after transplant for three rows plants and then mean will worked out.

* **Number of branches per plant**

The number of branches per plant at 30, 60, 90, 120 days after transplant will be counted for three rows plants and then mean calculated.

**3.5.2 Yield Parameters**

* **Total number of fruits**

The total numbers of fruits from three tagged plants will be counted in all the pickings and the average total numbers of fruits plant-1 for the each treatment will be worked out.

* **Fruit weight (g /fruit)**

Five numbers of fruits from each treatment will be weighed and worked out for single fruit weight and expressed in grams.

* **Fruit yield (t/ha)**

The fresh fruit yield from the net plot area will be taken to calculate the unit yield per hectare.

**3.6 Statistical Analysis and Interpretation of Data**

The data on various parameters were subjected to Fischer‟s method of analysis of variance and interpretation of data was done as described by Gomez and Gomez (1984).The level of significance used in F‟ and t-test was 0.05. Critical difference (CD) values were calculated whenever the F-test was significant.

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