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A study on insect pests associated with stored products in Malappuram district, Kerala

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Abstract
The Present paper may help to know about some groups of pests associated with stored products and the seasonal variation of pests. In our study three stations were selected such as site-1 House, site-2 Supermarket and site-3 Ration shop in Malappuram district, Kerala. A total of eight species from 10 different samples of stored products were investigated. The eight different species which were collected from the three different areas come under two different insect orders namely Coleoptera and Lepidoptera. The percentage of species occurrence from three different sites revealed that *Tribolium castaneum* (Red flour beetle) was the most dominant pest which constituted 18.46% of the total insect pest population in the three sites.

Keywords: insect pests, products, supermarket

Introduction

For thousands of years, insects have been a problem associated with storing surplus dried food, with evidence from archeological deposits (Buckland, 1981) and written records (Levinson and Levinson, 1994) [9] of the storage and infestation of cereals stretching back to 3000 BC. In dealing with the insects associated with stored products, it may be advisable to consider some of the terms used in applied entomology. The official term for what the writer calls stored products entomology is 'pest infestation'. The term pest as a troublesome or destructive person, animal or thing; (now rare) pestilence', and it tells us that the word came to us through the French 'peste' from the latin 'pestis' meaning plague. Many kinds of cereal products and other foods stored in kitchen cabinets or elsewhere in the home may become infested with insects or other organisms commonly referred to as "pantry pests". Practically all dried food products commonly found in the home are susceptible, including bird seed and dry pet foods. Pantry pests eat or contaminate food, thus making it unfit for humans. There are three basic ways in which the animal pests of stored products are generally categorized on the basis of systematics, types of damages, and the true stored product pests. true stored product pests, facultative stored product pests (Atwal, 1976) [2]. Control strategies Physical control Inert dusts, Ionizing irradiation, Thermal control, Ozonation, Fumigation, phosphine, and methyl bromide are the two common fumigants used for stored product protection world over (Rehman, 1942) [13].

Nowadays, many changes have occurred in the daily life of human beings. Lifestyle changes at different levels. Types of foods used by humans were also changed, and advanced technologies were adopted for all purposes. The food products available in today's market were polished and also they were treated with high amounts of chemicals. At the same time, along with these types of treatments, stored food products were infested by pest species. There is a need to know about the stored product pests because not only the pests were infesting the food products stored in the godowns, or markets, but also in the houses too. So this is important to know about the pests associated with stored products, and also the seasonal variation in the abundance of different pests (Cotton, 1956) [5]. This project may help to know about some groups of pests associated with stored products and the seasonal variation of pests.

Materials and Methods

Study Area

The study was carried out in three different sites.

Site-1 House

Site-1 is situated in Malappuram district in the state of Kerala in southern India; on the Malabar coast; belonging to Kannamangalam panchayat (11.43N, 75.90E) and Vengara town. Climate includes four alternative seasons to cover the climate of Kerala. They are the hot season (March-may), Southwest monsoon (Jun- September), Post monsoon (October- November) and north to west monsoon (December-February). The annual temperature ranges below a maximum of 35^0c and a minimum of 23.5^{0c}c only The mean relative humidity ranges from 60-95%. The food products from this area were stored on plastic bottles and buckets. The bottles were placed on the shelf's in the store room. Food products with large amounts like rice and wheat were stored on plastic or jute bags.

Site-2 Supermarket

The second site selected for the collection was a supermarket, this study site comes under the Vengara panchayath and Vengara town (11.43N, 75.90E). This site contains some other commodities rather than food products. The food products from this site were stored mainly in jute bags, and some of them are on plastic bags and the bags were stacked on the floor. Pulses and cereals were stored in small packets, and they were kept on the shelves. The annual temperature ranges below a maximum of 35^0c and a minimum of 23.5^{0c}c only The mean relative humidity ranges from 60-95%.

Site-3 Ration Shop

The Ration shop is situated at the Malappuram district (11.25N, 75.77E). Also known as Achanambalam is a city

in the state of Kerala in southern India; on Malabar coast; belonging to Kannamangalam panchayath. The annual temperature ranges below a maximum of 35.9^0c and the minimum 23.8^0c only. The mean relative humidity value ranges from 60-90%. The annual rainfall is excessive with over 3200. In this site, Food products are stored in a bulk for a short period, rice, wheat, pulses and cereals are the main items stored in this area. Rice and Wheat products were stored on jute or plastic bags and other items like pulses, flour, and cereals were stored in plastic carry bags.

Collection of Sample

Samples of ten selected stored food products were collected from those three sites from January to March (2021). Stored food products from those three sites were carefully analysed and collected different pest species which attack the particular stored grain, and the temperature and humidity of the collection site were recorded with the help of a Thermo hygro-metre. Hundred gram of the selected samples of food products along with the insect pests was collected on separate glass bottles and transported to the laboratory for the preservation of the insect and for further identification.

Preservation of the collected specimens

The collected specimens were taken into the laboratory for further processing. By using an electronic weighing machine 100gm of the food sample was measured. The insect species from the collected samples were counted and observed under the labomed clinical microscope with 10x10 magnification power. After that, the collected specimens were transferred into 70% alcohol by using a fine brush. Count the number of insects present on each sample and was collected the data on temperature and humidity of each collection was recorded. Insect pests collected from ten different samples at three collection sites were stored in separate glass bottles for identification.

Identification of Insects

Identification of pests associated with stored products was made by studying and comparing the morphological characters of the specimen with appropriate literature and standard identification keys. Identified keys are confirmed with the help of experts and research scholars in the field.

Results

A stored food product can become infested anywhere during the process from production until it arrives in your home. However, stored food is most likely to become infested in stores or in homes. Most of the stored food insects also are pests of stored grain or other commodities and may be relatively abundant outdoors. Food products that are left undisturbed on the shelves for long periods are particularly susceptible to infestation. However, foods of any age can become infested. Among the various groups of insect pests, Arthropods are the most diverse and numerous. Of this class, insect is the largest of all other groups in the world. Being the largest group, a detailed study of this group within a limited period is impossible. So that in the present work, I made a preliminary survey on Entomofauna associated with pests of stored products.

Among the various groups of insect pests, Arthropods are the most diverse and numerous. This class, insect is the largest of all other groups in the world. Being the largest group, a detailed study of this group within a limited period is impossible. So that in the present work, I made a preliminary survey on Entomofauna associated with pests of stored products. The samples were collected from three different sites designated as site-1, site-2, and site-3 (House, local store, and Ration shop respectively). The 10 stores collected include with present survey rice, wheat, green gram, green piece, bengal gram, dhal, maida, Sooji, brown gram and black gram. The eight different species collected from the three different areas, orders namely *viz*., *Coleoptera* and *Lepidoptera*. Out of the 7 species from order coleoptera falls under 5 families *viz., Curculionidae, Tenebrionidae, Chrysomelidae, Silvanidae,* and *Bostrichidae.* The lepidopteran species comes under the family *Gelichiidae.*

From the 2 orders recorded in three study areas, it was observed that order Coleoptera is the most abundant with seven families constituting about 92% of the total insect population. Lepidoptera exhibited only 8% of the total population. The percentage of species occurrence from 3 different sites revealed that *Tribolium castaneum* (Red flour beetle) was the most dominant pest which constituted 18.46% of the total insect pest population in the three sites. An abundance of the pest species from three study sites were in the order of *Sitophilus oryzae* (16.77%)> *Callosobruchus maculates* (15.96%)> *Callosobruchus chinensis* (15.25%)> *Oryzoephilus sorinamensis* (9.43%). *Sitotroga cereacella* (8.15%)> *Bruchus pisorum* (7.99%) *Oryzoephilus sorinamensis* (7.98%). (Fig: 1) A comparison of the insect diversity at three different sites follow a differing pattern with respect to site characteristics along with variation in the recorded temperature and relative humidity. The occurrence of the pests of stored products in three different sites followed by the order, site-2> site-3>site-1.

Composition of Insects in Site-1

A total of 20 specimens were collected from site 1 during the study period. The specimens were identified up to the species level and which come under two orders namely Coleoptera and Lepidoptera. The major pest species from site 1 were the rice weevil, *Sitophylus oryzae* from the family Curculionidae. Out of the 20 specimens from site-1, 5 of them were *Sitophylus oryzae*. This is followed by the red flour beetle, *Tribolium castaneum* from the family Tenebrionidae constitutes 3 and next is the cowpea weevi, *Callosobruchus maculates* from the family Chrysomelidae. *Sitotroga cereacella* and *Rhyzopertha dominica* from the family Gelechiidae and Bostrichidae respectively were the species that reported fewer number in the site 1. When humidity increases, the total number of pests will also increase. The relation between the total number of pests with temperature is inversely proportional and that with temperature is directly proportional. The recorded range of temperature and relative humidity was $27\text{-}31^0$c and 72-84% (Table 1) respectively.

Composition of Insects in Site-2

Site 2 shows the maximum number of species when compared to the other sites during the study. A total of 36 species were recorded in this study area. Both Coleopterans and Lepidopterans were recorded. Major pests of this site were the *Callosobruchus chinensis* (pulse beetle) from the family Chrysomelidae constitutes17.65% of total insects and

the red flour beetle (*Tribolium castaneum*) stands in the second position with17.11%. Both the *Bruchus pisorum* From the family Chrysomelidae and *Rhyzopertha dominica* constitutes 6.63%, and which is recorded as the minor pest of this site. Number of pests decreases with an increase in temperature. The recorded temperature and humidity of this site are 27.3- 30.6^{0}c and 74- 84% (Table 1) respectively.

SITE-3

When compared to site 1 and 2, site 3 has an intermediate position in the number of pests. Number of pests collected from the site-3 during the study were 26. The red flour beetle *Tribolium castaneum* revealed as the major pest of this site which constitutes 21.43% of the insect population and the pulse beetle *Callosobruchus maculates* were in the second position with 19.84% are the two abundant species from this site. The temperature and total number of pests are inverse proportionality. The temperature and humidity of this area were recorded as 28-35.1^{0}c and 77- 79% (Table 1) respectively.

One of the other objectives of my study includes knowing about the control measures taken up by large-scale storehouses. The warehouses are scientific storage structures especially constructed for the protection of the quantity and quality of stored products. Warehousing may be defined as the assumption of responsibility for the storage of goods. It may be called the protector of national wealth, for the produce stored in warehouses is preserved and protected against rodents, insects, and pests and against the ill- effects of moisture and dampness. A number of control measures were taken by the warehousing corporations for the protection of stored food items. The different types of control measures taken up by the department were started during the construction works of the building itself. Chemical method, Fumigation, and Basement treatment are the common methods adopted by the warehousing co.

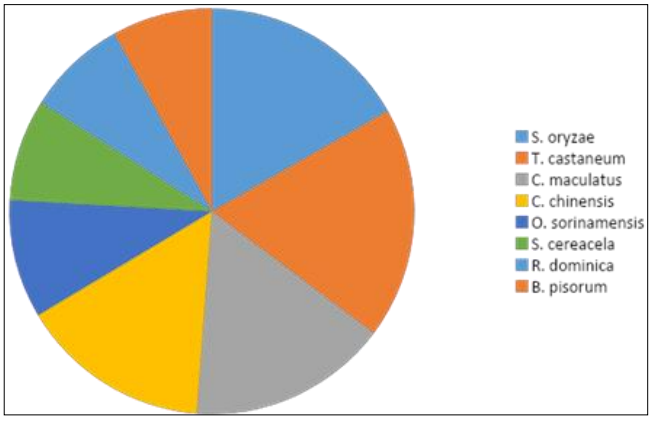

Fig 1: Percentage of pests in three different sites

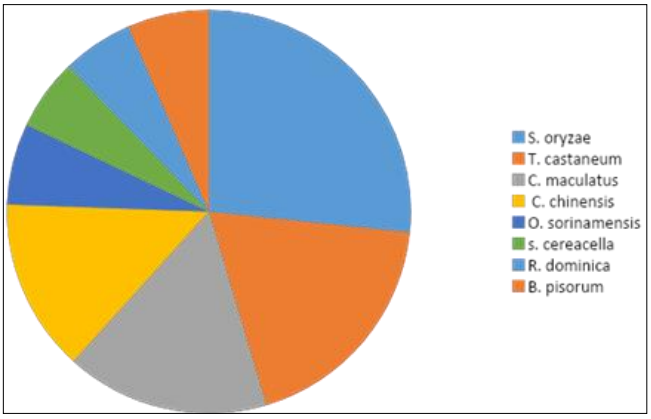

Fig 2: Percentage of pests in site1

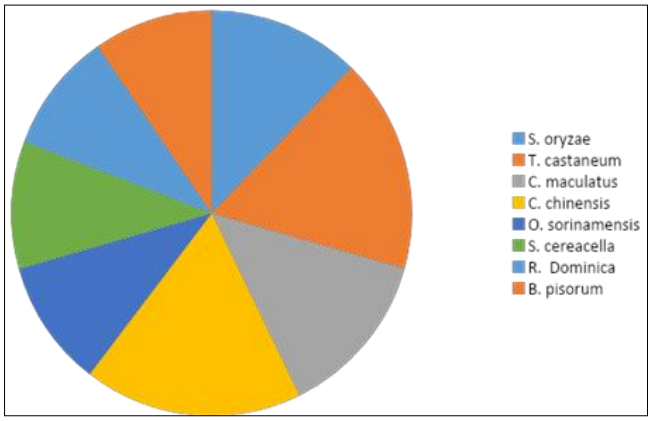

Fig 3: Percentage of pests in site 2.

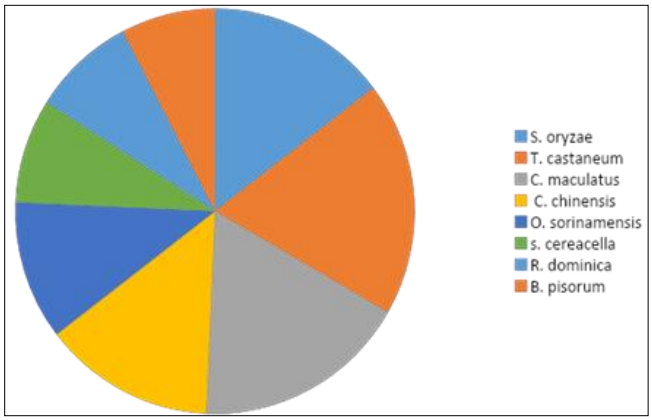

Fig 4: percentage of pests in site 3.

Table 1: Range of temperature and Relative humidity recorded from different sites.

	Site-1		Site-2		Site-3	
MONTH	Temperature (^{0}C)	Relative Humidity (%)	Temperature (^{0}C)	Relative Humidity (%)	Temperature (^{0}C)	Relative Humidity (%)
February	29.8	74	29.7	72	30.2	76
March	30.2	72	30.6	73	34.6	74

Table 2: List of species collected from site-1 along with recorded temperature and humidity

Month	Total number of species	Temperature (^{0}C)	Humidity (%)
February	11	29.8	74
March	9	30.2	72

Table 3: List of pests collected from site-2, along with recorded temperature and relative humidity

Month	Total number of species	Temperature (^{0}C)	Relative Humidity (%)
February	19	29.7	72
March	17	30.6	73

Table 4: List of pests collected from site-3, along with recorded temperature and relative humidity

Month	Total number of species	Temperature (^{0}C)	Relative Humidity (%)
February	15	30.2	76
March	11	34.6	74

Table 5: List of insects recorded in each sampling area.

Name of species	Abundance of species		
	Site-1	Site-2	Site-3
S. oryzae	+++	++	++
T. castaneum	++	+++	+++
C. maculatus	++	++	+++
C. chinensis	+	+++	++
O. sorinamensis	+	+	+
S. cereacella	0	+	+
R. dominica	0	0	+
B. pisorum	+	0	0

Most Abundant +++ Abundant ++ Moderate + Least 0

Discussion

The present study was based on the stored product pests in different habitats in relation to temperature and humidity. From this survey, it is revealed that the presence of pests associated with stored products strongly depends upon the atmospheric temperature and relative humidity as well as the mode of storage. Because insect pests may differ in their host specificity, requirements of temperature and humidity for rapid multiplication, mode of damage to commodities, and also in their susceptibility to insecticides and fumigants, correct identification of the species involved in the depredation of stores is important for successful control operations.

In this survey, site 2 revealed high abundance of stored product pests. This study area is characterized by the bulk amount of stored food products for a long period, compared to the other sites. Probably this may attribute to the high richness of stored product pests on this site. Stored products were infested anywhere including the farm sites, government stores houses markets, and houses also. In this study site 2 (supermarket) revealed a high abundance of stored product pests. It may depend upon many factors including the mode of storage too. A consultant firm estimated storage losses in wheat in Pakistan at government godown, market, and farm level. In their report submitted to the government in 1976, they have shown insect damage in government godowns to rarely exceeding 1%. At the market level, considerable damage has been reported with a maximum of 39.6% and a weighted average of 7.25%. At the farm level also, high weevil damage was observed with a maximum of 16.94% and weighted average of 1.94% (Amitage *et al*.,1994) [1].

During this study, 8 different specimens of stored product pests were collected and identified up to species level. The collected specimens fall under two orders- namely, Coleoptera and Lepidoptera. The earliest published reference to stored grain insect pests in the sub-continent is that of Lefroy (1906) [8]. The listed 16 species of insects infesting grains, of which only 11 are real pests of grains and pulses. The remaining five are pests of leather, silkworm, cocoons, dried fruits and spices. Pingale (1976) [12] has listed 37 species of insects that are pests of various stored products in India. The order Coleoptera, which is the largest order in the class Insecta, is the major order in the stored product pest classification. Order Coleoptera constitutes about 80% of total pests associated with stored products. Hinton (1945) [6] mentioned more than 600 species of beetles associated with stored products in various parts of the world. Beetles are the most diverse group under the Order Coleoptera. From this study also, order Coleoptera was the most abundant group with seven out of the total eight species.

From this study major pest species include *Sitophylus oryzae, Tribolium castaneum, Callosobruchus chinensis and Callosobruchus maculates.* The abundance of this species was highly influenced by physical factors such as temperature and humidity. Janjua and Nasir (1948) reported the hot plains of Baluchisthan presented unfavorable conditions for the development of *Sitophylus oryzae* which again is a major pest of rice, wheat, joar etc.

According to this study, the peak breeding period was from January to June. According to previous studies, the number of pests increases with adecrease in temperature and increase in humidity. In Indian atmospheric conditions humidity ranges increase during December, January, June, July, August, etc. Study also showed that number of pests increased during this months. Sing and Sing (1977) [14] explains the insect fauna condition prevailing in the Midnapur district of West Bengal. Out of the pest species *Sitophylus oryzae, Rhizopertha dominica* was found to be dominant throughout the year. The peak breeding period for most of the insect species was from July to October. Insects flourish at temperature products. On this site, food items were stored in either jute bags or plastic bags, and they were kept on the bare floor. This will provide a chance for pest infestation.

From this survey, it is revealed that the presence of pests associated with stored products strongly depends upon the atmospheric temperature and relative humidity as well as the mode of storage. In this survey, site 2 revealed a high abundance of stored-product pests. This study area is characterized by the bulk amount of stored food products for a long period, compared to the other sites. Probably this may attribute to the high richness of stored product pests on this site. Because insect pests may differ in their host specificity, requirements of temperature and humidity for rapid multiplication, mode of damage of commodities and also in their susceptibility to insecticides and fumigants, correct identification of the insect species involved in the depredation of stores is important for successful control operations.

Heating or cooling is used extensively to control stored-product insect and mite pests. For most stored- product insects 25-33^{0}c is optimal for growth and reproduction, at 13-25 or at 33-35^{0}c insects can complete their development and produce offspring, but <13 or>35^{0}c insects eventually die (Paul G. Fields- 1992). Insects flourish at temperatures 27.1^{0}c and 70 to 75 percent relative humidity, with the decrease in temperature, the life period is prolonged and at 25^{0}c, several insects stop breeding. It is observed that rice weevil (*S. oryzae*) thrives in hills, the tropical and

subtropical climates but its abundance is seen only in a few places. Oxygen concentration in the storage ecosystem plays an important role in the presence of pest species on the stored products. At 3 percent oxygen concentration insects can thrive but below 2 percent they cannot live (Oxley and Wickenden, 1963) [10].

Wang *et al* (2009) [15] noted that most insects could complete their development at the range of temperatures between 20^0c to 40^0c. Furthermore, Wang *et al* (2009) [15] found that *Rhizopertha dominica* can still produce eggs at 3^0c but none of them hatched. Baldasari *et al* (2005) [3] found that *R. dominica* capable of completing its reproduction at a temperature of $>17^0$c. They observed that at temperature between 7-27^0c, *R. dominica* still could produce eggs. Burk *et al* (2000) [4] found that at extremely low or high temperatures, warehouse insects were killed. Furthermore, they observed that a moderately high or low temperature had a less lethal effect, but it decreased population growth.

Sitophylus oryzae *Tribolium castaneum* *Callosobruchus maculates* *Callosobruchus chinensis*

Sitotroga cereacella *Oryzoephilus sorinamensis* *Rhyzopertha dominica* *Bruchus pisorum*

Conclusion

The presence of pests associated with stored products strongly depends upon atmospheric temperature and relative humidity as well as the mode of storage. A total of eight species from 10 different samples of stored products were collected. The eight different species which were collected from the three different areas come under two different orders namely *viz*., Coleoptera and Lepidoptera. The occurrence of the pests of stored products in three different sites followed by the order; site-2>site-3>site-1. From the two orders recorded in three study areas, it was observed that order Coleoptera is the most abundant with seven families constituting about 92% of the total insect population, Lepidoptera exhibited only 8% of the total population. The percentage of species occurrence from three different sites revealed that *Tribolium castaneum* (Red flour beetle) was the most dominant pest which constituted 18.46% of the total insect pest population in the three sites.

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References

1. Amitage DM, Cogan PM, Wilkin D. Integrated pest management in stored grain; combining surface insecticide treatments with aeration, Journal of stored products research,1994:(30):303-319.
2. Atwal AS. Agricultural pests of India and south east asia. Kalyani publishers, Darya Gang, New Delhi, 1976, 502.
3. Baldasari N, Martin A, Cavicchi S, Baronio P. Effects of low temperatures on adult survival and reproduction of *Rhyzopertha dominica*. Bull. Insectol.,2005:58:131-134.
4. Burk CS, Johnson JA, Maler De, Heaps JW. Temperature. In: Alternatives to Pesticides in Stored-Product IPM, Subramanyam, B. and D.W. Hagstrum (Eds.). Kluwer Academic Publishers, Massachusetts, 2000, 73-104.
5. Cotton RT. Pests of stored grains and grain products. Burgers publishing co., Minneapolis, Minnesota, USA, 1956.
6. Hinton HE. Beetles associated with stored products. British museum (NH) London, 1945, 1.
7. Janjua NA, Nasir MM. Stored grain pests and their control in Balochistan, Bull Dept. of Agric. Quetta, 1978, 32(2).
8. Lefroy HM. Insects infesting grains. Indian insect pests, 1906, 251-260.
9. Levinson H, Levinson A. Origin of grain storage and insect species consuming desiccated food. Anz. Fur Schadl.,1994:67:47-59.
10. Oxley TA, Gloria Wickenden. The effect of restricted air supply on some insects which infest grain, International Journal of Annals Applied Biology, 1963. https://doi.org/10.1111/j.1744-7348.1963.tb03698.x
11. Paul G. Fields. The Control of Stored-Product Insects and Mites with Extreme Temperatures, J. stored Prod. Res, 1992:28(2):89-18.

12. Pingale SV. Handling and storage of food grains. Indian Counc. Agric, Res, New Delhi, 1976, 186.
13. Rehman KA. Insect pests of stored grains in the Punjab and their control. Indian.J.Agric. Sci.,1942:12(4):564-587.
14. Sing R, Sing HP. Studies on varietal-cum-manurial responses on the incidence of paddy stem borer. (Tlyporyza incertulus Wlk.) Jv!adras Agric. J,1977:64(4):247-251.
15. Wang JJ, Ren Y, Wei XQ, Dou W. Development survival and reproduction of the Psocid Liposcelis paeta (Psocoptera: Liposcelidae) as a function of temperature. J. Econ. Entomol.,2009:102:1705-1713.