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Insect Pests Associated with Sweet Potato (*Ipomoea Batatas* L.) Genotypes Planted on Open Field in Umudike, Abia State, Nigeria

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ABSTRACT: Sweet potato (*Ipomoea batatas* L.) play a major role in human and animal nutrition and enterprise, however, the plant cultivation is associated with pest infection. Hence, the objective of this paper was to investigate the insect pests associated with sweet potato (*Ipomoea Batatas* L.) genotypes planted on open field in Umudike, Abia State, Nigeria using appropriate standard methods. Data obtained reveal that a total of 1454 different insect species were collected. The grasshopper recorded the highest number of 206(14.17%) while The Hawk moth recorded the least number of 12(0.83%). PGA14011-43 and Local best recorded the best vine (8.2) each while the least was recorded in OBARE and NAN (5.0) each. Genotype 87/OP/195 recorded the highest yield, followed by PGA14011-43 while the least yield was recorded in TU-PURPLE. The difference in the yield among the genotypes were statistically significant (P<0.05). Genotypes 87/OP/195 and PGA14011-43 can be released to farmers for commercial and subsistence production.

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Sweet potato (*Ipomoea batatas* L.) is the world's sixth most important food crop, after rice (*Oryza sativa* L.), wheat (*Triticum aestivum* L.), potato (*Solanum rootosum* L.), maize (*Zea mays* L.) and cassava (*Manihot esculenta* Crantz) (CIP, 2020). In developing countries, it is the fifth most important food crop (CIP, 2020). The crop belonging to the family Convolvulaceae, it is an important root crop in most countries (Ochieng *et al*., 2017). Sweet potatoes play a major role in the food industry and human nutrition because of their valuable content being a rich source of carbohydrates, some amino acids, vitamins, minerals, dietary fiber and other bioactive compounds (Akanji *et al*., 2023). Sweet potato is a major root crop which is grown for both export and local consumption. It is also the third most important root crop grown in eastern Africa after cassava and potato (FAO, 2011). Sweet potato is both a staple and a food security crop in eastern and southern Africa, and is mainly grown by smallholder women farmers especially in marginal areas. It includes many varieties that are drought resistant. (Mutuura *et al*., 1992; Bashaasha *et al*., 1995; Andrade *et al*., 2009). Although there are several varieties that have been bred for high yields, the production has been stagnant (MOA, 2007). The main reason has been reported as adverse weather conditions (MOA, 2007). This factor has masked the role of pests in reduction of the crop yield, especially because the crop is grown by low input users, who rarely manage pests. Sweet potatoes are usually inhabited by many insect species. Talekar (1982) reported at least two hundred species of insects that feed on sweet potatoes both in field and storage worldwide. The roots, foliage and even seeds of the plant were found to be vulnerable to the damage by these pests. There is a possibility of improving the

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sweet potato yields if pests are managed well. However, this can occur only if the pests are known particularly in terms of their damaging effects. Sweet potato is also grown for its vines as planting material; leaves are often eaten as a vegetable while shoots and roots are used as animal feed in many countries. In Africa, the sale of fresh sweet potato roots, vines and processed foods in both local and urban markets is becoming increasingly popular regarding contribution to household cash income (Abidin 2004; Kaguongo *et al*., 2012). Orange- fleshed sweet potato is also a rich source of beta-carotene, a precursor of bio-available vitamin A, and has potential of combating Vitamin A deficiency among rural resource constrained farmers in many developing countries (Mwanga *et al*., 2003; Jaarsveld *et al*., 2005; Low *et al*., 2007; Burri, 2011). The production of sweet potato in the world has been low due to several abiotic (drought, low rainfall, poor soils) and biotic (insect pests and diseases) factors (Gibson and Aritua, 2002; Ochieng *et al*., 2017). Among the major biotic constraints for sweet potato production, insect pests are recoded as the most important (FAO, 2013). The most serious and commonly reported insect pests for sweet potato in Africa are caterpillars of the sweet potato butterfly (*Acraea acerata* Hew., Nymphalidae), the Sweet potato weevils (*Cylas brunneus* F. and *Cylas puncticollis* Boheman), the clearwing moth (*Synanthedon* spp.), the sweet potato hornworm (*Agrius convolvuli* L.) and vectors of the sweet potato virus diseases, such as the sweet potato whitefly (*Bemisia tabaci*) (Nderitu *et al*., 2009). The two African *Cylas spp.* (*C. puncticollis* and *C. brunneus*) usually appear together in fields and cause huge yield losses of up to 100% especially during dry periods (FAO, 2013). Hence, the objective of this paper was to investigate the insect pests associated with sweet potato (*Ipomoea Batatas* L.) genotypes planted on open field in Umudike, Abia State, Nigeria.

MATERIALS AND METHODS

This research was carried out at National Root Crops Research Institute (NRCRI) Umudike, Abia State. Umudike is located in the humid forest zone of Nigeria and lies within latitude 05026' - 5025'N and longitude 07034' – 7036'E, with an altitude of 122m above sea level. The annual rainfall is about 2500 mm with its peak in the month of July to September. The area is characterized by daily minimum and maximum temperature 20oC and 32oC respectively, with humidity of about 82.6%.

Sources of Planting Materials: The materials were collected from National Root Crops Research Institute (NRCRI) Umudike, Umuahia, Abia State, Nigeria.

Method of Collection of Genotype: Twenty-five sweet potato genotypes were collected and each genotype was first fastened together with a twine. These were put in a collection bag and labelled both within the bag and outside it. Each genotype was given a unique number or name for easy identification as shown in table 1.

Table 1: List of the sweet potato genotypes used for the experiment

S/N	Names of Genotypes	Maturation period
1	PGA 14008-9	Three months
2	OBARE	Three months
3	KWARA	Four months
4	NAN	Three months
5	CRI-APOMUDEN	Three months
6	PG17362-NI	Three months
7	87/OP/195	Three months
8	PGN16021-39	Three months
9	CEMSA74-228	Three months
10	TIS87/0087	Three months
11	PGA14442-1	Three months
12	BUTTERMILK	Four months
13	PGA14011-43	Three months
14	PGA14398-4	Three months
15	CRI-DADANYUIE	Three months
16	LOCAL BEST	Three months
17	PGA14372-3	Three months
18	CRI-OKUMKOM	Three months
19	PO3/35	Three months
20	PGA14351-4	Three months
21	UMUSPO/3	Three months
22	TU-PURPLE	Three months
23	PG17265-NI	Three months
24	NWOYORIMA	Three months
25	PO3/116	Three months

Sweet potato Planting: Three months old sweet potato vine cuttings of between 25-30cm long, with 3 to 4 nodes were planted in the field on ridges of 3m long at an inter and intra row spacing of 1m and 0.3m respectively. The planting was done in the three locations simultaneously. Weeding was done at 6 and 12 weeks after planting. Compound fertilizer (NPK 20:10:10) was applied at 4 weeks after planting using side placement. The study was carried out from July to November, 2021. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The collected pests were later identified and grouped based on their taxonomic characteristics according to Ekman and Lovatt, (2015). Harvesting was done at 120 days after planting (DAP). Plots were harvested by lifting with garden fork. Vines were first cut with knife and the storage roots uprooted with garden fork.

RESULTS AND DISCUSSION

Insects representing fourteen species of five orders and in different stages of development were found to be associated with sweet potato crop in Umudike, Abia State. Their infestation level was, however, different. Individuals belonging to 6 species were noted as major pests of sweet potato. Further individuals of 8 species were minor pests while 3 species belonging to two orders were represented by beneficial insects. From the beginning of sampling, the vines were always infested by different insects throughout the growth period of the crop. Coleopteran and Hemipteran pests were the most abundant and widely distributed of the

total insect order recorded (Table 2). Twelve (12) of the insect species caused damage on the leaf, Sweet potato butterfly and clearwing moth only caused damages on the vine. White fly, Sweet potato weevil, scale and Hawk-moth caused damages on the leaf and vine while only sweet potato weevil caused damage to both the leaf, vine and the tuber. The insects that were classified as minor pests caused a minimal damage compared with those that were recognized as the major pests.

Table 2: Characterization of insect species sampled in sweet potato genotypes and their orders in 2021

Common name	Scientific name	Order	Part damaged	Pest status
White fly	*Bemisia tabaci*	Hemiptera	Leaf and vine	Major
Leafhopper	*Amrasca spp*	Hemiptera	Leaf	Minor
Mealy bug	*Phenacoccus solenopsis*	Hemiptera	Leaf	Minor
Aphids	*Myzus persicae* Sulzer	Hemiptera	Leaf	Major
Scale	*Pulvinaria* spp	Hemiptera	Leaf and vine	Minor
Sweet potato weevil	*Cylas spp*	Coleoptera	Leaf, vine and tuber	Major
Sweet potato beetle	*Colasposoma spp*	Coleoptera	Leaf	Minor
Tortoiseshell beetle	*Aspidomorpha spp*	Coleoptera	Leaf	Minor
Ladybird	*Cheilomensis lunata* F	Coleoptera		Beneficial
Leaf rolling caterpillar	*Branchmia convolvuli*	Lepidoptera	Leaf	Major
Hawk-moth	*Agrius convolvuli* (L.)	Lepidoptera	Leaf and vine	Major
Clearwing moth	*Synathedon dascyleles*	Lepidoptera	Vine	Major
Sweet potato butterfly	*Acraea acerata Hew*	Lepidoptera	Vine	Minor
Grasshopper	*Zonocerus variegatus*	Orthoptera	Leaf	Minor
Giant cricket	*Eugaster loricatus* Gerst	Orthoptera	Leaf	Minor
Bees	*Apis spp*	Hymenoptera		Beneficial
Carpenter ants	*Pheidole spp*	Hymenoptera		Beneficial

A total of 1454 insect pests were collected (Table3). The grasshopper recorded the highest number of 206(14.17%), followed by sweet potato weevil which recorded 192(13.21%), others were sweet potato butterfly 104(7.15%), white fly 102(7.02%), giant cricket 97(6.67%), leaf hopper 87(5.98%), clearwing moth 87(5.98%), sweet potato beetle 76(5.23%), aphids 64(4.40%), leaf rolling caterpillar 51(3.51%), tortoiseshell beetle 42(2.89%), mealy bug 30(2.06%), scale 28(1.93%) while the least was hawk moth 12(0.83%). There were considerable range of the beneficial insects that were observed on the crop. They included predators such as carpenter ants 147(10.11%), parasitoids (ladybird) 96(6.60%) and pollinators (bees) 33(2.27%).

Table 3: The prevalence of the sweet potato pests encountered in Umudike

Name of insect	Number encountered	Percentage (%)
Grasshopper	206	14.17
Sweet potato weevil	192	13.21
Carpenter ants	147	10.11
Sweet potato butterfly	104	7.15
White fly	102	7.02
Giant cricket	97	6.67
Ladybird	96	6.60
Leafhopper	87	5.98
Clearwing moth	87	5.98
Sweet potato beetle	76	5.23
Aphids	64	4.40
Leaf rolling caterpillar	51	3.51
Tortoiseshell beetle	42	2.89
Bees	33	2.27
Mealy bug	30	2.06
Scale	28	1.93
Hawk-moth	12	0.83
Total	1454	

The mean plant vine scores and the yield of the sweet potato genotypes are recorded in table 4. PGA14011-43 and Local best recorded the best vine (8.2) each while the least was recorded in OBARE and NAN (5.0) each. The difference in the vine scores were statistically significant ($P<0.05$). Genotype 87/OP/195 recorded the highest yield, followed by PGA14011-43 while the least yield was recorded in TU-PURPLE. The difference in the yield among the genotypes were statistically significant ($P<0.05$).

Table 4: Mean plant vine scores and the yield of the sweet potato genotypes in Umudike, Abia State, Nigeria

S/N	Names of Genotypes	vine scores	Yield (kg)
1	PGA 14008-9	7.0	42.0
2	OBARE	5.0	36.0
3	KWARA	6.0	39.0
4	NAN	5.0	44.0
5	CRI-APOMUDEN	8.0	78.0
6	PG17362-NI	8.0	33.0
7	87/OP/195	7.0	108.0
8	PGN16021-39	7.0	66.0
9	CEMSA74-228	7.5	93.0
10	TIS87/0087	7.4	27.0
11	PGA14442-1	6.7	72.0
12	BUTTERMILK	7.0	26.0
13	PGA14011-43	8.2	96.0
14	PGA14398-4	7.0	55.0
15	CRI-DADANYUIE	8.0	44.0
16	LOCAL BEST	8.2	55.0
17	PGA14372-3	7.5	69.0
18	CRI-OKUMKOM	7.6	47.0
19	PO3/35	5.5	33.0
20	PGA14351-4	8.0	39.0
21	UMUSPO/3	6.2	27.0
22	TU-PURPLE	6.5	6.0
23	PG17265-NI	7.5	36.0
24	NWOYORIMA	8.0	18.0
25	PO3/116	7.2	19.0
	Mean	7.3	48.0
	Range	5.0-8.2	6-108
	LSD	2.8	7.1
	Significant level	P<0.05	P<0.05

The results of this study showed that insect pests severely undermine sweet potato production in

Nigeria. The result is in agreement with the works of Agbessenou *et al*., (2016) and Ezin *et al*., (2018) who reported the insects as major and minor insect pests in their works. Few insects, Carpenter ants, lady beetles and bees from the Order Coleoptera and Hymenoptera respectively, were identified as beneficial insects but their populations were relatively lower than the pest species. It may be possible to exploit these beneficial insect species in future inundation biocontrol programmes, but more studies would be required on their bioecology and methods of breeding (Uwaidem *et al.*, 2018*).* From the beginning of sampling, the vines were always infested by different insects throughout the growth period of the crop. The crop attracted a wide spectrum of pests and was a refuge of several other insects. Coleopteran and Hemipteran pests were the most abundant and widely distributed of the total insect order recorded. A total of 1454 insect pests were collected from NRCRI farm in Umudike, grasshopper of the order Orthoptera had the highest number of individual species, followed by sweet potato weevil of order Coleoptera and sweet potato butterfly of the order Lepidoptera. The result is in agreement with the work of Uwaidem *et al*., (2018) who reported the insects as major pests of sweet potato. Members from these Orders (Orthoptera, Coleoptera and Lepidoptera) were responsible for the most significant damage to the foliage and the tuber (Ezin *et al*., 2018). However, economic damage was caused by white fly, leaf rolling caterpillar, sweet potato beetle and aphids. These species have been reported as major pests of sweet potato in other parts of West Africa (Agbessenou *et al*., 2016; Ezin *et al*., 2018) and they are considered in the current study as the key pests. The mean vine scores of the sweet potato genotypes showed that PGA14011-43 and Local best recorded the best vine while the least was recorded in OBARE and NAN. This indicates that apart from tuber yield benefits obtained from these genotypes, they can also be used as a good vine source especially where production is aimed at producing sweet potato vines. The vines can be used as forage for ruminants feeding due to their richness in proteins and minerals needed in livestock feeds (Kathabwalika *et al*., 2013; Ahmed *et al*., 2015; Akanji *et al*., 2023). The yield of sweet potato genotypes recorded showed that Genotype 87/OP/195 recorded the highest yield, followed by PGA14011-43. The result showed that genotype 87/OP/195 sweet potato converted most of its photosynthetic products into carbohydrates stored in tubers below ground. Most of the carbohydrate accumulated by the cultivar was being translocated to the roots and not the top parts for vine growth. The increase in tuber yield at the expense of vine growth was also reported by Akanji *et al*. (2023). Kareem (2013) reported that sweet potato tuber yield was highest in cultivars that had recorded low vine length. This entails that cultivars that produce high tuber yields are likely to produce low vine yield as well as low vine growth rate. Genotype 87/OP/195 was the highest yielding among all the genotypes while the least yield was recorded in TU-PURPLE. The differences in tuber yield could be attributed to genetic variations among genotypes in partitioning photosynthates. Differences in yield due to the genetic makeup among genotypes have also been reported in other sweetpotato trials (Nedunchezhiyan *et al*., 2007; Kathabwalika *et al*., 2013; Akanji *et al*., 2023) as well as other crops such as common beans (*Phaseolus vulgaris*) (Chataika *et. al*., 2010).

Conclusion: Sweet potato is a well-adapted staple crop cultivable in all agro-ecological areas of Nigeria, integral to different cultural diets and a potential crop for food security. Genotypes 87/OP/195 and PGA14011-43 can be released to farmers for commercial and subsistence production since they have the highest yield. Since the results were obtained during one-year trial, it may be ideal to recommend the replication of the trial over two or more seasons to increase the validity of the findings.

Conflict of Interest: The authors declare no conflict of interest.

Data Availability Statement: Data is available upon request from the first author

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