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Shivaji Hausrao Thube
Central Plantation Crops Research Institute-Regional Station, Vittal, Karnataka, India

RTP Pandian
Central Plantation Crops Research Institute-Regional Station, Vittal, Karnataka, India

Bhavishya
Central Plantation Crops Research Institute-Regional Station, Vittal, Karnataka, India

EK Saneera
Central Plantation Crops Research Institute-Regional Station, Vittal, Karnataka, India

C Mohan
Central Plantation Crops Research Institute-Regional Station, Kayamkulam, Kerala, India

NR Nagaraja
Central Plantation Crops Research Institute-Regional Station, Vittal, Karnataka, India

Correspondence
Shivaji Hausrao Thube
Central Plantation Crops Research Institute-Regional Station, Vittal, Karnataka, India

Major storage insect pests of Arecanut *Areca catechu* L. - A Survey

Shivaji Hausrao Thube, RTP Pandian, Bhavishya, EK Saneera, C Mohan and NR Nagaraja

Abstract
Present study was carried to access the major storage insect pests complex of arecanut, a survey was carried out in 30 different arecanut godowns at coastal region of Karnataka during May, 2017. Among the major storage insect pests recorded, flat grain beetle *Cryptolestes pusillus* (Schönherr) was most serious with 58.33 per cent infestation followed by cigarette beetle *Lasioderma serricorne* (Fabricius) with 21.74 per cent infestation, palm seed borer *Coccotrypes carpophagus* (Hornung) with 13.58 per cent infestation, coffee bean weevil *Araecerus fasciculatus* with 5.34 per cent infestation (DeGeer) and red flour beetle *Tribolium castaneum* with 0.9 per cent infestation (Herbst). Grade wise (fresh nuts = less than one year old stored nuts; single chole = more than one year old stored nuts; double chole = more than two year old stored nuts; and patora = cracked nuts of one year old storage) per cent damage of insect pests were also recorded during this study. Highest per cent damage recorded in patora (45 per cent) followed by fresh nuts (35.22 per cent), double chole (25.55 per cent) and single chole (14 per cent). Predatory anthocorid bug *Xylocoris flavipes* feeding on different stages of flat grain beetle *Cryptolestes pusillus* was recorded during study.

Keywords: arecanut; storage pests; *Cryptolestes pusillus*; per cent incidence; grade wise analysis; *Lasioderma serricorne*

1. Introduction
Arecanut (*Areca catechu* L.) is an extensively cultivated tropical palm and the dry kernel is used for masticatory purpose. The major arecanut growing countries are India, Sri Lanka, Bangladesh, Malaysia, Indonesia and Philippines [6]. India leads the world in production followed by Sri Lanka and Bangladesh. In India, arecanut is cultivated in about 4 lakh ha with a production of 4.78 lakh tonnes of nuts [8]. Arecanut is predominantly cultivated in traditional states like Karnataka, Kerala and Assam [4]. The productivity of arecanut during the last two decades varied between 1188-1640 kg ha^{-1} [3]. Planting material, higher trunk biomass, pests and diseases, low nutrient use efficiency and susceptibility to water stagnation/stress are the yield limiting factors in arecanut [5]. The ripe arecanuts, after harvest, are sun-dried for some days and stored for one year without husking. When market prices are reasonable, the arecanut are husked, and such nuts (chali) are sold in the market [3]. In godowns, this chali is stored in gunny bags for variable periods. Biotic factors including insect pest, arachnids and fungal pathogen causes severe damage to stored nuts which results into the qualitative as well as quantitative loss to the farmer.
Infestation of insect pest i.e *Araecerus fasciculatus* in stored arecanut was first reported during 1963 [1]. Later Nair and Oommen (1969) published his survey report on storage pests of arecanut in Kerala [7]. They listed 14 insects and mites and outlined the biology of the major ones. During 1979, Palm seed borer *Coccotrypes carpophagus* is reported as most serious insect pest of stored arecanut in Mangalore area of Karnataka [2]. As insects are highly adaptive fauna to climate change, their damage potential to crop/stored products may drastically increase in future.
In this study, assessment of major storage insect pests of arecanut was carried out for formulating the effective management strategies to reduce storage losses.

2. Materials and Methods
2.1 Survey
A survey was conducted in storage godowns of Agriculture Produce Market Committee

(APMC), Puttur, The Central Arecanut and Cocoa Marketing and Processing Co-operative Limited (CAMPCO), Mangalore, farmers as well as private vendors from Mangalore, Bantwal, Puttur, Chandalike, Vittal, Shankarnagar, Karkala and Udupi in coastal region of Karnataka.

2.2 Sample Collection
30 arecanut godowns were randomly selected and samples (30 nuts / sample) were collected during May, 2017. Based on the storage period samples were collected from fresh nuts, single chole, double chole and patora. Storage condition of each godown was critically observed.

2.3 Laboratory analysis
For grade wise analysis of collected samples, nuts were broken and insects were isolated for microscopic observation. All distinguishing morphological characteristics of isolated insects were observed with help of dichotomous key prepared by Canadian grain commission under microscope (Leica MZ75 stereomicroscope) and images with measurements were captured using Leica EC4 digital camera. Per cent infestation was calculated using the following formula,

Per cent infestation = Number of damaged nuts / Total number of nuts collected*100.
Per cent population of individual insect species recorded were calculated using the following formula,

Per cent population of individual insect species = Number of particular insect species observed / Total number of insect species observed*100.
By using above parameters kind and diversity of storage insect pests of arecanut were recorded.

2.4 Statistical Analysis
The obtained values of gradewise percent damage of insect pests were subjected to one way ANOVA (Analysis of variance) using https://www.graphpad.com/scientific-software/prism/.

3. Results and Discussion
Only godowns owned by cooperative societies were practising regular prophylactic measures against storage insect pests. Most of the private godowns do not follow regular cleaning and spraying. In order to impart yellowish hue to nuts most of the owner are fumigating there godowns with sulphur dust.
C. carpophagus is reported as major storage insect pest of stored arecanut during 1979 in Mangalore area of Dakshin Kannada district [2]. Over the period of time the trend of infestation is changed and *C. carpophagus* is replaced by *C. Pusillus*. The possible reason of changing this trend may be changes in storage conditions and moisture percentage of stored product. Maximum percent infestation of storage insect pests in arecanut is recorded in fresh nut grade during 1979 [2]. But in this study authors included only three grade i.e. fresh nuts, single chole and double chole. In our study we included four grades i.e. fresh nuts, single chole, double chole and patora. In our study storage pest infestation is maximum in patora grade. Probable reason is availability of cracks and crevices on nuts for egg laying of storage insect pests. Infestation trend in other grades is similar in both the studies. More infestation in fresh nuts is due to availability of more moisture percentage in nuts. Predatory anthocorid bug *Xylocoris flavipes* feeding on immature stages of flat grain beetle, *C. Pusilis* is first time reported from stored arecanut. Predatory potential of this pradator need to be evaluate against all storage insect pest of arecanut in future.
All of the insects recorded during survey damage the nuts by drilling holes into them followed by feeding and pulverising the nuts (Fig. 1). In case of heavy infestation some portion of nuts converted into fine powdered dust. All stages of insects were recorded inside the infested nuts. Highest percent incidence of storage insect pests was recorded in patora followed by fresh nuts, single chole and double chole (Fig. 2). The probable reason for this pattern of infestation may be availability of cracks on patora leads to enhance ovipositon and multiplication of storage pests. Highest incidence of flat grain beetle *C. pusilis* with 58.30 percent population was recorded during the study. Trend of other insect species are depicted in Fig. 3.

Fig 1: Arecanut sample infested by storage insect pests.

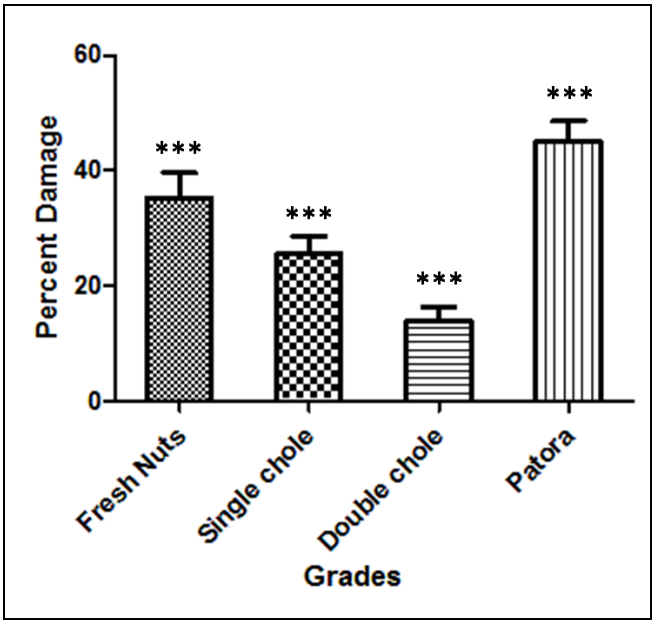

Fig 2: Grade wise percent infestation of storage insect pests in Arecanut (*** indicates significance difference in percent damage among different grades, p=<0.05).

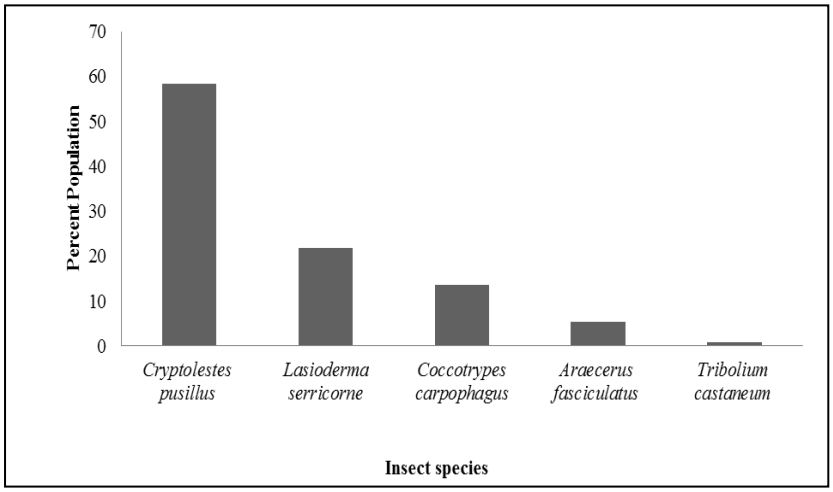

Fig 3: Percent population of major insects collected from from stored arecanut.

The insects and arachnids recorded so far on stored arecanut are listed in Table 1. Major storage insect pests of arecanut are discussed below.

1. Flat grain beetle, *Cryptolestes pusillus* (Schönherr) (Coleoptera: Laemophloeidae)

This pest is recorded from almost all samples collected irrespective of grade or storage period. Adults of this species are flattened, small (1.5 to 2.0 mm) in size, reddish brown in colour with long bead-like antennae (Fig. 4). It is cosmopolitan and is one the common insect pests of stored grain. Damage is usually restricted to stored product under high moisture conditions or relative humidity area. Both larvae and adults feed on stored nuts by boring inside. This insect also responsible for spreading fungal infection across the godowns. Predatory anthocorid bug *Xylocoris flavipes* (Fig. 5) feeding on different stages of *Cryptolestes pusillus* was also collected during survey.

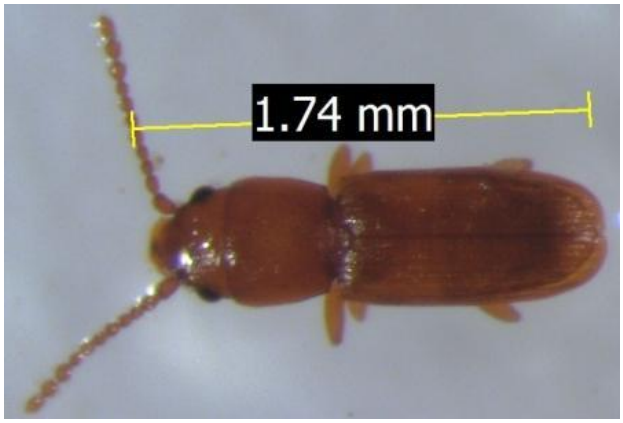

Fig 4: Adult of Flat grain beetle, *C. pusillus*

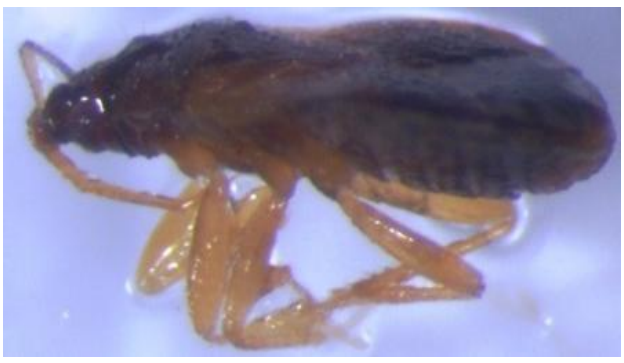

Fig 5: Predatory bug *X. flavipes*

2. Cigarette Beetle, *Lasioderma serricorne* (Fabricius) (Coleoptera: Anobiidae)

Although this pest is recorded from samples belongs to all grades but severe infestation were observed in single chole and patora grade, on the basis of adult collected from respective grades. Adult of this insect is small (2 to 3.5 mm long), reddish brown and oval in shape (Fig. 6). Larvae are white with numerous long hairs (Fig. 7). Larvae feed directly on nuts and in severe infestation nuts can be pulverised. Infestation of this pest can be detected by noticing larval cocoons, frass (excrement) and dead adult beetles in stored commodity.

Fig 6: Adult of Cigarette Beetle, *L. serricorne*

Fig 7: Larva of Cigarette Beetle, *L. serricorne*

3. The coffee bean weevil, *Araecerus fasciculatus* (DeGeer) (Coleoptera: Anthribidae)

This pest is recorded in majority from fresh/new stored nut (less than one year storage period) samples. Fresh nuts

contain more moisture percentage which may be the reason for more infestation of this beetle to the stored nuts. The adult beetle is small (3-4 mm) in size with a humped body outline and long legs (Fig. 8). The dorsal side is interspersed with dark and light brown and the antennae are long with a three-segmented club. Both adult and grub damage the nuts by making holes of 1.5-2.5 mm diameter.

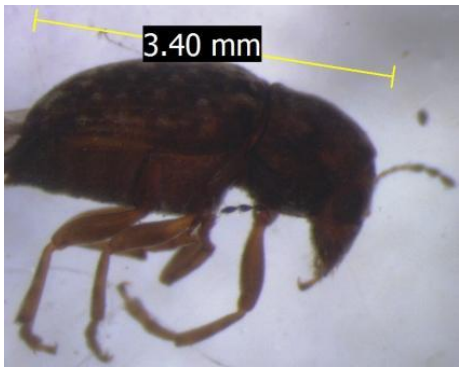

Fig 8: Adult of coffee bean weevil, *A. fasciculatus*

4. Palm seed borer *Coccotrypes carpophagus* (Hornung) (Coleoptera: Curculionidae)

Maximum infestation of this pest is recorded from freshly stored nuts and patora grade. The adult beetle is minute 1.2 to 2.5 mm in length and reddish brown in colour (Fig. 9). The frons is convergently aciculate with sparse, hair-like processes. Damage is caused mainly by the adult beetles which bore into the nuts and feed on internal contents. In samples with 100 % infestation with this insect were recorded.

Fig 9: Adult of Palm seed borer *C. carpophagus*

5. Red flour beetle *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae)

Freshly stored nuts with less than one year period was more infested by this insect pest. Adults are a small reddish brown beetle and are about 3-4 mm long (Fig. 10). Out of total samples collected only one sample was infested by this beetle. This pest is considered as generalist feeder and damage is not readily attributable to this pest. They feed and breed on broken pieces of arecanut and imparts to a pungent odour to the commodity.

Fig 10: Adult of red flour beetle, *T. castaneum*.

Table 1: List of insects and arachnids recorded from stored arecanut

S. No	Name of pest	Family	Authors
1	*Araecerus fasciculatus*	Anthribidae	Ayyar, 1963
2	*Coccotrypes carpophagus*	Scolytidae	Oommen and Nair, 1968
3	*Lasioderma sericorne*	Anobidae	Nair and Oommen, 1969
4	*Corcyra cephalonica*	Galleridae	"
5	*Setomorpha rutella*	Tineidae	"
6	*Ephestia cautella*	Phycitidae	"
7	*Tribolium castaneum*	Tenebrionidae	"
8	*Alphitobius piceus*	Tenebrionidae	"
9	*Microcrypticus scriptipennae*	Tenebrionidae	"
10	*Cryptolestes pusillus*	Cucujidae	"
11	*Carpophilus mutilatus*	Nitidulidae	"
12	*C. pilosellus*	Nitidulidae	Danial and Kumar, 1979
13	*Ahasversus advena*	Cucujidae	Nair and Oommen, 1969
14	*Attagenus gloriosae*	Dermestidae	"
15	*Thaneroclerus buquet*	Cleridae	Danial and Kumar, 1979
16	*Sitophilus oryzae*	Curculionidae	"
17	*Psocid* sp.	Psocidae	"
18	*Tyrophague putrescentiae*	Acaridae	Nair and Oommen, 1969

(Mariamma Daniel and T. Prem Kumar, 1979)

4. Conclusion

The present study revealed that flat grain beetle, *C. pusillus* is most serious storage insect pest of arecanut in all grades. In future to reduce losses due to storage insect pest in arecanut all management efforts should focused on this insect pest. Gradewise analysis of arecanut samples provide evidence that nuts belong to patora grade is most susceptible to attack of storage pests due to presence of cracks on surface. As compare to single and double chole grade fresh nuts are more susceptible due to presence of more moisture in nuts. Interestingly present study also revealed that, anthocorid bug *Xylocoris flavipes* predating on immature stages of flat grain beetle, *C. pusillus*. So, predatory potential of anthocorid bug *X. flavipes* need to be evaluate against all storage insect pests of arecanut in future.

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