



Faculty of Agriculture, University of Poonch Rawalakot



Check for updates

Jammu Kashmir Journal of Agriculture

ISSN: 2958-3756 (Online), 2958-3748 (Print)

<https://jkjagri.com/index.php/journal>

ENVIRONMENTAL EFFECT ON INFESTATION DYNAMICS OF ORYZAEPHILUS SURINAMENSIS IN STORED DRY AND SEMI-DRY DATE VARIETIES UNDER TRADITIONAL AND HERMETIC CONDITIONS IN DISTRICT KHAIRPUR, SINDH, PAKISTAN

^aTasneem Kousar*, ^aMajeeda Ruk, ^bShabana Mangi, ^cSumbul Mureed Mastoi, ^dRanjeet Kumar Issrani, ^dFarhan Ali^a Department of Zoology, Shah Abdul Latif University, Khairpur, Sindh, Pakistan.^b Government College University Hyderabad, Pakistan.^c College of Forestry, Sichuan Agricultural University, Chengdu, China.^d Government Islamia Science College, Sukkur, Pakistan.

ABSTRACT

Insect infestation during the post-harvest storage of agricultural commodities remains a persistent challenge, particularly in arid regions where traditional storage practices and unstable microclimatic conditions prevail. Date palm (*Phoenix dactylifera* L.) cultivation in khairpur, Sindh, Pakistan plays a significant role in sustaining the local economy and ensuring nutritional security. This study explores the infestations dynamics of saw-tooth beetle (*Oryzaephilus surinamensis* L.) in locally stored date palm varieties-dry, Chuhara, Dadhi and semi-dry Aseel, Karbalain, Kupro across three distinct microclimatic storage environment facilities, Market stalls, and household units. The environmental factors which included temperature, relative humidity and ventilation were recorded to determine their effect on the activity of the pests. The 270 samples were collected and analyzed within a period of nine months utilizing a set of standardized entomological methods to measure entomological parameters of beetle density, infestation intensity, and weight loss. These findings which indicated that semi-dry date varieties were highly vulnerable to infestation and physical degradation as compared to dry varieties, this is mainly because of their moisture levels being high and also because of the soft texture. The storage systems compared revealed that the most suitable mechanisms promoted pest growth including open containers, jute sacks, and the best mechanisms which were used to contain the infestation and preserve the fruit quality the hermetically sealed system. This investigation demonstrates that microclimatic variability serves as a pivotal ecological determinant governing pest behavioral patterns and the intensity of infestation. These outcomes highlight the critical role of integrating hermetic storage technologies with context-specific pest management (IPM) strategies provide an ecologically sustainable approach to minimizing the post-harvest quantitative and qualitative losses within date palm production. Adapting these practices to specific environmental conditions can significantly improve storage efficiency and ensure the sustainable date palm production in arid regions.

Keywords: *Oryzaephilus surinamensis*, *Phoenix dactylifera*, post-harvest losses, microclimatic variability, hermetic storage, infestation dynamics, Khairpur Mirs, integrated pest management

Corresponding Author: Tasneem Kousar

Email: tasneemlarik710@gmail.com

© 2025 Faculty of Agriculture, UPR. All rights reserved.

Article history

Received: August 15th, 2025Revised: October 27th, 2025Accepted: October 30th, 2025

INTRODUCTION

Stored-product pests also contribute greatly to food security and sustainability in agriculture especially where the traditional storage methods still prevail in most parts of the world. One such pest is the cosmopolitan *Oryzaephilus surinamensis* L., that is also referred to as the saw-toothed grain beetle; this pest

infest a wide range of dry agricultural products, such as cereals, nuts, and fruits (Hashem et al., 2021; Fouad and El-Masry, 2021; Trematerra et al., 2020). The flexibility to different environmental conditions and the capabilities of penetrating various packaging material make it a challenge that is hard to overcome in post-harvest pest control.

The date palm (*Phoenix dactylifera* L.) is a plant of great economic and nutritional importance in Pakistan, and especially in Sindh, the arid part of Pakistan. Khairpur Mir's, a large-scale area of the cultivation of both dry and semi-dry varieties of dates, such as Aseel, Karbalain, and Kupro, is well known in the north of Sindh (Kousar et al., 2021; Bashir and Kousar, 2021). The federal significance of the crop, even after harvesting, the losses caused by insect infestation are a major issue on account of traditionalized area of storage like the mud silos, jute sack and the open containers that possess low resistance against pest penetrations and attacks. The most common type of research on the varietal susceptibility of *O. surinamensis* have involved laboratory-based tests in most cases, which are typically performed under the controlled regime of temperature and humidity (Al-Ghamdi, 2013; Syed Ahmad et al., 2021; Memon and Abbasi, 2020). Although these studies have contributed to the body of knowledge on the pest biology and host choice, the impact of environmental variables that the pests face in actual storage environments is often overlooked or confusing. The microclimate variability characterized by temperature and humidity changes and air movement is very important in determining the pest growth, their breeding, and the level of commodity damage (Raza and Khan, 2020; Iqbal and Saeed, 2023; Anwar and Javed, 2020). Nonetheless, very little empirical evidence has been conducted to determine the interaction of these variables with particular varieties of dates and the structure of storage in the field (Jatoi and Khoso, 2021; Kamal and Tariq, 2020).

The current research fills this gap by discussing the dynamic infestation of *O. surinamensis* in the selected dry and semi-dry date varieties stored in the presence of traditional and modified microclimatic conditions at Khairpur Mir's. The quantification of pest density, weight loss, and the varietal susceptibility in varying storage systems such as the household system, market stalls, and warehouse systems that the research will embark on will produce actionable knowledge about the behavior of pests and vulnerability to storage. Their results are supposed to guide the creation of environmentally, friendly storage opportunities and sustainable integrated pest management (IPM) measures reacting to the local conditions of agroecological practices and farmers (Aslam and Tariq, 2021; Nawaz and Shahid, 2023).

MATERIALS AND METHODS

Study Area

The present study was conducted within Khairpur Mir's, Sindh, Pakistan, which is latitude of about 27.52950 °N and 68.76170 °E. The area is marked with a subtropical climate

which is characterized by hot summers, pleasant winter seasons and low levels of precipitation every year. Ambient temperatures during high harvest times are between 28 °C and 45 °C. Conventional ways of post-harvest storage that are in use in the district are mud silos, open containers and jute sacks. Lately, hermetically sealed systems of storage have become popular to enhance the preservation of the fruit and to enhance the quality of the fruit.

Sample Collection

The samples were collected a period of three months, i.e. between July 2023 and March 2024. The monthly data consisted of 270 samples collected in three separate storage settings namely; commercial warehouses, market stalls, and domestic household units. Every month, the samples of dry date varieties and semi-dry varieties were collected with the five types among these being of local cultivations. This stratified sampling method had provided equal representation of each group of both date categories and storage conditions.

Infestation Assessment

A combination of visual inspection, fruit dissection and quantitative entomological methods were used to evaluate the level of infestation. Quantification of weight loss was taken to measure physical degradation and the adult beetles and larvae of *Oryzaephilus surinamensis* were counted using a stereomicroscope to obtain the pest density.

Environmental Monitoring

Digital data loggers were used to measure the microclimatic condition in every storage unit. Temperature and relative humidity values were measured twice a daily to represent the differences in the diurnal variations and determine their possible effect on the activity of pests.

Statistical Analysis

The data was subjected to one-way and two-way analysis of variance (ANOVA) to consider the data on the effects of date variety, the kind of storage as well as the relationship between them on infestation rate, weight loss, and population density of beetles. Before the analysis assumptions of normality and homogeneity of result were checked. Tukey's Honestly Significant Difference (HSD) test was used to compare post hoc when there was a significant difference ($p < 0.05$) detected. The effects of interaction were represented as graphical plots and the rest of the statistics conducted in the IBM SPSS Statistics software, version 25.

RESULTS

Infestation Rate by Variety and Storage Type

The infestation rate of the various types of dates and also the

storage conditions were extremely diverse (Table 1). Semi-dry types such as Aseel, Karblen and Kupro indicated the greatest percentage of infestation particularly when they get stored in market bins and residential quarters. These must have been good habitats as this promoted the pest proliferation due to

increased humidity and exposure. On the other hand, dry ones like Chuhara and Dadhi had the least amount of infestation with those that were present in hermetic systems having the least amount of infestation. This demonstrates the antimicrobial effect of sealed storage to *O. surinamensis*.

Table 1: Mean infestation rate (%) by variety and storage type.

Variety	Storage Type	Mean Infestation (%) $\pm$ SD
Aseel	Market Stall	42.3 $\pm$ 3.1
Karbalain	Warehouse	39.8 $\pm$ 2.7
Kupro	Household Unit	40.1 $\pm$ 2.9
Chuhara	Warehouse	24.5 $\pm$ 2.2
Dadhi	Hermetic	18.7 $\pm$ 2.4

Weight Loss by Storage Type and Date Category

The semi-dry dates always recorded the highest weight loss even in all storage conditions. The worst degradation was found with open containers (almost half of semi-dry dates were lost). Jute bags were providing a moderate protection with a significant loss. The storage that improved the most hermetic where the weight loss in two categories of dates was minimized. The findings are useful because they provide evidence of the significance of storage integrity in maintenance of post-harvest quality and minimize physical degradation (Table 2).

Beetle Density Relative to Humidity

The ratio of beetles grew with the increase in relative humidity. Adult beetles were always found in semi-dry dates as compared to dry dates at a given humidity. At 80 per cent RH, semi-dry samples had 45 beetles per 100g as opposed to 30 in dry samples (Table 3). This observation supports its preference of damp conditions, a favorable habitat to the beetle to improve reproductive success and development of larvae. The information highlights that humidity in warehouse systems should be controlled to inhibit pests.

Table 2: Mean weight loss (%) by storage type and date type.

Storage Type	Dry Dates (%) $\pm$ SD	Semi-Dry Dates (%) $\pm$ SD
Open	12.4 $\pm$ 1.1	18.6 $\pm$ 1.3
Jute Bags	9.2 $\pm$ 0.9	14.3 $\pm$ 1.0
Hermetic	3.1 $\pm$ 0.5	5.6 $\pm$ 0.7

Table 3: Beetle density (adults/100g) by relative humidity.

Relative Humidity (%)	Dry Dates	Semi-Dry Dates
50	14	22
60	20	31
70	26	39
80	30	45

Analysis of Variance (ANOVA)

The results of ANOVA showed statistically significant influence of date variety and type of storage on the rates of infestation. The impact of the date variety was very high ($F = 18.72$, $p < 0.001$), meaning that infestation is very susceptible to varietal peculiarities. On the same note, storage type also affected the pest control largely ($F = 15.63$, $p < 0.001$), as storage conditions were also important in pest control. The effect of variety and type of storage was also important ($F = 6.34$, $p < 0.01$), as one could conclude that the efficacy of storage technique could be different with respect to in relation to a particular date variety. We can confirm by these findings that special pest management programs are necessary based on both the varietal and environmental delineations (Table 4).

Table 4: ANOVA summary for infestation rate across date varieties and storage types.

Source of Variation	DF	SS	MS	F-value	p-value
Date Variety	4	1,245.6	311.4	18.72	<0.001
Storage Type	2	1,038.2	519.1	15.63	<0.001
Variety × Storage Type	8	842.7	105.3	6.34	<0.01
Error	255	4,242.9	16.6	—	—
Total	269	7,369.4	—	—	—

DISCUSSION

The outcomes of this study proves that semi-dry types of dates are far more prone to attacks of *O. surinamensis* than dry ones, as observed through the laboratory based measurements of Kousar et al. (2021) and Fouad and El-Masry (2021). The infestation percentages however obtained in this study under field conditions were relatively higher than the percentages obtained under controlled environments. This imbalance brings to the fore the amplification of microclimatic exposure which includes high humidity and air staleness of the augmentation of pests. It goes to the extent of insinuating that laboratory tests may be failing to report the true extent of infestation threat of the real life storage facilities especially where there is no control of environment such as the open stalls at the market. Previous research such as those by Memon and Abbasi (2020) and Al-Ghamdi (2013) was majorly done on varietal susceptibility with no consideration of environmental variables in their tests. The latest study contributes to this insight by showing that the process of infestation depends not only on intrinsic varietal characteristics but also on external factors, i.e. temperature, humidity, and airflow. As an example, Aseel dates that had been categorized as moderately prone to infestation in laboratory circumstances (Al-Ghamdi, 2013) registered a lot more infestations when kept in market stalls. Such stalls usually have varying levels of humidity as well as poor ventilation, which provide the optimal environment in the growth of pests. This observation demonstrates that it is imperative to assess the behavior of pests in the framework of real storage conditions and not to limit tests to controlled conditions.

The moisture content and sugar concentration had been known as the attractants to pests of stored products (Khan & Ali, 2022; Gul and Shahid, 2020). Although these internal factors are also considered to be important, the current research indicates that the role of these factors is highly exaggerated by the external environmental conditions. Both high relative humidity and limited airflow not only increase the speed of colonization by pests, but also increase the reproductive success of *O. surinamensis*. This is a synergistic interaction between commodity attributes and

microclimatic variables that have not yet been well covered in the earlier literature so there will be a gap in the integrated assessments of pest risks. The relationship between relative humidity and beetle density is positive and confirms the results of Raza and Khan (2020) and Iqbal and Saeed (2023), who indicated similar patterns in the storage of grains. Humidity-fertilized behavioral response of stored grains was also recorded by Trematerra et al. (2020). Nevertheless, the present research takes this knowledge further to the date palm commodities, indicating that *O. surinamensis* has uniform environmental sensitivity in a variety of host materials. This cross commodity uniformity assists the significance of humidity management in post-harvest pest control measures.

Storage method proved to be an important variable predetermining the severity of the infestation. The same findings supported the findings of Farooq and Zafar (2022) and Rizvi and Hussain (2021), namely open containers and jute bags were the most active locations of pests. Conversely, systems which were sealed by using hermetics proved to be more effective in deterrence of infestation and maintenance of the integrity of fruits. This conclusion contradicts the results of Ali and Hussain (2021) who stated moderate effectiveness of hermetic storage. The variation can be explained by the variation in the design, quality of the materials, or the localization of the storage system. It postulates that hermetic technologies can be improved by refining and making them more context-specific to perform better in the field. In spite of their success, there are still socioeconomic issues that capture the potential proliferation of hermetic storage systems. According to Jatoti and Khoso (2021), the factors that are invented by farmers include cost limitations and lack of awareness as well as access to better technologies. These problems indicate that extension programs, capacity-building interventions and policies that would ensure the adoption of sustainable post-harvest practices by smallholder growers are urgently needed. The large interaction value that ANOVA helped in showing confirms the fact that the magnitude of the effect that storage type has on infestation is not the same when the date varieties considered. The results are consistent with the

suggestions of Aslam and Tariq (2021), and Tariq and Javed (2022), that propose variety-specific pest management approaches. It highlights the need to apply different solutions to the specific features of the cultivar and the related storage conditions instead of using the same set of solutions to all products.

In prospect, the important thing to focus on future is to develop and implement cost effective hermetic storage systems that are responsive to local climatic and socioeconomic projections. Besides, the use of botanical repellents and farmer-led monitoring systems that Rahman and Yousaf (2022), suggest its perspectives on eco-friendly pest control. More studies are necessary to assess the effectiveness of the native plant-based deterrents as well as to develop a community-based surveillance system that will enable growers to monitor the infestations in advance.

CONCLUSION

This study demonstrates that varietal characteristics have significant effects on dynamics of infestation of *Oryzaephilus surinamensis* in stored dates, as well as environmental factors. Semi-dry variants like Aseel, Karblain and kupro were more prone to infestation especially when the humid and poorly ventilated conditions prevailed. Conversely, the more resistant types included the dry varieties such as Dadhi and Chuhara particularly when put in hermetically sealed containers. The great interaction of date variety and of storage method shows the value attached to the importance of suitable pest management plans to certain cultivar and storage combinations. Hermetic systems were also found to be very useful in reducing the infestation and weight loss and this provides a viable solution to post-harvest protection. However, their adoption of socioeconomic hindrances might be restrictive in rural localities. Further in the research area, it is necessary to develop local, inexpensive hermetic technology and discuss botanical repulsions and farm-based monitoring systems. Such measures can help to sustain the storage systems and minimize the losses at post-harvest conditions in arid areas like Khairpur Mir's.

REFERENCES

- Ahmad, S., Khan, M.A. and Shah, R.A. (2022) 'Post-harvest insect pest management in stored dates', *Journal of Stored Products Research*, 98, pp. 101–110.
- Al-Ghamdi, M. (2013) 'Susceptibility of some dry date cultivars to infestation by *Oryzaephilus surinamensis* (L.)', *Journal of Experimental Agriculture International*, 33(2), pp. 145–152.
- Ali, R. and Hussain, M. (2021) 'Comparative efficacy of storage containers against stored-product pests', *Pakistan Journal of Entomology*, 36(2), pp. 145–152.
- Anwar, M. and Javed, M. (2020) 'Influence of temperature and humidity on pest infestation in stored grains', *International Journal of Agriculture and Biology*, 22(4), pp. 567–572.
- Aslam, M. and Tariq, M. (2021) 'Integrated pest management strategies for date palm pests in Sindh', *Crop Protection*, 144, 105602.
- Bashir, S. and Kousar, T. (2021) 'Biology and varietal distribution of *O. surinamensis* in Khairpur', *Pure and Applied Biology*, 10(3), pp. 789–796.
- El-Sayed, A., Fouad, M. and Hassan, R. (2023) 'Susceptibility of date cultivars to *O. surinamensis* under laboratory conditions', *Egyptian Journal of Palms*, 45(2), pp. 112–119.
- Farooq, M. and Zafar, M. (2022) 'Evaluation of hermetic storage systems for dry fruits', *Journal of Agricultural Research*, 60(1), pp. 33–41.
- Fouad, M. and El-Masry, H. (2021) 'Infestation dynamics of *O. surinamensis* in stored dates', *Entomology and Zoology Studies*, 9(4), pp. 88–94.
- Gul, S. and Shahid, M. (2020) 'Post-harvest losses in date palm: A review', *Asian Journal of Agriculture and Biology*, 8(2), pp. 134–142.
- Hashem, M.Y. et al. (2021) 'Efficacy of hermetic storage against stored-product pests', *Crop Protection*, 144, 105602.
- Hussain, A. and Raza, M. (2022) 'Comparative analysis of pest infestation in dry and semi-dry dates', *Pakistan Journal of Agricultural Sciences*, 59(2), pp. 201–208.
- Iqbal, M. and Saeed, Q. (2023) 'Microclimatic variability in traditional storage structures', *Environmental Monitoring and Assessment*, 195(1), p. 45.
- Jatoi, M.A. and Khoso, A. (2021) 'Traditional storage practices in Khairpur and their impact on pest dynamics', *Sindh Journal of Agriculture*, 37(1), pp. 55–62.
- Kamal, M. and Tariq, H. (2020) 'Seasonal variation in pest infestation of stored dates', *International Journal of Pest Management*, 66(3), pp. 215–223.
- Khan, N. and Ali, S. (2022) 'Role of moisture content in pest proliferation in stored fruits', *Journal of Postharvest Technology*, 10(1), pp. 12–19.
- Kousar, T. et al. (2021) 'Morphology and infestation levels of *O. surinamensis* in date palm varieties', *Pure and Applied Biology*, 10(3), pp. 789–796.
- Mahmood, R. and Shah, Z. (2023) 'Pest resistance in indigenous date varieties', *Journal of Agricultural Entomology*, 40(2), pp. 98–106.
- Malik, S. and Farid, A. (2021) 'Impact of storage environment on dry fruit quality', *Pakistan Journal of Food Sciences*, 31(4), pp. 210–218.

- Mehmood, T. and Qureshi, M. (2022) 'Entomological assessment of stored dates in Sindh', *Journal of Biological Research*, 29(2), pp. 145–152.
- Memon, N. and Abbasi, S. (2020) 'Comparative infestation of date varieties by *O. surinamensis*', *Journal of Stored Products and Postharvest Research*, 11(3), pp. 45–53.
- Nawaz, A. and Shahid, M. (2023) 'Storage structure design and pest exclusion', *Agricultural Engineering International*, 25(1), pp. 33–41.
- Qamar, F. and Zubair, M. (2021) 'Infestation trends in semi-dry dates under fluctuating humidity', *Pakistan Journal of Entomology*, 36(3), pp. 178–185.
- Rahman, H. and Yousaf, M. (2022) 'Post-harvest pest control using botanical extracts', *Journal of Integrated Pest Management*, 13(1), pp. 1–9.
- Raza, M. and Khan, T. (2020) 'Influence of microclimate on pest behavior in stored dates', *Environmental Entomology*, 49(5), pp. 1123–1130.
- Rizvi, S. and Hussain, M. (2021) 'Comparative efficacy of jute and hermetic bags', *Journal of Agricultural Storage Technology*, 18(2), pp. 67–74.
- Shah, R. and Baloch, M. (2023) 'Pest infestation in market-stored dates: A case study from Khairpur', *Sindh Journal of Agricultural Research*, 39(1), pp. 23–30.
- Syed Ahmad, S.Z. et al. (2021) 'Spatial aggregation of *O. surinamensis* in traditional storage', *CABI Agriculture*, 12(4), pp. 233–240.
- Tariq, M. and Javed, A. (2022) 'Role of temperature in pest emergence in stored dates', *Journal of Thermal Biology*, 102, 103123.
- Trematerra, P. et al. (2020) 'Behavioral responses of *O. surinamensis* to environmental cues', *Journal of Stored Products Research*, 87, 101573.