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EFFICACY OF NEEM OILS IN THE MANAGEMENT OF OKRA FLEA BEETLE (*PODAGRICA* SPP), IN THE RAINFOREST, ZONE OF SOUTH EASTERN, NIGERIA.

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ABSTRACT

Investigations on the efficacy of Neem parts in controlling okra leaf beetles (*Podagrica uniforma* and *Podagrica sjostedti*) were carried out between the months of May to August, 2009. Treatments comprised of ripe seeds oil, unripe seed oil, neem leaf oil and control which were laid down in Randomized Complete Block Design (RCBD) with four replications. Results showed that the application of neem seed oil affected the populations of *Podagrica* species (7.25 *Podagrica* spp/plant) when compared with unripe neem seed oil (9.19 *Podagrica* spp/plant), neem leaf oil (10.56 *Podagrica* spp/plant), and control (24.44 *Podagrica* spp/plant). On the average, 12% damage to leaves and pods were observed in ripe neem seed oil plots compared with 52.60% damage in control plots. With respect to yield parameters, more green pod per plant (5.50g) and overall green pod yield of 367.00 kg ha^{-1} were recorded in neem seed oil treated okra plants compared with other neem plant parts and control with 54.00 kg ha^{-1}. However, other neem plant parts yielded green pods much well than control. Thus ripe neem seed oil could be used as an alternative biopesticide for flea beetle control in okra farms by farmers. However, further investigations are on going to determine the appropriate rate and admixture of crude extract of neem seed oil with other biopesticides for adequate management of okra pests in rainforest zone of Owerri, Imo State, Nigeria.

Keywords: Okra, flea beetles, population, leaf damage, neem oils, extract, green pod yield

1. INTRODUCTION

Okra (*Abelmoschus esculentus* (L.), Moench), belongs to the family, (Naveed *et al*., 2009). This crop is one of the most widely known and utilized species of the family Malvaceae (Naveed *et al*., 2009). It is an important annual vegetable crop widely grown in the tropics and sub tropics for its tender fresh pods that are rich in vitamins and minerals (Oyelade *et al*., 2003; Andras *et al*., 2005; Saifullah & Rabbani, 2009). Okra is a tropics and subtropics vegetable crop cultivated for its immature edible green fruits, which are used as vegetable both in green and dried state (Arapitsas, 2008). In Nigeria, leaves, buds and flowers areedible, and is grown essentially for its green pods (Ayuk, 1997. Okra plant is grown both during the rainy season as well as in the dry season under irrigation (Ayuk, 1997). Okra is predominantly produced by peasant farmers' usually in home gardens or in mixture with other cereal crop (Lombin *et al*. 1988). Okra can be prepared in a variety of ways. The young pods are thinly sliced for preparation of okra soup for use with foofoo. The fibrous pods and fresh pods are dried and then ground into powder, which is then used for thickening soup/stew. Regular nosebleeds, bleeding gums, heavy menstrual bleeding, or easy bruisingresults from low level of blood cells (Bakre and Jaiyeoba, 2009).

Addition of more vitamin K-rich foods like okra to diets helps improve blood's ability to coagulate (Bakre and Jaiyeoba, 2009).

Okra is used to improve heart health. The soluble fiber within okra helps to reduce serum cholesterol and therefore decreases the chances of cardiovascular disease (Ngoc *et al*., 2008).

Ngoc *et al*., (2008) maintained that consuming okra is an efficient method to manage the body's cholesterol level. Additionally, okra is loaded with pectin that can help in reducing high blood cholesterol simply by modifying the production of bile within the intestines (Ngoc *et al.*, 2008). Rehn and Espig (1991) earlier stated that okra contains about 20% edible oil and protein, while its mucilage is utilized for medicinal purposes. Okra flowers can be very attractive and sometimes used in decorating the living room (Schippers, 2000).

Okra is susceptible to many agricultural pests and more vulnerable to *Podagrica* spp, which make extensive circular holes on the leaves, causing reduction in the leaf area, photosynthetic vigour, and yield of the okra plant. Literature has revealed about 10,000 species of insects some of which are agricultural pests of okra (Hill & Walker, 1982). Majority of the pests attacking okra include members of the order Coleoptera, Heteroptera, Homoptera and Lepidoptera (NRC, 1992). Insects' damage on okra may range from defoliation and deformation of leaves and fruits by the larvae and adult insects, to the destruction of the flowers, stalks and roots, which create entry points for fungal, bacterial and viral pathogens.

Synthetic insecticides have been used for controlling okra pests, especially *Podagrica* spp, but regrettably, insecticides cause a lot of health hazards to the applicator, consumers and the environment. Synthetic pesticides are most often implicated in poisonings, injuries, and illnesses according to 1996 data from the American Association of Poison Control centers (Brett, 2015). Epidemological studies of organophosphates exposed populations show lympholmas in grain workers, lymphomas in resin workers, (Newcombe *et al.* 1994). Also Nwecombe *et al.* (1994), and American Chemical Society, (1994) suggest that organophosphorus induced chromosomal aberrations, immune dysfunction, suppression of natural killer (NK) cell activity and cytotoxic T lymphocytes(CTL) activities were reported to be due to organophosphorus exposure.

In 2013, U.S. poison centers answered more than 3.1 million calls, including approximately 2.2 million calls concerning human exposures to poisons. Just under half of all exposure cases managed by poison centers involved children younger than six, but as in previous years the more serious cases occurred in adolescents and adults (Brett, 2015)

It is also unfortunate that insecticides whose use have been banned or heavily restricted in the United States of America and Europe because of their danger, easily find their way into Nigeria and other African countries through ministries of agriculture, Research liaison Services, and agro-chemical dealers (Alkoili, 1989). The vast majority of the deaths therefore occur in developing countries, like Africa, Asia and Latin America. In Kenya alone the ministry of health reported 700 pesticide related deaths a year. In Bangladesh Ramaswamy (1992) also reported that 6948 metric tones of pesticides were marketed by private pesticides dealers between 1990 to 1991 representing 18% of the annual increase which was viewed as alarming. Besides health risks chemical insecticides have other disadvantages. They pollute water supplies, kill beneficial insects along with pests and they are also very expensive (Nandy, 1996; Haslam, 1991). A focus of many past conservative efforts has been to seek more selective pesticides or to time the use of pesticides to minimize their negative impacts to natural enemies. The use of insecticides not only increases cost of production but also causes environmental pollution and human health hazards (Kabil *et al.*1996; Rashid *et al.* 2003), develop the pest resistance, (Forrester, 1990; Ekesi, 1999), and also destroy natural enemies (Ulriches *et al.* 2001). Sometimes persistent pesticides accumulate in the higher food chain of both wildlife and human and become concentrated by biomagnifications (Senapati, *et al.* 1992)

Okra consumers complain of hazards associated with the use of synthetic pesticides and therefore this problem initiated research on the use of alternative pesticides (bio-pesticides) for the control of flea beetles. Earlier, Nas, (2004), reported that as a result of health hazards, undesirable side effects and environmental pollution caused by the continuous use of synthetic chemicals, there is a renewed interest in the application of botanical pesticides for crop protection. Many researchers studied the insecticidal action of plant materials (Dialoke *et al*., 2014; Akhaauri and Yadav, 2002; Prajapati *et al*. 2003; Oparaeke *et al*. 2005). Botanical pesticides are unique because they can be easily produced by farmers and small industries (Roy, 2005). Bio-pesticides are important group of pesticides that can reduce pesticides risks, because they are natural pesticides, derived from plants and other biological systems in nature. They are safer to humans and the environment than conventional pesticides. They do not have residual effects. One of such plants is neem plants which contain an active ingredient Azadirachtin and offers good protection against field and storage pests. Schmutterer (1990, 1995 and 2002) reported that extracts of neem tree at concentrations ranging from 0.1-1.0 ppm controlled insects that developed resistance to chemical pesticides. The effectiveness of neem seed kernel extract (NSKE) was also reported against *Aphis gossypii* Glover by Mishra and Mishra 2002:; and Madathir and Basedow, 2004)

Neem extracts are cheap and available to resource poor farmers. Farmers in Owerri locality have little knowledge of the use of neem plants for the control of *Podagrica* spp. This research was therefore initiated to examine the effectiveness of oil from neem plant parts in controlling okra flea beetles in Imo state, Nigeria.

2. MATERIALS AND METHODS

2.1 Site Selection

The experiment was carried out at the Department of Crop Science and Technology, Teaching and Research farms, Federal University of Technology Owerri, (FUTO) Imo state in first week of 2009 growing season. The State lies on latitude of 5^0 27^N and longitude 7^0 12^E. The experiment started from 1st week of May and finished by the end of August, 2009

a. Preparation and extraction of oil from neem plant parts

The neem plant parts weighing 900 g of ripe neem seeds, 900 g of unripe neem seeds, and 350 g of neem leaves were harvested from neem tree abundant in Federal University of Technology Owerri (FUTO) school compound and air dried in the Departmental farm house to avoid direct contact with ultraviolet rays. The neem parts were oven dried at 60°C for 12 hours to stabilize the moisture contents. Prior to extraction, the air dried neem moisture stabilized plant parts were crushed separately in mortar and pestle and put in different containers. The extraction of oil from neem plant parts were carried out at the Department of Crop Science and Technology, Teaching and Research laboratory in March 2009 following methods outline by Oparaeke *et al*. 2005.

From the whole lot of crushed ripe seeds and unripe seeds, one hundred grams (100g) of each sample were weighed with a sensitive weighing balance and put into two separate litres specimen bottles containing petroleum spirit (solvent), while 150 g of the crushed leaves with another mortar were also put into another specimen bottle containing the solvent. These mixtures were shaken thoroughly for two (2) hours using a laboratory instrument called reciprocating shaker and the solutions put into a thimble instrument and oil extracted with the use of thermal soxhlet apparatus. The oil extracts were air-dried to remove traces of the solvent. The extracted oils were put in separate plastic containers with tight lids and stored in a refrigerator at 4-10°C prior to use.

2.3 Land preparation

A land area measuring 12 m by 18 m (216 m^2) was cleared and stumps removed. The field was marked out into four blocks. Each block contained four plots with each plot measuring 1.5 m × 3.0 m. The blocks and plots were separated by 2.0 m pathways. The variety of okra used was Clemson's spineless. There were five (5) rows of okra per plot. Two seeds of okra were planted per hole at the spacing of 30 cm within and 30 cm between rows and later thinned down to one plant per hole to give a total of 50 plants per plot.

2.4 Sterilization of poultry manure

The manure used was fully composed for 30 days and later put in drum and heated under firewood for 40 minutes. To each of the plots, 5 kg of sterilized poultry droppings were admixed with soil to help raise the level of soil fertility.

2.5 Treatments and Experimental design

There were four treatments comprising ripped neem seed oil (RNSO), unripe neem seed oil (URNSO), neem leaf oil (NLO) and zero neem oil as control. The experiment was laid down in randomized complete block design (RCBD) with four replications. One level of concentration of neem parts per litre of water was used in this experiment. Hence, seven mililitres of oil per one litre of water was prepared from each part of neem and applied to the flea beetles (*Podagrica* spp) infested okra as treatment. Treatments were applied at seven days interval for four weeks and data taken were as listed below.

2.6 Observations

The following observations were made during the research .These includes:

(a) **Insect count:**
Flea beetles physically present on randomly selected six okra plants (three plants each from the two outer borders per plot) were counted visually. This count started from seven days after planting and continued at weekly interval till 100% green pod maturity (harvesting stage: before the fibrous tissue becomes thick).

(b) **Number of leaf damage per plant**
In a plot, ten plants (five plants each from two border rows) were used to assess the number of leaves with holes and cuts due to damage by the beetles.

(c) **Number of green pods per plant**
The three middle rows from each plot were used to assess the number of pods per plant.

(d) **Green pod yield (kg^{-1})**
Before the fibrous tissue becomes thick, three middle rows were harvested, weighed and recorded for green pod assessment.

2.7 Analysis of data

Podagrica spp counts and leaf damage were subjected to square root transformation before analyses of variance were carried out. Separation of means for statistical significance was by the use of Least Significance Difference (LSD) at 5 % probability level as outlined by Obi (1 986).

3. RESULTS AND DISCUSSION

The result in Figure 1, shows the population trend of flea beetles on okra plants treated with neem oils from seven days after planting till 100 percent maturity. The population of flea beetles in the plots treated with ripe neem seed oil was at minimal of 7.25 *Podagrica* spp per plant compared with control (24.44 *Podagrica* spp per plant, neem leaves (10.56 *Podagrica* spp per plant) and unripe neem seed oil (9.19 *Podagrica* spp per plant). This result suggests the efficacy of the active ingredients azadirachtin, melean triols and salannin contained in the neem plant particularly the ripe seeds (Drew, (1992). The efficacy may have to do with repelling activities of the active ingredients when sprayed on the crops. This result agrees with the earlier research performed by National Research Council, (1992). The damage in the form of circular holes and cuts was also significant, at $P<0.05$. From the result, the ripe seed oil was more efficacious in controlling the damage by okra leaf beetles. Ripe neem seed oil controlled flea beetles from damage on okra leaves and this agrees with reports from Emosairue & Ubana (1996), Emosairue & Ukeh (1996) who equally reported the effects of neem seed extracts on flea beetles destroying okra leaves. Various insect pests identified in the field include, flea beetles, grasshoppers, white flies, aphids, *Dysdercus superstitious* (Volkeri Fabr) (NRC, 1992).

From Table 1, the result also revealed that okra green pod production was significantly ($P<0.05$) higher in plants growing on the plots treated with ripe neem seed oil compared to the untreated plots. Spraying of ripe neem seed oil gave a yield of 5.5 g of green pods per plant, and overall green pod yield of 367 kg ha^{-1} compared with the control that yielded 0.81g per plant and 54 kg ha^{-1} overall yield respectively. The negligible damage to the leaves suggests the insecticidal and repellent action of the active ingredient which acted and reduced the population of the flea beetles. This invariably led to high green pod yield of okra as okra flowers were spared to develop into pods. The promising effect of ripe neem seed oil against *Podagrica* spp on okra plants which in turn increased the green pod yield (367 kg ha^{-1}) in this present study agrees with the finding of Mudathir and Basedow, (2004) and Pun *et al.* (2005). The active ingredients do not kill the flea beetles immediately, but inhibit their feeding, repel and disrupt their growth and reproduction (Drew, (1992).

4. CONCLUSION

Neem plants are abundant in the tropical environment, mainly used as wind breaks and provide shade against soil erosion. Its usage as a bio-pesticide has not received much attention by farmers in Owerri, Agro-ecological zone, Nigeria. The oil from the ripe seeds has been found to possess strong anti-feedant properties and could therefore be used as an alternative bio-pesticide by farmers in Owerri, and the entire region of Nigeria, in view of its availability, low cost and safety to humans and environment.

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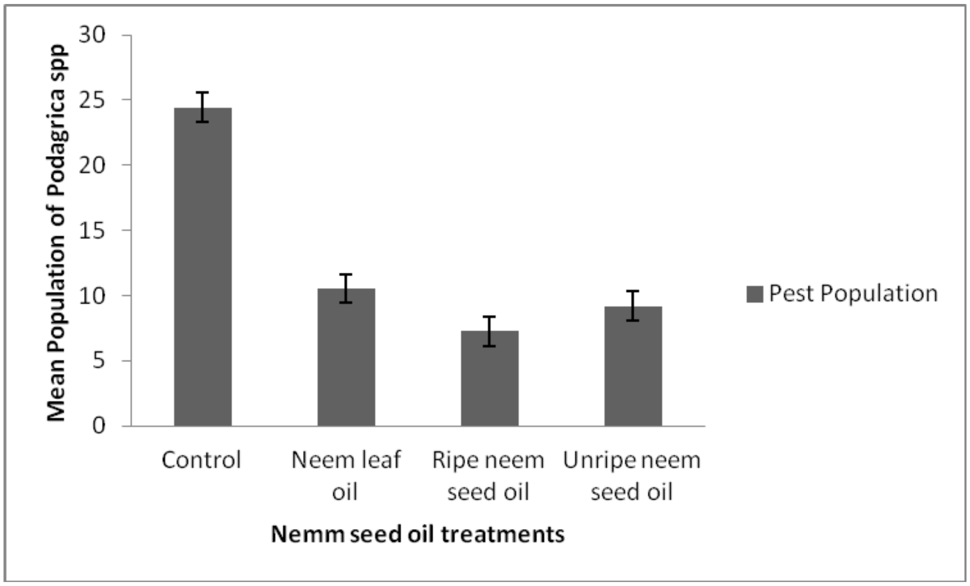

Figure 1: Effect of neem plant parts extract on the population of *Podagrica spp*. per plant. Bars represent LSD ($P<0.05$).

Table 1: Effect of neem oil on the population of *Podagrica* spp, damage and yield (kg ha^{-1}) of okra (*Abelmoschus esculentus*) in Owerri, Imo State.

Treatments	**Leaf damage by *Podagrica spp* per plant**	**Green pod yield (g) per plant**	**Green pod yield (kg ha^{-1})**
Control	52.60	0.81	54.00
Neem leaf oil	28.80	1.81	121.00
Ripe neem seed oil	12.00	5.50	367.00
Unripe neem seed oil	17.70	2.62	147.00
LSD 0.05	7.72	0.86	58.50
SE	10.9	1.22	82.20
CV (%)	39.3	45.5	48.0

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