Available online at www.elixirpublishers.com (Elixir International Journal)

Entomology

Elixir Entomology 94 (2016) 40302-40306

ISSN: 2229-712X

Field Evalutation of Selected Plant Extracts Formulation against Foliage Beetles of Okra (*Abelmoschus esculentus* Moench)

Olaniran, O.A[1], Yusuf, S.Y[2], Adebayo, T.A[1] and Alao, F.O[1,*]

[1]Department of Crop and Environmental Protection,Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.
[2]Department of Crop Protection, University of Ilorin, Kwara State, Nigeria.

ARTICLE INFO

Article history:
Received: 25 March 2016;
Received in revised form:
6 May 2016;
Accepted: 12 May 2016;

Keywords
Podagrica spp,
Zonocerus variegatus,
Okra,
Annona squamosa,
Moringa.

ABSTRACT

This experiment was conducted to determine the potential of formulated *Annona squamosa* (Linn) and *Moringa oleifera* (Lam) against *Podagrica* species (jacoby) and *Zonocerus variegatus* (Loew) of okra during the major planting season of 2013 and 2014. The experiment was set up in a Randomized Complete Block Design and each treatment was replicated three times. The paste was separately mixed with Texapol, Nitrosol, Black soap and Salt at different proportion. The solution collected was stored in a 5-littre keg for further use. The result revealed that the formulated extracts had significant effect in all the tested parameters when compared with unprotected plants. Ethanolic plant extracts had higher insecticidal efficacy (36.1 to 46.9%) than Acetonic extracts which had the efficacy ranging from 18.4 to 29.3%. The yield obtained from ethanolic plant extracts treated plots was two times that of Acetonic extracts. The solution was stored at a room temperature for three months without being fermented. Therefore, these plant extracts can be used in the management of insect pests of okra especially in organic farming system.

Introduction

Okra (*Abelmoschus esculentus L.* Moench) belongs to the family of Malvaceae related to hibiscus and cotton [15]. It is widely cultivated vegetable [30, 31]. It is grown as annual or biannual crop. Basically, okra is a tropical to subtropical crop and is responsive to frost temperature, drought and water logging conditions. However, the cultivars from different geographical region have adapted distinctive character specific to the area where they are grown [15].

Okra contains vitamins A, B complex and C. it is rich in iron and calcium and is higher than many vegetables in thiamin, riboflavin and niacin. [26].The stem can be used in making rope and paper, while the young pod is used in cooking soup [14, 28]. The foliage provides a good source of fodder to livestock [3].

Insect pest infestation has been a major setback for the productivity of many crops all over the world. The available literature has shown that insect pests cause major damage to the foliage and fruits of plants as well as the stems [9] these forms of damage had resulted to an increase in the poor yield of various crop plants, okra is not an exceptional.

One of the major constraints to the cultivation of okra in Nigeria is high insect pest infestations [5, 9]. Large number of insect attack okra leaves and fruits namely*: Podagrica spp, Bemisia tabaci, Zonocerus variegatus, Aphis gossypii, Dysdercus superstitiosus* [11, 34]. *Podagrica spp.* not only cause direct damage to okra plants but also serves as vector of okra mosaic virus [3, 33]. It has also being implicated to have caused premature falling of pods [4]. White flies (*Bemisia tabaci)* Jassids (*Empoasca lubica)* and Aphid (*Aphis gossypii*) attack okra pod and flowers. They are primary target of spiny boll worm (*Earias insulanaa*) while the caterpillar of the American boll worm (*Heliothis armigera*) prefers the reproduction parts of the plants including buds, flowers and fruits [5].

In view of the destructive potential of the aforementioned insect pests, control becomes imperative. The use of synthetic insecticides has become a common practice in developing countries due to their quick effectiveness [6] but most of these synthetic insecticides have been implicated to have caused environmental hazard, insect pest resistance and resurgence and some have been proved as carcinogenic. These problems have resuscitated the old idea of using plant extracts [7]. Botanical insecticides are naturally occurring chemicals extracted from plants and are available as an alternative to synthetic chemical formulations but they are not necessary less toxic to human (16). Botanical insecticides break down readily in the soil and are not stored in plant or animals tissue (23).

Moringa oleifera (Horseradish) tree is a pan-tropical species that is known by such regional names as benzolive, drumstick tree, kelor, marango, saijhan and sajna [13]. *M. oleifera* can be grown in a variety of soil conditions preferring well-drained sandy or loamy soil that is slightly alkaline (1-8). The main constituents of Moringa plant are deic, palmitic and stearic acid, saponins, glycoside, gum, protein, vitamins: A (8855iuper 100g), B1, B2, B3, C, Minerals: calcium, iron, phosphorus, magnesium (8, 22, 23). The medicinal effect of the plant was ascribed to their possession of anti-oxidants, which are known to suppress formation of reactive oxygen species and free radicals [26, 31]. *Annona squamosa* is commonly known as Sitaphal, sweetsop, and Custard Apple, is a native of West Indies and is cultivated throughout India, mainly for its edible fruit.

Leatemia and Isman [19] reported that plant parts of some species of this family have been used traditionally as insecticides.

Tele:
E-mail address: foalao@lautech..edu..ng

Powdered seeds and leaves of Annona have been used traditionally to treat head and body lice [25] antimicrobial and insecticidal activities have already been reported in leaves, stems and seeds of this plant species [24].

This research work was therefore conducted to determine the effectiveness of *A. squamosa* and *M. oleifera* in the control of leaf-feeding beetles of okra.

Materials and Method

Study Site: The field experiment was conducted in the cropping season of 2013 and 2014 at Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm, Ogbomoso, Oyo state. This region is on longitude $4^0$3'E and latitude $10^0$5'N. The region can be described as humid tropical falls in Southern Guinea Savannah of Nigeria.

Experimental Design and Management

Experimental land were ploughed and harrowed once. Eighteen plots were arranged and demarcated in a Randomized Completed Block Design with three replicates. The plot size was 2 m x 2 m with a planting space of 0.5 m x 0.5 m between and within the plant rows respectively. Two to four seeds of okra variety (NH47-4) were planted per hole which was later thinned to one plant per stand after two weeks of planting. Manual weeding was done fortnightly.

Formulation of Botanical insecticides

The leaves and seed of *M. oleifera* and *A. squamosa* respectively were washed to remove sand, dust and chemical contaminants, the plant extracts were dried to reduce the moisture content. Each of the plant was crushed with electric blender and it was later soaked in a 10- litre bucket for 12 hours. Ethanol and Acetone were used as extracting agents, this was done separately. Filtration was done with muslin cloth and filtrate collected was stored in a 10-litre keg. Each of the filtrate was loaded into the steam water bath for 24hours in other to evaporate the solvents. The paste or the residue collected was stored separately in a refrigerator which was used as an active ingredient in the formulation of botanical insecticide.

The 33.3% of active ingredient (paste) was separately diluted with adjuvant substances such as Texapon (11.11%), Nitrosol (22.22%), Salt (22.22%) and Black soap (11.11%). Hence, the mixture was equivalent to 100 ml. the unsprayed plots and synthetic insecticide (karate) which was treated at 0.5 ml per plot were included for comparison. Each concentration of both synthetic and botanical insecticides was diluted with 1000 ml of water to achieve the same spraying volume.

Treatment Application

100 ml was measured from stock solution which was later diluted with 900 ml of water. Foliar application was done with hand-held sprayer (2-litre capacity) and ensured it had contact with target crop as well as insect pests. The spraying was done early in the morning to avoid photo degradation of the extracts. Some plots were left unsprayed to serve as control. Four -weekly application was done at seven days interval

Data Collection

Data were collected on insect population densities and collections were done early in the morning by visual observation. The physiological data collected were based on number of plant heights, percentage defoliated leaves, damaged fruit per plot and yield was calculated in kg/ha which was later converted to ton per hectare (t/ha).

Data Analysis

The data collected were subjected to Analysis of variance (ANOVA) and significant means were separated with Ducan multiple range text at 5% probability level

Results

The result presented in Table 1 clearly showed that Ethanoic *A. squamosa* extract significantly controlled *P. sjostedtii* when compared with Acetonic *A. squamosa* at 1WAT. Similarly, significant lower *P. sjostedtii* infestation was observed in the ethanolic *M. oleifera* than Acetonic *M. oleifera* at 1WAT. However, none of the tested plants extract was significantly effective as Lamdacyhalothrin. At 2WAT, significant difference was not detected among plants extract treated plants, this observation was similar to what was observed at the 3WAT. Ethanolic *M. oleifera* and *A. squamosa* significantly protected the okra plants when compared with Acetonic *M. oleifera* and *A. squamosa* treated plants at 4WAT. However, all the plant extracts irrespective of the organic solvents exhibited significant insecticidal action against *P. sjostedtii* when compared with unprotected plants.

Table 1. Effect of botanical insecticides on Podagrica sjostedtii population on okra.

	Weeks After treatment				
Treatments	**1**	**2**	**3**	**4**	**Efficacy**
Control	4.36^a	4.67^a	7.31^a	4.77^a	
Acetonic Annona squamosa	3.92^{ab}	3.43^b	5.64^b	4.44^{ab}	17.43
Acetonic Moringa oleifera	2.91^{ab}	3.39^b	5.16^b	3.46^{bc}	29.32
Ethanolic Moringa oleifera	2.67^b	3.03^b	4.63^b	3.17^c	36.05
Ethanolic Annona squamosa	2.52^b	2.81^b	4.53^b	2.79^c	40.08
Lambdacyalothrin	0.71^c	0.71^c	2.85^c	1.34^d	73.42

Means with the same alphabet(s) along the column are not significantly different.

Insecticidal efficacy of Acetonic *M. oleifera* and Ethanolic *M. oliefera* was significantly similar in the control of *P. uniformis* but insecticidal potential of Ethanolic *A. squamosa* significantly had lower *P. uniformis* infestations than plants sprayed with Acetonic *A. squamosa* at 1WAT (Table 2). Meanwhile, Ethanolic *M. oleifera* and *A. squamosa* extracts had more insecticidal activities than Acetonic *A. squamosa* and *M. oleifera* at 2WAT. Significant difference was not observed among the plants extracts at 3WAT (Table 2). Meanwhile, there was no significant difference in the insecticidal potential of Ethanolic and Acetonic *M. oleifera* in the control *P. uniformis* at 4WAT. Among the botanical insecticides, plots treated with Ethanolic *A. squamosa* extracts had the least *P. uniformis* infestations but none of the plant extract compete effectively with Lambdacyhalothrin at 4WAT (Table 2).

Table 2. Effect of botanical insecticides on *Podagrica uniformis* population on okra.

	Weeks After treatment				
Treatments	**1**	**2**	**3**	**4**	**Efficacy**
Control	4.94^a	5.67^a	6.12^a	4.52^a	
Acetonic Annona squamosa	4.45^a	3.13^b	4.72^b	3.54^b	25.46
Acetonic Moringa	3.01^b	2.72^b	4.52^b	3.29^{bc}	36.28

oleifera	2.96^{b}	2.26^{bc}	4.45^{b}	2.85^{bc}	41.08
Ethanolic Moringa oleifera	2.90^{b}	1.56^{cd}	4.04^{b}	2.78^{c}	46.92
Ethanolic Annona squamosa	0.71^{c}	0.71^{d}	0.71^{c}	0.71^{d}	86.64
Lambdacyalothrin					

As presented in Table 3, all the plant extracts compete effectively with Lambdacyhalothrin in the control of Z. variegatus populations except Acetonic A. squamosa at 1WAT but at 2WAT, application of Ethanolic A. squamosa significantly failed to control Z. variegatus infestations, whereas, significant difference was not observed between the protected plots and unprotected plots.

Table 3. Effect of botanical insecticides on *Zonocerus variegatus* population on okra.

	Weeks After treatment				
Treatments	**1**	**2**	**3**	**4**	**Efficacy**
Control	1.46^{a}	1.64^{a}	0.71^{a}	0.71^{a}	
Acetonic *Annona squamosa*	1.34^{a}	0.71^{b}	0.71^{a}	0.71^{a}	23.23
Acetonic *Moringa oleifera*	1.17^{b}	1.10^{ab}	0.71^{a}	0.71^{a}	18.36
Ethanolic *Moringa oleifera*	0.71^{b}	0.71^{b}	0.71^{a}	0.71^{a}	37.17
Ethanolic *Annona squamosa*	0.71^{b}	0.71^{b}	0.71^{a}	0.71^{a}	37.17
Lambdacyalothrin	0.71^{b}	0.71^{b}	0.71^{a}	0.71^{a}	37.17

Means with the same alphabet(s) along the column are not significantly different.

Table 4 clearly showed that there was no significant difference in the percentage fruit damaged at 1st and 3rd harvest between the protected fruits and unprotected fruits but this observation contradicted what was observed at 2nd harvest. In reference to defoliated leaves, all the botanical insecticides had the same significant potential in the protection of leaves but Lambdacyalothrin had the least defoliated leaves (0.33%). However, the applied plant extracts significantly performed better than unprotected plants (Table 5).

Table 4. Effect of insecticides on number of fruits damaged (%) of okra.

Treatments	1st harvest	2nd harvest	3rd harvest
Acetonic Annona squamosa	7.28^{a}	5.90^{a}	5.16^{b}
Acetonic Moringa oleifera	6.84^{a}	6.20^{a}	6.10^{a}
Ethanolic Annona squamosa	6.39^{a}	7.00^{a}	6.22^{a}
Lambdacyalothrin	6.36^{a}	7.20^{a}	6.02^{a}
Ethanolic Moringa oleifera	6.07^{a}	7.00^{a}	5.78^{a}
Control	4.46^{b}	201.2^{a}	5.68^{ab}

Means with the same alphabet(s) along the column are not significantly different.

Among the plant extracts, ethanolic *A. squamosa* extracts treated plots had highest plant height followed by the plots sprayed with ethanolic *M. oleifera* extracts but all the plant extracts treated plots produced/resulted into significant plant height when compared with unprotected plants which had the least plant height.

The yield obtained from Lambdacyhalothrin was significantly better than botanical treated plants. Among the botanical insecticides, Ethanolic *A. squamosa* treated plots had highest yield (571.7kg/ha) followed by Ethanolic *M. oleifera* which had 420.2kg/ha. 209.3 kg/ha obtained from untreated plots was significantly lower than botanical insecticides treated plots except the plots treated with acetonic *A. squamosa* which had the least yield(207.4kg/ha)

Table 5. Effect of insecticides on defoliated leaves of okra.

Treatments	Defoliated (%)	Plant Height(m)
Control	126.00^{a}	4.70^{a}
Acetonic Annona squamosa	66.00^{b}	4.60^{a}
Ethanolic Moringa oleifera	95.67^{b}	3.93^{ab}
Acetonic Moringa oleifera	93.00^{b}	3.90^{ab}
Ethanolic Annona squamosa	96.33^{b}	3.90^{ab}
Lambdacyhalothrin	0.33^{c}	3.67^{b}

Means with the same alphabet(s) along the column are not significantly different.

Table 6. Effect of insecticides on yield of okra (t/ha)

Treatments	1st harvest	2nd harvest	3rd harvest	4th harvest	Yield (t/ha)
Lambdacyalothrin	124.00^{a}	108.33^{ab}	225.67^{a}	151.67^{a}	609.7^{a}
Ethanolic *Moringa oleifera*	88.33^{b}	111.67^{ab}	132.67^{b}	87.33^{cd}	420.0^{c}
Acetonic *Moringa oleifera*	85.67^{b}	49.67^{b}	80.00^{bc}	148.67^{ab}	364.1^{d}
Ethanolic *Annona squamosa*	38.00^{c}	172.67^{a}	226.33^{a}	134.67^{abc}	571.7^{b}
Control	20.00^{c}	46.67^{b}	50.00^{bc}	92.67^{bcd}	209.4^{e}
Acetonic *Annona squamosa*	8.67^{c}	78.33^{b}	60.00^{bc}	60.00^{d}	207.0^{f}

Means with the same alphabet(s) along the column are not significantly different.

Discussion

This experiment demonstrated the effectiveness of *M. oleifera* and *A. squamosa* in the control of field insect pests of okra *P. sjostedti*, *P. uniformis* and *Z. variegatus*. The result obtained clearly showed that the two plant extracts effectively controlled the observed insects when compared with the result obtained from untreated plants. This result concur with the earlier report by Adebayo [2] who observed that *T. vogelii* had insecticidal action against insect pests of okra, similar observation was reported by Musa *et al* [23] who reported that *A. squamosa* and *T. vogelii* significantly suppressed *P. uniformis* and *P.sjostedtii* infestations of Okra. Variation was observed in the degree of effectiveness of the tested plant extracts against the observed insects. This goes in line with earlier report by Isman [16] who reported on the variation in the efficacy of the active ingredient of plant extracts to different species of the same insect.

The data also suggest that organic solvents played a prominent role in the insecticidal potential of the tested plant extracts. Ethanolic *M. oleifera* and *A. squamosa* exhibited higher insecticidal efficacy than Acetonic *M.oleifera* and *A. squamosa*. This is an indication that ethanol is the best organic solvent for the extraction of insecticidal active chemical compounds for the two plant extracts. However, Ethanolic *A.squamosa* had higher insecticidal potential than Ethanolic *M. oleifera*, this result suggests that Acetonogin (18) reportedly isolated from *A. squamosa* proved to be effective against the observed insects when compared with Quercetin and Kampeferol which are the insecticidal compound derived from *M. oleifera* [27].

It was observed on the field that untreated plants had the least plant height whereas the synthetic treated plants had highest plant height. Among the botanical treated plants, the plant height was within the same range but significantly higher than that of unprotected plants. This revealed that the target insects contributed negatively to the plant growth. Also, the rate of leaf defoliation correspond to the population density observed by the insects, this is due to the fact that unprotected plants had highest insect infestations had highest number of defoliated leaves.

Among the plant extracts, Ethanolic *A. squamosa* had the highest yield (571.7 kg/ha) followed by Ethanolic *M. oleifera* which had 420.1 kg/ha. However, none of these plant extracts compete effectively with Lambdacyhalothrin (609.5 kg/ha), this can be attributed to the inability of synthetic insecticide to degrade easily in the environment and environmental factors such as wind, sunlight and temperature which reduced the insecticidal potential of the plant based insecticides [12], this property has constituted as environmental pollution. Consumption of pesticide residue has been reported to have been resulted into negative effect on human health. In view of this, use of plant extracts in the management of insect pests can be considered as an alternative for the cultivation of this crop.

Conclusion

Based on this result, ethanol is considered appropriate for the extraction of active compound of the tested plants *A. squamosa* and *M. oleifera* and it was discovered that this formulation can be stored at a room temperature for three (3) months. This discovery serves as an advantage to the rural farmers who have no access to electricity.

Refferences

[1] Abdul, D.A.S. Economic importance of *Moringa oleifera* in Tafa Govt Area of Niger State. NDE project. Federal College of Forestry Mechanization, Kaduna, Nigeria. (2007), PP,34

[2] Adebayo, T.A (2003). Efficacy of mixture formulations of synthetic and botanical insecticides in the control of insect pests of okra and Cowpea Ph. D thesis. Ladoke *Akintola University of Technology, Ogbomoso, Nigeria* P114.

[3] Agunloye, O. Effect of cypermethrin on the population of *Podagrica uniformis* (Jacoby) and *Podagrica sjostedti* (Jacoby) and yield of okra. *Tropical Pest Mgt.* (1986) 32(1); 55-57

[4] Ahmed, B.I., Abdulhamed, A., Yusuf, S.R., and Aliyu, M. Comparative study of the defoliatory activities of *Podagrica sjostedti* and *P. uniformis* (Coleoptera; Chrysomelidae) on two intercropped okra varieties in Bauchi state Nigeria. *Savannah Journal of Agriculture.* (2006) 1(1); 12

[5] Ahmed; M.M.M. Studies on the control of insect pests in vegetables (Okra, Tomato and Onion) in Sudan with special reference to Neem preparation. Dissertation for Building The Deg. Of Agric. sci. university of Gunsen, Germany. (2000) 112pp.

[6] Alao F.O., (2011). Preliminary Evaluation of the Insecticidal Potential of Organic compost Extracts Against Insect pests of Okra (*Abelmoschus esculentus* (L.) Moench). (2011) 1(3): 123-130.

[7] Alao, F.O and Adebayo, T.A. (2015). Comparative efficacy of *Tephrosia vogelii* and *Moringa oleifera* against insect pests of Watermelon (*Citrulus lanatus* Thumb). International letter of natural sciences. (2015) 35 71-78

[8] Anjorin, T.S, Ikokou, P and Okolo, S (2010). Mineral composition of *moringa oleifera* leaves, pods and seeds from two regions in Abuja, Nigeria, *International Journal of Agriculture Biology.* (2010), 12: 431-434

[9] Banjo, A.D., O.A. Lawal, O.E. Fapojumo and E.A. Songonuga, (2003). Farmers' knowledge and perception of horticultural insect pest problems in Southwestern Nigeria. *Afri. J. Biotech.* (2003), 2(11): 432-437.

[10] Echezona, B.C., Asiegbu J.E., and Izuagba A.A. (2010) Flea beetle populations and economic yield of okra as influenced by Nigeria and 2,3- Dihydro-2,2-Dimethyl Benzofuran. *African crop science journal.* (2010), 18(3); 97-105.

[11] Egwuta, R.L. (1999). Field trials with systemic and contact insecticides for the control of *P.uniformis* and *P. sjostedti* Coleopteran; Chrysomelidae on okra. *Tropical pest mgt.* (1999), 28(2);115-121.

[12] Eileen A. Buss and Sydney G. Park Brown. (2013). Natural Products for Managing Landscaping and Garden Pests in Florida. EDIS.

[13] Fashey J.W (2005). Moringa oleifera: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. Trees Life J., 1: 5 (http://www.ttljournal.org/images/articles/20051201124931586_3.pdf).

[14] George, R.A.T. (2005). Horticulture; Principle and Practices. 3rd edition. Pearson Edu. Publisher U. K. (2005), PP,208

[15] George, R.A.T., (1999). Vegetable seed Production . 2nd edition CABI Publishers. London, 532Pp.Isman, M.B (2006). Botanical insecticides, deterrents and repellents in modern agriculture and increasingly regulated world. *Annual Review of Entomology.* (1999), 51:45-66

[16] Isman (2006). Botanical insecticides, deterrents and repellents in modern agriculture and increasing regulated world. *Annual Review of Entomology.* 51: 45-66.

[17] Isman M.B (2008). Perspective Botanical Insecticides: For Richer For Poorer. *Pest Management Science.*

[18] Landolta, J.L, Ahammadsahibb, K.I, Hollingworthb, R.M, Barrr',Crane', F.L, Buerckd, N.L, McCabed, G.P and McLaughlin, J.L (1995). Determination of structure-activity relationships of Annonaceous acetogenis by inhibition of oxygen uptake in rat liver mitochondrion. *Chemico-Biological interactions* 98(14): 1-13.

[19] Leatemia, J.A and Isman, M.B (2004). Insecticical activity of crude seed extracts of *Annona spp*. *Lansium domesticum* and *Sandoricum koetjape* against *Lepidopteran* larvae. *Phytoparasitica.* (2004), 32(1): 30-37

[20] Mehta, A and Argrawal, (2008). Investigation into the mechanism of the action of *Moringa oleifera* for its anti-asthmatic activity. Orient. Pharm. Exp. Med., 8: 24-31.

[21] Mittal, M; Mittal, P, Agarwal, AC (2007). Pharmacolgnostical and Phytochemical investigation of

antibiotic activity of Moringa oleifera (Lam) leaf. IndoPharm, 6:70-72.

[22] Morton, J.F (1991). The horseradish tree, *Moringa pterygosperma* (Moringacea) a boon to arid lands? Economic Botany. 45: 318-333.

[23] Musa, A.K; Yusuf S.Y and Adebayo, T.A (2013). Estimate of flea beetles (Podagrica spp) population and their defoliating effects on okra (Abelmoschus esculentus L. Moench) treated with plant extracts and synthetic pyrethroid, Lambdacyhalothrin. *International Journal of Advance research* 1(8) 829-834.

[24] Nava-Diaz, C.S, Osada-klavasoe, S,redon-sanchez, G. and Ayala-escobar, V. (2000). Organismos association a chirmoyo (A. Chermola M:II) Agrociencia. (2000), 34. 217-226.

[25] Oberlies, N.H, chang, C.J and mclaughlin, J.L (1997) structure activity relationships of diverse *annonacers acetogenins* against multidrug resistant human mammary *adennocarcinnoma, Journal of medical chemistry*, (1997), 40:2012-2106.

[26] Ogbunugafor, H.A, Eneg, F.U, Ozumba, A.N, Igwo-ezikpe, M.N, Okpuzor, J, Igwilo, I.O., Adenekan, S.O. and Onyekwelu, O.A. (2011). Physic-chemical and antioxidant properties of Moringa oleifera seed oil. *Pakistan Journal of Nutrition*. 10(5): (2011), 409 – 414

[27] Pace-Asciak, C.R; Hahn S; Diamandis, E.P; Soleas, G; and Goldberg, D.M (1995). The red wine phenolics transresveratrol and quercetin block human platelet aggregation in eicosanoid synthesis: Implication fro protection against coronary heart disease. *Clinchim Acta* 235(2) 207-219

[28] Raemakers, R. (2001). Crop Production in Tropical Africa and vegetable production in warm climates. Macmillan Publishers Belgium. (2001), PP,453.

[29] Rice, R.P. Rice, L.W. and Tindall H.D. (2000). Fruit and vegetable Production in warm climate. Macmillan London. (2000),PP, 196.

[30] Schippers, R.R. (2002). Africa Indigenous vegetable crop production Hobbs Publishers, U. K. (2002), PP112.

[31] Sofidiya, M.O, Odukoya, O.A, Familoni, O.B and Inyagha, S.I (2006). Free-radical scavenging activity of some Nigerian medicinal plant extracts. *Pakistan Journal of Biological Science*. (2006), 9(1):1438 – 1441

[32] Tindall, H.D. (2000). Vegetable in the Tropical, Macmillan Hampshire Hong Kong. (2000), PP 326 .

[33] Uddin II, R. O. and Odebiyi J. A. (2011). Influence of intercropping on the incidence, abundance and severity of pest damage on okra *Abelmoschus esculentus* (Linn) Moench (Malvaceae) and chilli pepper capsicum frutescence Linn (Solanaceae). *Journal of Agriculture Science*. (2011), 3 (3); 63-66.

[34] Wood, A., and Ambridge, L. (1999). A Guide to insect pest of Nigeria crops, Identification, Biology and Control Natural Resources Institute Publishers. (1999), PP 197.