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Assessment of African Star Apple (*Chrysophyllum albidum*) Fruit Damage Due to Insect Pests in Ibadan, Southwest Nigeria

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ABSTRACT

Damage of fruits by insect pests is one of the major problems faced by fruit sellers in many parts of the country. African star apple *Chrysophyllum albidum* G.Don. is one of the indigenous fruits that are highly damaged by insect pests during the fruiting season and in storage. A survey of markets and environs were carried out in Ibadan metropolis during the fruiting seasons for two years to determine the associated insect pests and the extent of damage done to *C. albidum*. Samples of ripe fruits were randomly collected from seven markets and homestead trees at different locations in Ibadan metropolis. Samples were examined in the laboratory at the Federal College of Forestry for damage and the causative agents were identified. Collections made periodically from green fruits to ripening in orchard at Forestry Research Institute of Nigeria showed that infestation of unripe fruits was by scale insects *Coccus hesperidum* L. while the ripe fruits were mainly attacked by fruit flies (*Drosphillla* spp. and *Cerattis capitata* Weid). Infestations were most severe in the market samples than the homestead tree samples. Severity of infestation ranged between 10-35% of the sampled fruits during the periods of the study. There were no significant differences ($p>0.05$) in the number of fruit fly species collected from different markets or from trees in the sampled locations. There were positive and negative correlations between the ripeness of fruits and attack by fruit flies and scale insects respectively.

Key words: Nigeria, indigenous fruits, damage, *Ceratitis capitata, Coccus hesperidum*

INTRODUCTION

African star apple *Chrysophyllum albidum*, G.Don Sapotaceae is a common tree that distributed in the tropical rain forest and coastal region of West Africa. It is primarily a forest tree species and its natural occurrences have been reported in diverse ecozones in Nigeria, Uganda, Niger Republic, Cameroon and Cote d'lvoire (Bada, 1997).

The plant often grows to a height of 36.5 m though it may be smaller (Bada, 1997). The African star apple fruit is a large berry containing 4-5 flattened seeds or sometimes fewer due to seed abortion (Keay, 1989).

The plant recently has become a crop of commercial value in Nigeria. The fleshy pulp of the fruits is eaten especially as snack and relished by both young and old (CENRAD., 1999). The fleshy and juicy fruits, which are popularly eaten, are the potential source of a soft drink (ICRAF., 2007; Okafor, 1981). The fruits are also suitable for the production of fruit jams and jellies (Ureigho and

Ekeke, 2010). It is reported as an excellent source of vitamins, irons, flavours to diets and raw materials to some manufacturing industries (Adisa, 2000; Bada, 1997; Okafor and Fernandes, 1987; Umelo, 1997).

The bark, foliage and fruit of some *Chrysophyllum* species are also used in traditional medicines. The African star apple is produced commercially in West Africa (Amusa *et al*., 2003; Falade and Aworh, 2004).

Ecologically, the tree has an efficient nutrient cycling and the high rate of mineralization of the leaves improves the quality of the top soil. Adesina (2005) and Achinewhu (1983) reported that fruit pulp of Chrysophyllum *albidum* contains 21.8 mg/100 g ascorbic acid and the skin contains 75 mg/100 g while Edem *et al*. (1984) reported 446 mg and 239 mg/100 g for pulp and skin respectively.

In spite of deforestation, which has resulted in substantial loss of these indigenous fruit trees, the remaining few ones which are being conserved are now undergoing domestication problem (Adisa, 2000). However, the joy of good fruit harvest by individual farmer or forest dweller is shorter-lived. This is because substantive percentages of the harvested fruits are lost due to post-harvest and marketing problems (Ladipo, 1994). The plant is susceptible to attack by various pests and diseases leading to low germination, seedling mortality and reduction in quantity and quality of fruit yield (Adelaja, 1997). Insect pests are one of the major constraints that have limited the quantity and quality of fruits produced in the country. However, there is limited information on the level of damage done by insect pests on *C. albidum* fruits. This study is therefore aimed at identifying the insects that cause damage to *C. albidum* in Ibadan metropolis, determine their extent of damage and estimate fruit loss due their attack.

MATERIALS AND METHODS

Market survey: Surveys were conducted for two years in seven fruits markets in Ibadan during the harvesting periods of *C. albidum*. However, Oja-aba market was not sampled during the first year due to logistic problems. Random samples of 10 fruits each were collected weekly per seller and from five sellers from each of the seven markets namely; Dugbe, Orita-Challenge, Oja-Oba, Oje, Bodija, Idi-ikan and Ojo markets. The sellers were interviewed using questionnaires on the sources of their *C. albidium* fruits, insect damage and control methods applied against insect pests. The fruits were bulked for each market, carried to the laboratory at the Federal College of Forestry Ibadan and were dissected to observe for larval presence. The mean number of larvae per fruit was determined for each market. The Larvae were maintained in the damaged and reared in cages to adult hood for proper identification. The emerged adult insects were identified at the National Horticultural Research Institute of Nigeria (NIHORT) Ibadan using available keys.

Field sampling for insect pests attacking *C. albidum* on farm: Fruits on ten trees randomly selected in the *C. albidum* orchard in the Forestry Research Institute of Nigeria (FRIN) Ibadan were sampled fortnightly by collecting ten fruits per tree. Fruit collections were made from unripe to ripe stages. The fruits were given arbitrary rating of 1-3 according to their level of ripeness. i.e., 1 = Unripe, 2 = Ripening and 3 = Ripe. During sampling, the canopy of each tree was divided into 2 strata and fruits were taken from five points along the circumference of each stratum; thus totaling ten fruits/tree. Fruits from each tree were bagged, labeled and taken to the Laboratory at NIHORT, Ibadan for insect isolation and identification.

Ten ripe fruits were also collected weekly from homestead trees at five local government areas in Ibadan metropolis. They include; Oluyole, Ido, Ibadan south east, Ibadan south west and Ibadan North local government areas. Three trees were sampled per Local Government. Fruits from each location were bagged, label appropriately and taken to the laboratory at FRIN for insect isolation and identification. External observation of the fruits was made before dissecting for fruit fly larval assessment. Any insect encountered both externally and internally was recorded. The larvae found in the fruits were reared to adulthood within the fruits in the rearing cages and were identified using available keys.

Statistical analyses: Descriptive statistics was used for variable assessed in the market survey, Data collected on the number of insect larvae found on dissected fruit were subjected to Analysis of Variance (ANOVA) and Duncan Multiple Range test was used to separate the means of significant tests. Correlation analyses were conducted separately between scale insect and fruit fly populations and the level of ripeness of *C. albidum* fruits.

RESULTS AND DISCUSSION

Insects of two dipterous genera were identified to be causing damage to the *Chrysophyllum albidum* fruits at market, the homestead trees and star apple orchard in Ibadan. The dipterous species were *Drosophilla* spp. (Diptera; Drosophyllidae) and *Ceratitis capitata* Weid (Diptera; Tephridae). *Drosophilla* were more prominent than *Ceratitis* but the latter caused more damage to *C. albidum* fruits. Scale insects *Coccus hesperidum* L. (Homoptera; Lecomidae) were identified on green fruits collected from FRIN orchard. These decreased as the fruits ripened. Although some fruits did not show any external signs of damage, fruit fly larvae were isolated from them when dissected. This corroborated the answers to the questionnaire administered to sellers whereby they claimed to be ignorant of the probable ways of insect infestation.

Market samples showed that Dugbe had the highest fruit flies attack with 30 and 35% of larvae infestation on the first and second year respectively. This was followed by Idi-ikan market 30 and 32% for first and second year respectively (Table 1). Fruit Samples collected from markets had more larval infestation than those collected from homestead trees. Percentage of attacked fruits ranged between 15-30 and 10-35% for fruit samples of homestead trees and markets samples respectively.

The results of the homestead trees showed that infestation was higher at Oluyole Local Government with maximum of 25 and 30% fruit damage followed by Ibadan north local government 18 and 21.66% for first and second year, respectively (Table 2). The trend in the

Table 1: Fruit damage by insect pests in market samples in Ibadan

	Fruit damage (%)	
Markets	First year	Second year
Dugbe	30	35
Orita-	28	33.3
Oja-Oba	*	31.66
Bodija	25	28.33
Oje	26	31.66
Idi Ikan	30	32
Ojo	10	15

*: Not sampled during the first year due to logistic problems

Table 2: Fruit damage by insect pests in homestead tree samples in Ibadan

	Fruit damage (%)	
Locations	First year	Second year
Oluyole Local Govt.	25	30.00
Ido Local Govt.	16	20.00
Ibadan North Local Govt.	18	21.66
Ibadan Southeast Local Govt.	15	18.33
Ibadan Southwest Local Govt.	16	20.00

Table 3: Population of *C. capitata* and *Drosophilla* spp. in the market samples in Ibadan

	C. capitata		*Drosophilla* sp.	
Markets	First year	Second year	First year	Second year
Dugbe	1.80	3.30	2.80	4.10
Orita challenge	1.60	3.10	0.50	3.00
Oja-oba	*	3.30	*	3.80
Bodija	1.80	3.20	2.50	4.00
Oje	1.40	2.80	2.80	4.20
Ojo	1.00	1.80	1.00	2.00
Idi-ikan	1.20	2.70	2.00	2.70
Significance	Ns	Ns	Ns	Ns

Ns: Non significant at p = 0.05, *: Not sampled during the first year due to logistic problems

Table 4: Population of insect pests of *C. albidium* in an orchard in Ibadan

	Sampling periods (weeks)			
Descriptions	1	2	3	4
Mean damage (%)	4	4	10	27
Mean number of scale insects/fruit	1.7	1.2	0.2	0
Mean larval number /fruit fly	0.6	0.7	1.0	1.6

results indicated that the fruit fly population was increasing with time since no control measure was applied as reported by the fruit sellers. The mean population of *C. capitata* larvae/fruit ranged from 1.0-1.8 and 1.8-3.3 for first and second year respectively while the mean population of *Drosophilla* larvae/fruit ranged from 0.5-2.8 and 2.0-4.2 for first and second year respectively in the various markets sampled (Table 3).

Thirty percent (30%) of the traders indicated that they purchase their fruits from nearby villages, while 70% purchased from suppliers who transport the fruits from the villages to the various markets. All the sellers claimed to have purchased clean fruits. However, market observations indicated poor storage system. The fruits were often exposed and thus subjected to further attack by the fruit flies. This contributed to higher infestation recorded on the samples collected from the market. The present investigation revealed that fruit flies are limiting factors to the quantity and quality of marketable *Chrysophyllum albidum* fruits based on the level of damage observed.

In the orchard, insects identified on green fruits (especially around the fruit stalk) were the scale insects *C. hesperidum*. They were absent on fully ripe fruits when various periods of sampling were compared (Table 4). The numbers of damaged fruits, scale insects and fruit flies showed significant differences between the earlier and later sampling periods ($t = 3.19$, $p<0.01$; 2.13, $p<0.04$; 2.46, $p<0.02$, respectively). Correlation analysis of scale insect population against level of ripeness indicated that the number/fruit decreased with level of ripeness of the fruit ($r = -0.84$; $p<0.02$). Fruit attack by scale insects in the orchard may have contributed to infection by rot fungi, especially in the region of fruit stalk where the scales were attached prior to ripening. The number

of fruit fly larvae in the fruits increased as the fruit ripened (Table 4) and was positively correlated with the level of ripeness of the fruits ($r = 0.82$; $p<0.003$). The result of the increased population of fruit fly larvae with the increased level of the fruits ripeness agrees with the observation made by Dhouibi *et al*. (1995), Umeh *et al*. (1998) that citrus fruit attack by *C. capita* increases with the increase in the level of ripeness. The preference of ripe fruits are linked to changes in the physio-chemical properties of such fruits (Umeh *et al*., 2009) making them more attractive to the fruit flies *Drosophilla* sp. was predominant over *C. capitata*, this also agrees with observation made by Umeh *et al*. (2002) on the study of insect pest of *Chrysophyllum albidum* fruits in south west Nigeria. There was no significant differences ($p<0.05$) in the number of *Drosophilla* sp. collected at different markets or locations of the homestead trees. However, *C. capitata* showed a significant difference only at the 5th week ($p>0.05$) at both market and homestead tree samples.

CONCLUSION

Therefore, Intensive efforts should be geared towards providing the basic information needed for designing a suitable integrated pest management strategy for the crops in the field. Fruit sellers should be educated on the appropriate methods for preserving fruits to reduce pest infestation and thus mitigate economic losses.

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