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SURVEY AND IDENTIFICATION OF STORAGE INSECT PEST OF *Tamarindus indica* (L) IN ZAMFARA STATE, NIGERIA

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ABSTRACT

A Survey of storage insect pests of *Tamarindus indica* in Zamfara State was conducted in order to identify the storage insect pest of *T. indica* and to determine the nature of insect pest damage on the fruit. Eight markets were selected based on the concentration of tamarind marketers and convenient sampling was used to select 10 tamarind marketers given a sample size of 80 respondents. Semi structured Questionnaire was used to collect demographic data of tamarind marketers. The data obtained were analysed using descriptive statistics. The result of the identification of storage insect pest of tamarind indicated *Caryedon serratus* as the sole insect pest of stored tamarind. Results indicated that all the tamarind marketers (100%) were male and 35% of them are within the age group of 41-70 years, while 91.25% are married. Results revealed 75% had Quranic education, 37.5% spent 20 years and above in tamarind marketing. The result of the nature of insect damage on the fruit revealed that the pest bore into seed and damage the kernels of the tamarind. It was evident from the research that *C. serratus* was prevalent in the study area in all markets visited, which the consequence is the destruction of quality of the tamarind fruit rendering it unfit for consumption. Preventive measures against the insect pest from infesting tamarind in storage are therefore recommended.

Keywords: Survey; Identification; Storage insect; *T. indica*

INTRODUCTION

Over the years, forest produce contributed significantly to economic development, industrial growth and general welfare of the world population (Jimoh and Onabanjo, 2012). Forest products have been gathered for food, medicine, fibers, resins, bio-chemicals, oil as well as animal feed. The tropical forests of Nigeria are rich in plant species (biodiversity) with high potentials to meet the fundamental needs of man which are basically food, shelter, and medicine (Zhigilla *et al*., 2016).

Stored forest products are subjected to insect infestation (bruchids, weevils, chalcids, etc). High temperature and moisture conditions of storage provide conditions for insect development. Many of these insects are good fliers and move to newly stored produce from the fields to infest bins. Insects can reach a high population size if left unchecked in bins. Therefore, it is important to control the insect population size before it gains irrevocable damage to the stored forest products (Kulkarni and Joshi, 1998).

Tamarindus indica (L) is a leguminous tree in the family Fabaceae, it is indigenous to tropical Africa (Diallo *et al.*, 2007). The genus *Tamarindus* is a monotypic taxon, *T. indica* is known as tamarind (the trade and English name) having only a single species. It has been cultivated for so long in the Indian subcontinent and sometimes reported to be indigenous to India where it is known as 'tamar-i-hind' meaning date of India (Abubakar *et al.*, 2008). It grows wild in Africa as diverse as Sudan, Cameroon, Nigeria, and Tanzania. In Arabia, it is found growing wild in Oman especially Dhofar, where it grows on the sea-facing slopes of mountains. It reached South Asia likely through human transportation and cultivation by 400 BC (Raghavan, 2006). *T. indica* is widely distributed throughout the tropical belt, from Africa to South Asia, Northern Australia, and throughout Oceania Southeast (Asia, Taiwan, and China) (Julia, 1987).

Tamarind is valued mostly for its fruit, especially the pulp, which is used for a wide variety of domestic and industrial purposes. The pulp is used as raw material for the manufacture of tamarind juice concentrate, tamarind pulp powder, tartaric acid, pectin, tartrates and alcohol. Almost all parts of the tree find some use or the other in food, chemical, pharmaceutical, and textile industries, and as fodder, timber, and fuel (Santosh *et al*., 2011).

According to Kiaya (2014) since the beginning of agriculture (2000 BC), farmers and produce marketers have been concerned about losses recorded after harvest and during processing, due partly to spoilage, insects, and rodents. This problem aggravates and becomes of greater importance as world food demand grows. Controlling postharvest losses could presumably add a sizable quantity of food to the global food supply. Thus, there is a need to intensify food production for the future, hence the need for this study.

MATERIALS AND METHODS

Study Area

The study area is Zamfara State located in Northwestern Nigeria and occupies 39,762 square kilometers (NBS, 2010). Zamfara state shares borders with Sokoto State and Niger Republic in the north, Katsina State in the east while Kaduna, Niger and Kebbi States to the south (Zhigila *et al*., 2016). It lies within latitude 12^0 10^1N and longitude 6^0 15^1E. According to NBS (2010), the State has an estimated population of 3,278,873 (NPC, 2006). Zamfara state is mainly populated by Hausa and Fulani people, with few Gwari, kumuku, Kambari, Dukawa, Bussawa, and Zabarmawa ethnic communities. Other tribes include the Igbo, Yoruba, Kanuri, Nupe, and Tiv. The State is basically an agricultural state with over 80 percent of the people engaged in various forms of agriculture. Major agricultural products include millet, guinea corn, maize, rice groundnut, cotton, tobacco, and beans.

The climate of Zamfara according to Garba and Dalhatu (2015) is characterized by two climatic seasons; dry season which lasted from (November to April) and the rainy season which commences from May and ends in October. It also has mono-modal rainfall with an annual mean of 1000 mm. The temperature of the area is tropically warm rising up to 38^0C

(Zhigilla *et al*., 2016). The relative humidity is below 70% (Odjugo, 2010). The vegetation of the area falls under the Sudan savanna agro-ecological zone. According to Garba and Dalhatu (2015), consist of short grass forming a matrix for thorny shrubs and scrubs.

Sampling Procedure and Sampling Size

A reconnaissance survey was carried out in order to identify tamarind markets within the state so as to make plan for full implementation of market survey. It was discovered that markets exist for tamarind fruits in the two ADP zones (Gummi and Kaura Namoda), and the two zones were considered for the study. Purposive sampling was used to select four markets in each zone based on the concentration of tamarind marketers. The markets selected were, Shinkafi, Kasuwar Daji, Gusau and Wanke Markets in Kaura Namoda zone, and Talata Mafara, Jangebe, Maru and Gummi markets in Gummi zone; Convenient sampling was employed to select 10 tamarind marketers from each market visited. The sample size was 80 respondents and therefore 80 copies of the questionnaire were administered to tamarind marketers. Information collected includes insect pests of stored tamarind, nature of insect damage on the fruit, the management strategies adopted locally in managing storage insects of the tamarind fruit and area of tamarind collection.

Insect Pest Identification

Infested tamarind fruit samples were collected from each of the four markets visited in each of the two agricultural zones. Collected samples of tamarind were kept in the Laboratory for 6 to 7 days under observation before the emergence of adult insects. After emergence, insects were isolated from the infested tamarind fruit and processed with a 70% alcohol solution. Three insect specimens per bottle were prepared after sterilizing bottles with an autoclave. The specimens were taken to the Entomology unit, Crop Protection Department, Institute of Agricultural Research (IAR) ABU, Zaria for identification. The specimens were identified as *Caryedon serratus*.

Data Collection and Analysis

Data were collected on the demographic information of the tamarind marketers, storage insect pests of tamarind, nature of insect damage on the fruits and areas of tamarind collection.

Data obtained were analysed using Descriptive statistics in form of frequency and percentage.

RESULTS AND DISCUSSION

Demographic Information of Tamarind Marketers

Table 1 showed that 100% of tamarind marketers are male. The result revealed that age range of 41-50 years and 61-70 years have the highest percentages of 35% each. This is followed by 31-40 years range (20%) and the least percentage was observed for 71-80 years of the age range (10%). The result obtained revealed that majority of tamarind marketers are

married men with a percentage of 91.25% and the least percentage of 8.75% are those that are single. Table indicated that 75% of the tamarind marketers had Quranic education, the least percentage of 3.75% is those who went to tertiary institutions. The result showed that majority of tamarind fruit consumed and sold in the state (58.75%) were obtained from zone 1 of the state comprising (Gusau, Shinkafi, Kaura Namoda, Zurmi, Tsafe, and Bungudu Local Government). The least is from Zone II with 41.25% representing (Gummi, Anka, Bukkuyum, Talata Mafara, Maru, Maradun and Bakura Local Government) as indicated in Table 1.

Table 1: Demographic information of tamarind marketers

Variables	Frequency	Percentage (%)
Sex		
Male	80	100
Female	0	0
Total	80	100
Age		
30-40	16	20
41-50	28	35
61-70	28	35
71-80	8	10
Total	80	100
Marital Status		
Single	7	8.75
Married	73	91.25
Total	80	100
Educational Level		
Quranic	60	75
Primary Cert	8	10
SSCE	9	11.25
Tertiary Education	3	3.75
Total	80	100
Experience (years)		
10	26	32.5
20	30	37.5
30	15	18.75
Above 30	9	11.25
Total	80	100
Markets		
Zone I	47	58.75
Zone II	33	41.25
Total	80	100

Source: Field survey, 2019

Problems Encountered by Tamarind Marketers in Storing Tamarind

Result in Table 2 presented two major problems encountered by marketers while storing the product. Results indicated that 98.75% of the tamarind marketers experienced storage insect pest problem, while 1.25% of the respondents attributed the problem to harsh weather conditions.

Table 2: Distribution based on problems encountered in storing tamarind

Storage problems	Frequency	Percentage (%)
Storage insect	79	98.75
Weather condition	1	1.25
Total	80	100

Source: Field survey, 2019

Storage Insect Pest of *T. indica*

Results showed that only one insect pest was identified to be the sole storage insect pest affecting tamarind in all the locations surveyed as presented in Table 3.

Table 3: Insect pest observed infesting tamarind in storage

Insect *T. indica*	Frequency	Percentage (%)
Groundnut bruchid	80	100
Total	80	100

Source: Field survey, 2019

Nature of Insect Pest Damage on the Fruit

The nature of the damage on tamarind fruit was assessed and the result (Table 4) indicated that the insect bore the tamarind fruit and seed with a higher percentage of 93.75%, while 6.25% of the respondents believed that the insect pest attack could lead to changing the color of the tamarind fruit.

Table 4: Nature of damage on the fruit

Damage on fruit	Frequency	Percentage (%)
Changing tamarind taste	5	6.25
Boring tamarind fruit	75	93.75
Total	80	100

Source: Field survey, 2019

Control Measures of Insect on Stored Tamarind

Some management strategies adopted by tamarind marketers in storing tamarind fruit are presented in Table 5, which indicated that the majority of the tamarind marketers (60%) do not apply anything before storing tamarind. But 10% of the marketers use insecticides powder (Nuvan) to manage insects on stored tamarind as also shown in Table 5.

Table 5: Control measures adopted by tamarind marketers

Control measures	Frequency	Percentage (%)
Pepper powder	24	30
Insecticide powder	8	10
None	48	60
Total	80	100

Source: Field survey, 2019

Constraints Faced in Tamarind Marketing

Findings in Table 6 revealed that price fluctuation of tamarind is the major challenge faced by tamarind marketers in Zamfara state and this accounted for 41.25%. The least problem was observed for infestation on stored tamarind which some marketers presumed not to be a problem (1.25%).

Table 6: Constraints faced by tamarind marketers in Zamfara State

Constraints in business	Frequencies	Percentage (%)
Insect problem	1	1.25
Tamarind scarcity	4	5
Price fluctuation	33	41.25
Law patronage	20	25
Small capital	22	27.5
Total	80	100

Source: Field survey, 2019

Effect of *C. serratus* Infestation on Market Value of Tamarind

Table 7 indicated that 77.5% of the tamarind marketers believed that insect infestation has no effect on the market value of tamarind. The least percentage of the tamarind marketers (7.5%) agreed that insect infestation led to the devaluation of the tamarind fruit.

Table 7: Effect of infested by *C. serratus* on market value of tamarind fruit

Effect on market value	Frequency	Percentage (%)
Devaluation of tamarind	12	15
Changing tamarind taste	6	7.5
No effect on tamarind	62	77.5
Total	80	100

Source: Field survey, 2019

DISCUSSION

The result of the research indicated that all the tamarind marketers are male. This could result from the fact that religion and culture of the area makes the business mostly engaged by men. Results revealed that the age group of most tamarind marketers is within 41-50 and 61-70 years and are mostly married men. This could be due to the majority of tamarind marketers combined farming with tamarind business as second alternative means of livelihood. It was also understood from the result that a greater proportion of tamarind

marketers in the study area were married individuals who used tamarind business as another means of providing family needs aside from farming. The educational level of the tamarind marketers indicated that most of the tamarind marketers had Quranic education, and few of them had formal education. Similarly, most of the tamarind marketers spent more or less twenty years in tamarind marketing. This may imply that they ran farming with tamarind business to supplement the family income. The research result showed that a greater proportion of tamarind consumed and sold elsewhere in the State are sourced from ADP Zone I of the State because of the large expense of land in the area with abundant tamarind tree stands due to climatic and site conditions of the area that favors tamarind production.

The result revealed that *Caryedon serratus* is the sole insect pest attacking tamarind in the study area. The insect pest belongs to Bruchidae family, it is grayish-brown in color with white spot on the head and has segmented body (head, thorax, and abdomen), compound eyes, two pairs of segmented antenna, three pairs of legs that are attached to thorax. This finding is in line with Manjunath *et al.* (2018) who described the morphology of *C. serratus* as grayish-brown in color with the segmented body. Head with eyes and pronotum, cylindrical segmented antenna. Furthermore, the abdomen is covered by elytra with terminal pygium. The reason for the presence of this insect pest could be attributed to the location of the area within the tropical region of Africa with an environment that favors the growth and development of this insect pest. This is in line with the finding of Arnett *et al.* (2002) who revealed in a study that, the species is dominant in Africa, Caribbean, Europe, and Northern Asia (excluding China), Oceania and South America. *C. serratus* is also found in tropical Asia and African countries breeding on common trees such as *T. indica* L, *Cassia fistula, Acacia arabica* as well as on harvested groundnut.

The majority of the tamarind marketers observed that *C. serratus* insect is responsible for infesting and boring the tamarind fruit in storage. This could be due to nature prognathous mouth part of the insect which has the ability to eat the fruit and bore into the seed of tamarind. This finding is in line with the report of Sakhare *et al.* (2018) which revealed that *C. serratus* is the only species of insect pests that can penetrate hard pods to infest kernels causing varying degrees of losses from 19.0 to 60 percent. However, Yusuf *et al.* (2019) reported *C. serratus* as insect pest of tamarind responsible for low yields due to its ability to infest the tree at different stages (fruits and seeds) in both field and store. The insect bore into the seed, feed on the pulp internally and leave behind its excreta which deteriorates the market value of the fruit. Also Patta (2003) stated that, a qualitative losses of 85 per cent in pods of groundnut and 64.7 percent in kernels with weight loss of 34.9 percent in pods and 27.1 per cent in kernels, with decrease in oil content from 3.5 to 3.3 percent and increase in free fatty acid content indicating qualitative degradation of oil in groundnut was attributed to *C. serratus.* This insect is a serious pest of tamarind, groundnut, shea butter and locust bean in storage. It was found out that, the pest can damage groundnut both shelled and unshelled and tamarind in storage to an unacceptable state rendering it unfit for consumption for both humans and livestock. This finding also agreed with Oaya *et al.* (2012) who reported that *C. serratus* could give up to 80 and 90% loss on unshelled and shelled groundnuts respectively within three months of storage. In addition to this, 78.68% loss was also recorded within the same period of storage with tamarind.

CONCLUSION

It was evident from the research that *Caryedon serratus* was prevalent in the study area in all markets visited, which has the tendency of reducing the quality of tamarind fruit rendering it unfit for consumption.

Based on the findings of the research it was recommended that, preventing this insect pest from infesting tamarind in storage is necessary to maintain the quality of seed and nutritional content of the fruit for sustainable demand of tamarind for both domestic and industrial usage.

REFERENCES

Abubakar, M., Ukwuani, A., and Shehu, R. (2008). Physiochemical screening and antibacterial activity of *Tamarindus indica* pulp extract. *Asian Journal of Biochemistry,* 2: 134-138.

Arnett, R., Thomas, M., Skelly, P. and Frank, J. (2002). *American Beetles. America*: CRC Press 2nd (Ed). Pp. 88.

Diallo, B., Jolly, H., Mckey, D. and Chevallier, H. (2007). Genetic diversity of *Tamarindus indica* populations: Any clues on the origin from its distribution. *Journal of Biotechnology,* 7: 1-7.

Garba, J. and Dalhatu, S. (2015). Soil erosion constraints to sustainable crop production in central senatorial district of Zamfara, North-Western Nigeria. *Journal of Soil Science and Environmental Management,* 3: 42-50.

Jimoh, S., and Onabanjo, O. (2012). Potentials of *Tamarindus indica* (Linn) in jam production. *Journal of Agriculture and Social Research,* 12: 1-15.

Julia, F. (1987). *Fruits of Warm Climate.* Wipf and Stock Publishers. Pp. 550.

Kulkarni, N. and Joshi, K.C (1998). Insect pest of forest trees seeds: their economic impact and control measures. *Journal of Tropical Forest Science* 10: (4) 438-455.

Kiaya, V. (2014). Post-harvest losses and strategies to reduce them. *Action Contre la Faim (ACF) International*, Pp. 25.

Manjunath, J., Manjunath, K., Hariprasad, K.V., Muralikrishna, T., Prasad, T.N., and Ravindra Reddy, B. (2018). Morphological and genitalia description of peanut seed beetle *Caryedon serratus Olivier*. *International Journal of Current Microbiology and Applied Sciences* 7: (8) 2971-2983.

NPC. (2006). National population commission. census data. Federal Republic of Nigeria.

NBS. (2010). Annual Abstract of statistic. Nigeria: National Bureau of Statistics.

Odjugo, P. A. (2010). Adaptation to climate change in agricultural sector in semi-arid region of Nigeria. *2nd Internatinal Comference: Climate Sustainability and Development in Semi-arid Region*. Fortaleza-Caera, Brazil. Pp. 1-14.

Oaya, C.S., Malgwi, A.M., and Samaila, A.E (2012). Damage potential and loss caused by Groundnut Bruchid *Caryedon serratus* Olivier (Coleoptera: Bruchidae) on stored groundnut and Tamarind in Yola. *Journal of Agriculture and Veterinary Science* 1: (6) 58-62.

Patta, S. (2003). Growth and development of Tamarind Bruchid, *Caryedon serratus* (Olivier) and It's management during groundnut seed storage. *M.Sc. Thesis, Acharya N.G Ranga Agricultural University Rajendranagar, Hyderabad. India.*

Raghavan, S. (2006). *Hand Book of Spices, Seasoning, and Flavoring* 2nd Ed. CRC Press. Pp. 30.

Santosh, S., Bhadoriya, G. A., Jitendra Narwaria, G., and Alok Pal, J. (2011). *Tamarindus indica*: extent of explored potential. *Pharmacognosy Review*, 5: 73-81.

Sakhare, V.M., Mutkule, D.S and Kharade, V.G. (2018). Biology of Groundnut bruchid, *Caryedon serratus (*Olivier*)* on different groundnut varieties. *Journal of Entomology and Zoology studies.* 6: (4) 1577-1580.

Yusuf, S.R., Ado, R.A., Sule, H., and Wudil, B.S. (2019). Infestation and damage by *Caryedon serratus* (Olivier) weevil on stored *Tamarindus indica* (Linneaus) fruits in Kano state, Nigeria. *Asian Journal of Advanced Research and Reports,*5(3):1-10.

Zhigila, A., Cleophas, B., Sawa, B., Sulaiman, D., and Chidibere, C. (2016). Plants species diversity, abundance, and distribution in communities of Zamfara state, Nigeria: implication for conservation. Researchgate publication. Pp. 92-98.