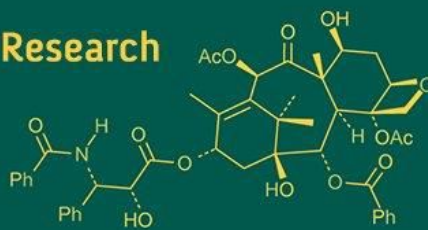


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Population dynamics of oriental armyworm, *Mythimna separata* in wheat ecosystem of Kashmir valley

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Abstract

A field study was undertaken at the Division of Entomology, Faculty of Agriculture, Wadura, SKUAST-Kashmir, during 2022-23 and 2023-24 to examine the seasonal abundance and weather-associated population dynamics of the oriental armyworm *Mythimna separata* (Walker) in wheat (*Triticum aestivum* L.) under temperate conditions. Wheat, being a vital staple and a key contributor to food and nutritional security, faces significant yield losses due to this insect pest. Adult populations were monitored using funnel-type pheromone traps, and larval density was assessed by counting live larvae on 10 randomly selected wheat plants. The correlation between pest incidence and prevailing temperature and relative humidity was analyzed for both years. During 2023, adult emergence occurred late, peaking in the 20th standard meteorological week (SMW), whereas in 2024, moths appeared earlier in 13th SMW and remained active for a prolonged period with a peak during the 16th SMW. Larval infestation followed the adult trend, with population peaks observed at 17th and 21st SMW during both years respectively. Statistical analysis revealed a positive relationship between adult catches and both maximum temperature and relative humidity, though the larval population was less influenced with the later one in the second season. The study concludes that warmer and humid conditions favor pest multiplication and extended field persistence, while dry spells suppress their buildup. Understanding these climate-linked fluctuations is essential for developing forecasting models and integrated management strategies for *M. separata* in wheat ecosystems of the Kashmir valley.

Keywords: *Mythimna separata*, wheat, population dynamics, temperature, relative humidity, Kashmir valley

Introduction

Wheat, *Triticum aestivum* is one of the major food grain crops of India. During 2023-24 its area has gradually increased by 2.37 lakh ha from 339.20 lakh ha during 2022-2023 to 341.57 lakh ha in 2023-2024 in the country (Anonymous, 2024) ^[1]. Globally, wheat is grown in several countries which make it the second most growing crop after maize in the world level and after rice in the country. Under Kashmir conditions because of the climatic constraints, it is included in the double cropping system after rice to get more profit from the single piece of land. It has the ability to withstand both cold as well as less water conditions (Rinki *et al.*, 2017) ^[16]. Seeing its wider adaptability and importance, wheat productivity is often synonymously measured with the global food security as it contributes 20 per cent towards global food calories and proteins (Shiferaw *et al.*, 2013; Pan *et al.*, 2024) ^[19, 13]. It is used as a main ingredient in several food products which has made it a widely growing cereal crops in the world (Igrejas and Branlard, 2020) ^[9]. The protein content in wheat is influenced by its variety, environmental and cultural conditions. Apart from being a food grain it is also an efficient sustainable fodder crop which is relied upon by many farmers in the Kashmir valley. Despite having several benefits, its yield is reduced by many biotic factors specially insects. Out of all, are the oriental armyworm *Mythimna separata* (Walker) belonging to the family noctuidae of the order lepidoptera. This pest has the ability to migrate, feed and damage several major crops specially from the grass family Gramineae (Li *et al.*, 2019) ^[11]. Its host range includes vegetables, root crops, cucurbits, legumes, cereals, sugarcane, solanaceous crops, fruits, ornamentals, cut flowers, and weeds (Navasero and Navasero,

2022)^[12]. The voracious feeding by the late larval instars, their powerful flight capability and high fecundity make their outbreaks unpredictable and unpreventable (Li *et al.*, 2019)^[11]. However, insects being poikilothermic in nature, temperature has a major role to play in influencing almost every aspect of their physiology, behaviour, survival, development, reproduction, and locomotion (Qin *et al.*, 2018)^[15]. Studies have shown the effect of changing environmental conditions on insects' natural population triggering their migration in response, from unfavourable habitats, to the colonization on new habitats across long distances (Chapman *et al.*, 2015; Dingle, 2014; Sappington, 2018)^[4, 5, 17]. Two external physical factors temperature and relative humidity highly influence the insect migration and offspring population outbreaks (Broufas *et al.*, 2009; Fischer *et al.*, 2011)^[3, 6]. Current study has targeted the same in order to make strategic plans to monitor the pest population and bring it below the economic threshold levels.

Materials and Methods

The present study has been carried out in the wheat fields of Division of Entomology, Faculty of Agriculture, Wadura, SKUAST-Kashmir during 2022-23 and 2023-24. Wheat variety Wadura Wheat 102 (WW-102) was planted as per the standards recommended by SKUAST-Kashmir. The field was maintained without any insecticidal application. Field monitoring of this adult male pest population was done by installing funnel type pheromone traps in the wheat

fields procured from pheromone chemicals Hyderabad and mechanically by counting the number of live larvae from randomly selected 10 plants. Their installation was done in the last week of March and observations were recorded on a regular basis early in the morning. The height of the trap should be kept a little higher than the crop height. After every one month the lure was changed and replaced by a new one till the end of the cropping period. Wheat sowing was carried out in the first week of October and ended in June second week. To know the effects of different weather parameters specially temperature and relative humidity on the population dynamics of the oriental armyworm, its adult trapped and number of live larvae were compared and recorded each day along with the associated weather data of that particular day.

Results

The observations on the number of males trapped (MT) and live larvae (NLL) were recorded on a regular basis from pheromone traps and wheat field respectively during both the years 2023 and 2024. The results stated that the adult emergence and larval infestation was quite late and retrieved earlier due to unfavourable conditions during 2023. The adult was first noticed on the 17th SMW, peaked during 20th SMW and ended by 24th SMW fig. 1. Whereas, the larval infestation started in the 18th SMW, peaked in 21st SMW and ended by 24th SMW fig. 1.

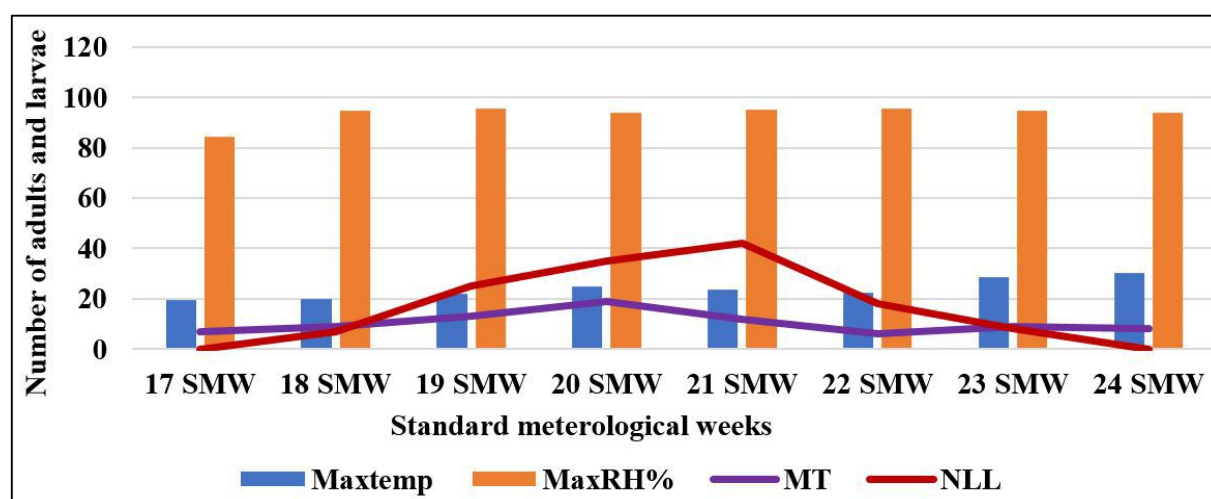


Fig 1: Variations in adult males trapped (MT) and number of live larvae (NLL) of *M. separata* with weather during 2023

However, during 2024, adults were noticed earlier in their usual timing *i.e.* 13th SMW, peaked during 16th SMW and stayed in the fields for a longer period and ended by 24th SMW fig. 2 and the larval infestation started from the 14th SMW, peaked during 18th SMW and retrieved by 24th SMW. It was concluded from both of the observations that increased adult population alternates with low larval population at both initial and retrieval generational period. After the initial observation of the adults one generation

starts and complete within 30-35 days. The next adult emergence marked the completion of one generation and starting of another. Out of all the weather parameters, temperature and relative humidity was found to be positively correlated with the adult but not significantly with larval population. This could be because of the light shyness nature of the insect which makes it less active under high temperature or sunshine.

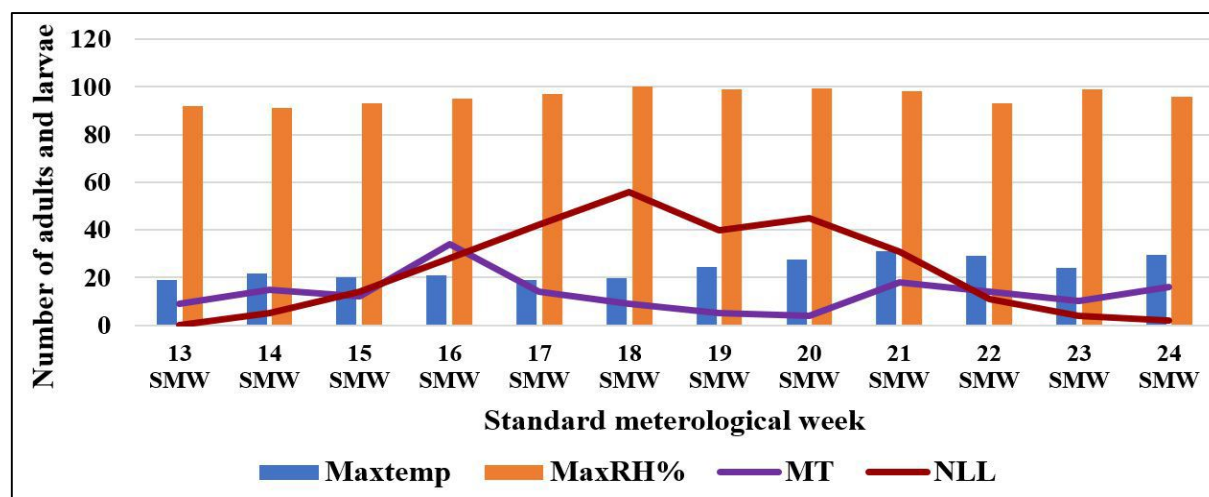


Fig 2: Variations in adult males trapped (MT) and number of live larvae (NLL) of *M. separata* with weather during 2024

Discussion

The current experiment stated that under fluctuating temperature and relative humidity the flight capacity is also affected and often reduced. The males trapped (MT) in the pheromone trap and the number of live larvae (NLL) recorded during 2022-2023 and 2023-2024 were positively correlated with maximum temperature as well as maximum relative humidity significantly however maximum relative humidity being not significantly affecting the larval count during second season. In the other hand, Jiang *et al.* (2011) [10] witnessed a decline in adult reproduction and flight capacity with increasing temperature and humidity as seen through lowered fecundity, mating rate and longevity which does not go with our findings. India, has seen several outbreaks of this pest in the past with Puttahrudriah and Usman in 1957 reporting the same after heavy rainfall followed by drought, flooding, and the adoption of trash mulching in fields. Climatic variability plays a crucial role in influencing pest population buildup and seasonal occurrence. Prolonged dry weather during the early part of the year (January-April) followed by high humidity in the mid-monsoon months (July-August) tends to enhance the frequency of pest generations. In Vietnam, population trends have been observed to fluctuate with changes in relative humidity and rainfall, where heavy monsoon showers and subsequent flooding often coincide with severe pest outbreaks. In contrast, in Bangladesh, infestation levels rise soon after drought periods, while in Fiji, pest incidence usually follows episodes of intense precipitation (Grist and Lever, 1969) [8]. Within monsoon-dominated agroecosystems, prolonged dryness may suppress the activity of natural enemies such as larval parasitoids and entomopathogenic organisms, whereas warmer and more humid conditions favor increased egg laying and rapid pest development. Current, correlation findings are in confirmation with Sharma *et al.* (2002) [18] who stated a positive correlation of rainfall, maximum and minimum relative humidity and negative correlation of maximum temperature with number of moth catches. In the other hand, Geela *et al.* (2025) [7] observed a positive correlation of maximum temperature with adult catch. Our finding in regard to positive impact of maximum temperature and maximum relative humidity with moth catch is in accordance to Bhat *et al.* (2024) [2] except the negative impact of maximum relative humidity with the catch.

Conclusion

From the field study conducted during 2023 and 2024 to know the effects of the weather parameters in context with temperature and relative humidity on the population dynamics of the oriental armyworm, *Mythimna separata*, it was concluded that both of these parameters have a significantly positive correlation with each other. However, during the second season, the larval population was not significantly correlated with maximum relative humidity depicting their light shyness confirming the noctuid behaviour of the insect. After knowing the climatic nature influencing the pest population its early monitoring and management measures should be implemented to reduce their population below economic threshold level.

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