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Original Paper

Comparative assessment of insect pests population densities of three selected cucurbit crops

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The study on the relative abundance of insect pests is a critical factor for a successful implementation of insect pest management program. Therefore, this experiment was conducted to compare the intensity of insect infestations among the selected three cucurbit crops (Cucumber, Egusi melon and Watermelon). The experiment was set up at Teaching and Research Farm Ladoke Akintola University of Technology, Ogbomoso in a Randomized Complete Block Design replicated three times. Significant difference was observed in the tested crops in respect to insect population density on leaf, flower and fruit. Among the tested crops, watermelon was observed to be the most susceptible to the observed insects meanwhile the cucumber had the least insect infestation rate 0.00 at P <0.05. Also the insect infestation was low as the maturity of the leaves increased. The population density of flea beetle (*Phyllotreta cruciferae*) and spotted beetle (*Diabrotica undecimpunctata*) were observed to be relatively higher at vegetative stage and decreased at flowering stages while *Dacus cucurbitae* caused significant economic damage during the fruiting stage to watermelon, melon and cucumber fruits (33.3, 20.0 and 1.0) respectively. This research work demonstrated that control of insect pests should be initiated at each growing stage of the selected crops.

Keywords: cucumber, *Dacus cucurbitae*, *Phyllotreta cruciferae*, watermelon, melon

1 Introduction

The most economically important cucurbits according to world total production are watermelon (*Citrullus lanatus*), cucumber (*Cucumis sativus*) and melon (*Cucumis melo*) (FAO, 2006). Fruits of Cucurbitaceae have a considerable economic value. One of the main uses of the cucurbits apart from their fruits, leaves, flowers and occasionally their root is that of their seeds. The seed kernels of the Cucurbitaceae family found in markets throughout West Africa are an important source of oil used for food (FAO, 2006).

In spite of all the numerous benefits associated with cucurbits, cultivation of this crops have been militated by several problems such as; diseases infection, insect infestations and soil fertility. The major insect pests of this family include the following: *Bactrocera cucurbitae*, *Phyllotreta cruciferae*, *Diabrotica undecimpunctata*, *Aulocophora africana*, *Monolepta* spp, *Coccinellidae* spp, *Zenocerus verigatus* and *Dacus cucurbitae* (Allwood, 1999; Dihillon et al., 2005).

Monitoring of the insect pests can be used to determine distribution of pests in other to have effective insect pests' management. However the process of assessing the level of population density of insect pests gives an insight to predict pest outbreak (Alao, 2015). Therefore, monitoring of insect pests is an important aspect of pest management strategies because this gives the warning of the timing and extent of pest attack which will improve the efficacy of control strategies.

However, variation occurs in levels of insect infestation within and among plants of the same family which can be attributed to many mechanisms, such as differences in host nutritional, quality, suitability of the physical environment and abundance of competitor consumers or natural enemies (Clancy et al., 1988; Oyetunji et al., 2014).

Plants are generally exposed to a variety of biotic and abiotic factors which may alter their genotypic and/or phenotypic properties resulting in different mechanisms of plant resistance which enable plants to avoid, tolerate or recover from the effects of pest attack. Such mechanisms of plant resistance have been effectively used against insect pests in many field and horticultural crops (Gogi et al., 2010).

Plants typically contain significant amounts of preformed chemicals produced via secondary metabolism. These include phenolics of varying structural sophistication, terpenoids, and steroids. The concentrations of these

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compounds in particular tissues may be very high. Some preformed compounds are directly toxic, while others exist as conjugates such as glycosides that are not directly toxic but become toxic following disruption of the conjugate (Bowyer et al., 1995).

Inducible resistance mechanisms are active, energy-requiring systems typified by specific recognition of an invader that ultimately leads to the production of proteins or metabolites that are antagonistic to the invader. These resistance mechanisms have been most studied in regard to plant pathogens, but the same or similar mechanisms clearly function against insect pests. Such active resistance mechanisms are usually referred to collectively as the hypersensitive response (Dixon et al., 1996).

In view of the aforementioned facts, there is a need to assess the incidence of insect pest infestations and the difference in susceptibility of the selected crops (watermelon, melon and cucumber) in other to develop a successful integrated pest management program.

2 Material and methods

2.1 Site of study

The field experiment was carried out at Ladoke Akintola University of Technology (LAUTECH) Teaching and Research farm, Ogbomoso, Oyo state. Ogbomoso is located on longitude 4° 30′ E and longitude 10° 5′ N. The climate could be described as hot, humid, tropical, fall in Southern Guinea Savanna of Nigeria with mean temperature of 27 ^{0}C, annual rainfall of 1,400 mm and marked with wet and dry season.

2.2 Experimental design and management

Nine plots were laid out in a randomized complete block design with three replicates. The size of the plot was 6 m by 6 m with 1 m by 2 m gap between adjacent plots and block respectively. The treatment consists of Watermelon, Egusi melon and Cucumber. Three to four seeds were dropped per hole and later thinned to one plant per stand two weeks after planting. Weeding was done manually. Application of insecticide was avoided throughout the studied period.

2.3 Data collection

The population densities of insect pests were visually counted from each plot. Defoliated leaves and damaged flowers were determined as described by Alao and Adebayo (2015). The infested fruits were counted and percentage of fruit damaged was calculated.

2.4 Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) using Randomized Complete Block Design. Significant means were separated with least significant difference (LSD) at 5% probability level using statistical analysis software (SAS) 2002.

3 Results and discussion

This result demonstrated that *P. cruciferae* and *D. undecimpunctata* are the major insects on cucumber plants at vegetative stage. In respect to watermelon, apart from *P. cruciferea* and *D. undecimpunctata*, *Monolepta* spp. and *A. africana* could be considered as major insects at vegetative stage. This result was similar to what was observed on melon except that *Z. variegatus* infestation was considerably low (Table 1). This result also confirmed the earlier research work that *D. cucurbitae* can only attack flowers and fruits (Dhillion et al., 2005). Several studies have proved that variety or genotype of the same species could defer significantly in their resistance to insect infestations (Dhillon et al., 2005; Oyetunji, et al., 2014). Considering the tested crops, the level of insect infestation was considerably high on watermelon while cucumber had the least insect infestations at vegetative stage. This may be attributed to the difference in the antixenosis and antibiosis factors of each crop (Felkl et al., 2005). It can be concluded that cucumber may possess any of these factors than other two crops.

Table 1 Distribution of insects at vegetative stage at two weeks intervals

	Crops		
Observed insects	cucumber	watermelon	melon
Phyllotreta cruciferae	7.00^a	16.0^a	13.0^a
Diabrotica undecimpunctata	7.00^a	13.0^b	10.0^b
Aulocophora africana	3.00^b	8.00^c	6.00^c
Monolepta spp.	3.00^b	8.00^c	6.00^c
Coccinellidae spp.	3.00^b	7.00^d	5.00^d
Zenocerus variegatus	2.00^b	7.00^d	3.00^e
Dacus cucurbitae	0.00d	3.00e	3.00e

Means with the same alphabet along the column are not significantly different at $P < 0.05$

The result shows that *D. cucurbitae* had the least significant (P <0.05) infestation on cucumber followed by *Z. variegatus*. There were significant (P <0.05) difference was among other insects but *P. cruciferea* and *D. undecimpunctata* had the highest infestation showing that *P. cruciferae* and *D. undecimpunctata* attacked cucumber more than other insects. Among the observed insects, *D. cucurbitae* was not observed on cucumber, while *P. cruciferae* had highest infestation on all the tested crops (Table 1).

Z. variegatus and *D. cucurbitae* infestations were significantly (P <0.05) low when compared with other insects on melon. Meanwhile, no significant difference (P <0.05) was observed between the infestation of *A. africana* and *Monolepta* ssp indicating the same level of infestation. With reference to flowering stages, *cucurbitae*, *D. undecimpunctata* and *Coccinellidae* spp have significant highest infestation on watermelon than other crops. This shows that *P. crucifere*, *D. undecimpunctata* and *Coccinellidae* spp might have caused serious economic damage than other insects (Table 2). As regard watermelon, observation shows that nearly all the insects observed had serious attack on watermelon except *Z. variegatus* which had significant least infestation. However, similar trend was observed on melon but the attack was less severe when compared with watermelon. This can be attributed to physical or biochemical variations of the tested crops. This observation is in line with Gogi et al. (2010) who reported that plant varieties possess physical and biochemical variations which can be due to environmental stress or genetic makeup which alter the nutritional value for herbivores.

Table 3 shows that the observed insects had made the same significant damage on cucumber. Meanwhile, *D. cucurbitae* had the highest significant infestation on watermelon. However, no significant difference was observed among *A. africana*, *Coccinellidae* spp and *Z. variegatus* infestation on watermelon. With reference to melon, *D. cucurbitae* had the highest infestation when compared with other insects, *A. africana* and *Z. variegatus*. Generally, it was observed *D. cucurbitae* heavily attacked watermelon and melon fruits through oviposition. Meanwhile, *D. cucurbitae* can be described as the major insect pest of watermelon and melon.

Based on this result, cucumber plant had least insect infestation when compared with other crops. This is an indication that cucumber might have possessed certain deterrent chemicals or antinutrients properties against

Table 2 Distribution of insects at flowering stage at two weeks interval

	Crops		
Observed insects	cucumber	watermelon	melon
Phyllotreta cruciferae	4.00^{a}	6.00^{ab}	7.33^{ab}
Diabrotica undecimpunctata	4.33^{a}	8.67^{a}	5.33^{ab}
Aulocophora africana	4.33^{a}	5.67^{ab}	4.67^{b}
Monolepta spp.	3.00^{ab}	8.33^{a}	1.67^{c}
Coccinellidae spp.	4.00^{a}	7.67^{a}	4.67^{b}
Zenocerus variegatus	1.67^{ab}	2.67^{b}	4.67^{b}
Dacus cucurbitae	0.33^{b}	8.67^{a}	8.00^{a}

Means with the same alphabet along the column are not significantly different at P = 0.05

Table 3 Distribution of insects at fruiting stage at two weeks interval

	Crops		
Observed insects	cucumber	watermelon	melon
Phyllotreta cruciferae	0.33^{a}	3.67^{bc}	2.67^{b}
Diabrotica undecimpunctata	1.33^{a}	4.67^{b}	1.00^{bc}
Aulocophora africana	0.33^{a}	0.67^{d}	0.00^{c}
Monolepta spp.	1.33^{a}	2.67^{c}	2.00^{b}
Coccinellidae spp.	1.67^{a}	1.00^{d}	1.33^{bc}
Zenocerus variegatus	0.33^{a}	0.33^{d}	0.00^{c}
Dacus cucurbitae	1.00a	9.00a	8.00a

Means with the same alphabet along the column are not significantly different at P = 0.05

the studied insects. Whether a plant is accepted or rejected as food by insects depends largely on it chemical composition in addition to physical factors such as toughness, hairiness etc. In addition, chemical inhibitors play an important role in the inhibition of oviposition on host plants (Afzal et al., 2009; Stotz et al., 1999). The result presented in figure 1 shows that watermelon had 30% defoliated leaves followed by melon. Meanwhile, cucumber had the least defoliated leaves (10%) at 2 week after planting (WAP). However, at 3 WAP watermelon had the highest percentage defoliated leaf while cucumber had the least. At 4 WAP, none of the leaves was defoliated by leaf feeding insects on cucumber but watermelon and melon had the same percentage defoliated leaves (20%). But at 5 WAP, 20% of watermelon leaves were defoliated while cucumber leaves were not attacked by the leave eating beetles. At 6 WAP, none of the leaves of cucumber and melon was defoliated but 10% of watermelon leaves was defoliated. At 7 and 8 WAP all the tested crops were not attacked by leaf eating beetle. This result clearly shows that as maturity of the leaves increased, the level of insect infestation decreased. This may be attributed to the variation in the quantity and quality of the nutritional or chemical traits of the leaves. The literature also confirms that chemical compounds such as alkaloids and terpenoids have antibiotic and antixenosis effect on herbivores (Kennedy and Barbour, 1992).

The data suggested that watermelon had the highest leaves attacked followed by melon. The visual observations in the field show that cucumber leaves have more trichomes than melon while watermelon had the least trichomes. However, the authors reported that glandular trichomes have chemical exudates that confer resistance through antibiosis and kill or reduce pests, feeding on them and entrap pests that forage on the leaves (Simmon and Gurr, 2005). Also, other plants physical traits such as leaf pubescence, epicuticular wax toughness, thickness and so on can reduce survival of progeny and feeding of adult insects (Kennedy and Barbour, 1992). This might have been attributed to the low infestation observed on the cucumber leaves.

Figure 1 shows that 10% and 20% of the flower of watermelon were defoliated at 7 and 8 WAP respectively while none of the flower of melon and cucumber was attacked. But at 9 WAP, watermelon has the highest percentage defoliated flowers (30%) followed by melon (10%) while none of the flower of cucumber were defoliated. Meanwhile at 10 WAP, 20% of the flower of watermelon was defoliated while none of the flower of cucumber was defoliated. However, at 11 WAP, the tested crops were not attacked. Generally, watermelon has the highest percentage of defoliated flowers followed by melon. This may be due to physical appearance of the flower (such as colour) and late flowering of some plant. According to Parachnowitsch et al. (2012); flowering phenology and late flowering genotypes often escape insect pests.

The result shows that 1% of the cucumber fruits were damaged while watermelon has the highest fruit damaged (33.3%) followed by melon (20%).

This variation in the fruit damage may be due to different level of allelochemicals compounds of the fruits. Total sugar (reducing sugar and non-reducing sugar) and pH are low in resistant fruits and high in susceptible ones, whereas tannis, phenols, alkaloids and flavonoid content are high in resistant fruits and low in susceptible one (Gogi et al., 2010; Ismail et al., 2010).

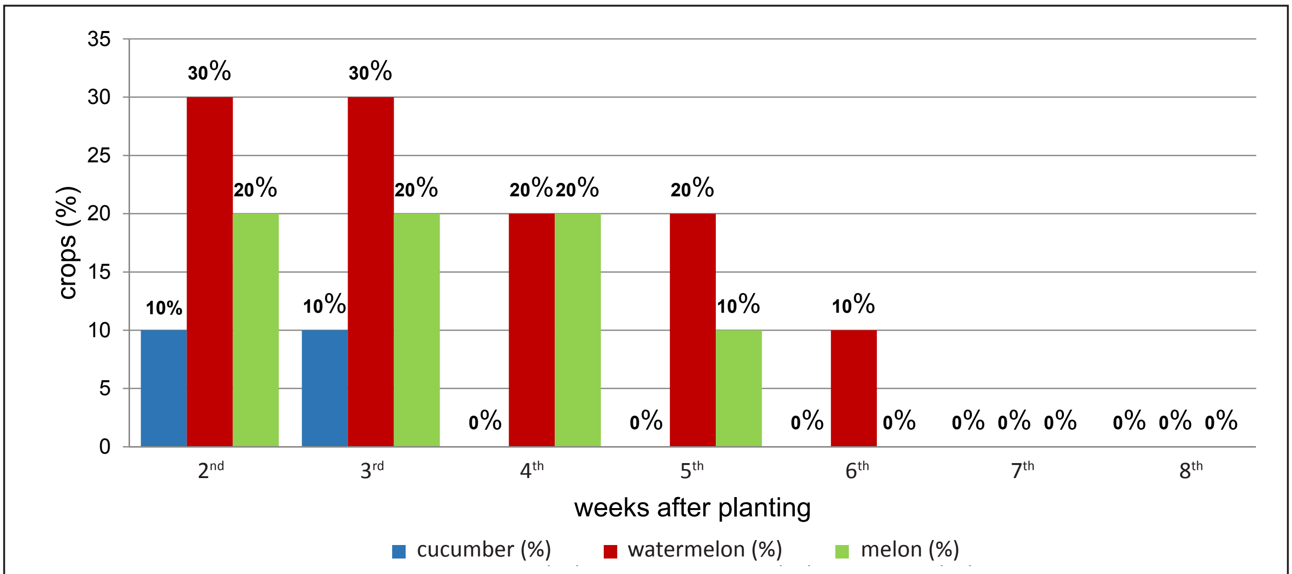

Figure 1 Percentage (%) of Defoliated Leaves Per Week

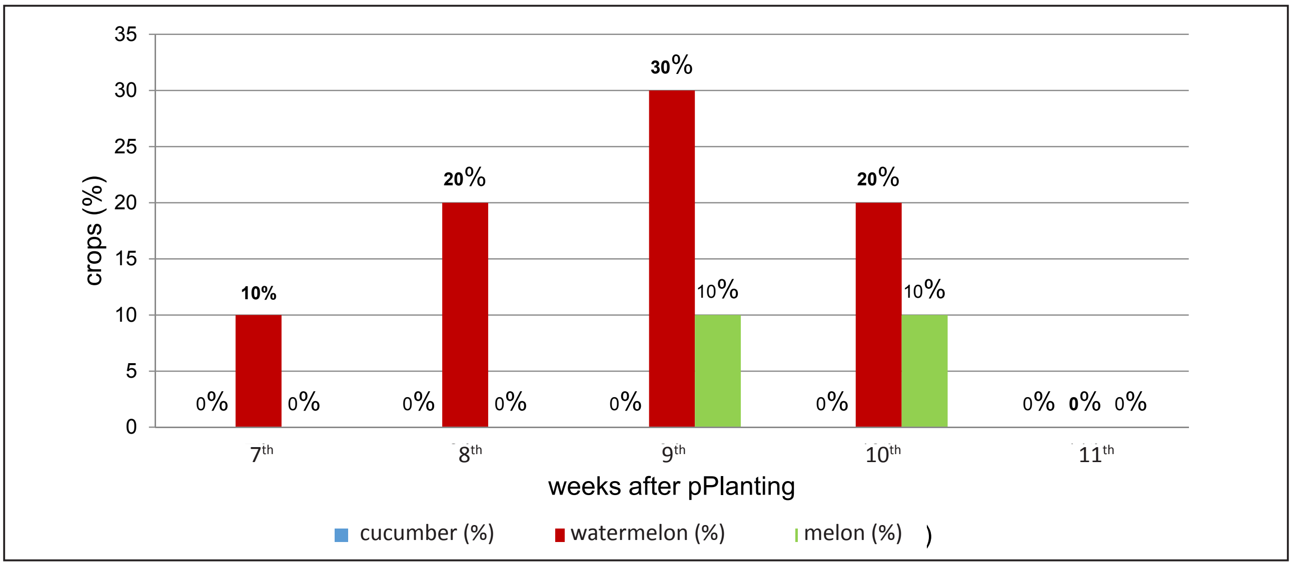

Figure 2 Percentage (%) of Defoliated Leaves Per Week

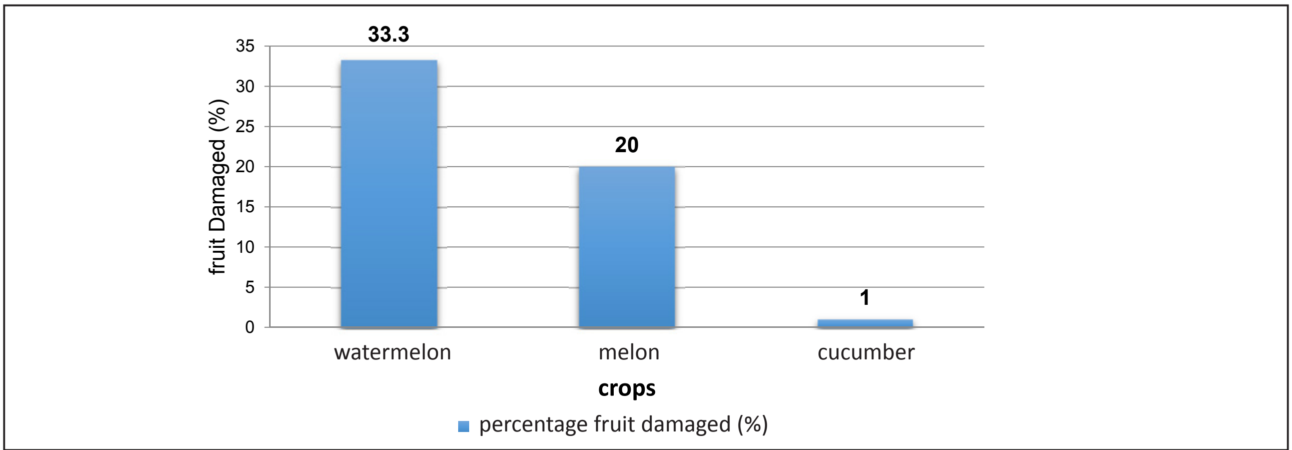

Figure 3 Percentage (%) damaged fruit

4 Conclusions

The field observation showed that eight major insects were observed on the three selected crops. *cucurbitae*, *D. undecimpunctata*, *Z. variegatus*, *A. africana*, *Monolepta* species and *Coccinellidae* species are the major leaf eating beetles. Meanwhile, *P. cruciferae*, *D. undecimpunctata* and *Monolepta* species also attacked the flowers of the target crops the intensity of infestation was not significantly high when compared to the level of infestation by *D. cucurbitae*. Among the observed insects, *D. cucurbitae* caused more economic damaged to the tested crops because it attacked the productive part of the plants which were flowers and fruits.

Among the observed insects, *P. cruciferae* constituted the largest population density at vegetative stage. Watermelon was observed to be highly susceptible to the studied insects' meanwhile cucumber had the least infestation. Differences in the susceptibility rate can be linked to the nutritional and chemicals of the leaves such as alkaloids and terpenoids which have antibiotic and antixenosis effect on herbivores (Ismail et al., 2010). Afzal et al. (2009) and Stotz et al. (1999) also support the view that chemical composition and physical factors play major role in the inhibition of oviposition on host plants. This assessment of insect pests infestation will greatly assists in the management of insect pests and judicious use of pesticides.

Further research will be conducted to determine the level of alkaloids, terpenoids and proximate composition on the fruits of the selected crops in relation to insect infestation.

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