**Seasonal Incidence and Abundance of Insect Fauna in Safflower (*Carthamus tinctorius* L.) of the Southern Telangana Zone (STZ) of Telangana, India**

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ABSTRACT

A study was conducted at IIOR-Rajendranagar and IIOR-Narkhoda farms in Hyderabad during the Rabi season of 2023–2024 to assess the diversity, abundance, and correlation of insect pests and natural enemies with weather parameters. Insect populations were monitored weekly using pitfall traps, sweep nets, sticky traps, and visual counts. A total of 5,929 and 6,751 insect specimens at IIOR Rajendranagar farm and IIOR Narkhoda farm, belonging to 50 families across 12 orders, were recorded. Among these, Diptera (12 families) and Hymenoptera (11 families) were the most dominant orders, followed by Hemiptera, Coleoptera, and Orthoptera. The seasonal incidence of major pests, particularly aphids, was analyzed in relation to meteorological factors such as temperature, relative humidity, evaporation, sunshine duration, wind speed, and rainfall. Aphid infestations were observed from the 48th Standard Meteorological Week (SMW) to the 9th SMW, with peak populations recorded in the 5th SMW. The population of lady bird beetle and chrysopa was recorded 21 days after germination recorded during 48th SMW it gradually increases upto 5th SMW at both the locations and continued upto 9th SMW. The population of natural enemies (coccinellids and chrysopa) increased with increase in the pest population. This study provides valuable insights into insect biodiversity and pest-weather interactions, which aids in the development of effective pest management strategies.

***Keywords:*** *Safflower, insect families, pest, natural enemies, correlation, weather parameter*

1. INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an important oilseed crop cultivated in semi-arid regions such as India, Iran, Egypt, Pakistan and the Mediterranean countries due to its high drought tolerance and adaptability to low-moisture conditions. In India, safflower is primarily grown in Karnataka, Maharashtra, and Telangana, with a total cultivated area of 1.09 lakh hectares, yielding 90,000 tons in 2022–2023 (Indiastat, 2022–2023). In Telangana, safflower is mainly cultivated in Vikarabad, Sangareddy, Nizamabad, Kamareddy, and Nirmal districts as a rainfed Rabi crop. Among the 36 insect species reported on safflower in India (Bharaj *et al*., 2003), the safflower aphid (*Uroleucon compositae* Theobald) is the most destructive, causing yield losses ranging from 35%–72% in severe infestations (Ishaq *et al*., 2004). Aphid population dynamics are influenced by weather conditions. Studies indicate a positive but non-significant correlation with relative humidity (Patil *et al*., 2002) and a negative correlation with temperature (Akashe *et al*., 2008). Aphids typically appear during the pre-branching stage, with low temperatures, high humidity, and cloudy weather favoring their multiplication. As the temperature rises and humidity drops, aphid population gradually decrease and eventually vanishes when the crop reaches physiological maturity. Understanding these environmental interactions is crucial for developing effective pest management strategies to minimize safflower yield losses.

2. material and methods

The study was conducted at the IIOR- Rajendranagar farm (17°19'13.3" N latitude and 78° 24'41.8" E longitude) of 542.6 meter elevation above mean sea level (MSL) and the IIOR-Narkhoda farm (17°15'30.1608" N latitude and 78°19'11.1324"E longitude), with an altitude of 569 meters above MSL, during 2023-2024 Rabi season, to assess insect diversity and pest populations in safflower crop. Insect collection was carried out at weekly intervals using multiple sampling methods, including pitfall traps, sweep nets, sticky traps, and visual counts.

In safflower, aphids were identified as the major insect pests, Coccinellids and Chrysoperla spp. were identified as natural enemies. Their population dynamics was monitored by selecting 10 randomly tagged plants per field. Observations were made on a 5 cm twig from each tagged plant, and data were recorded weekly to analyze the correlation between aphid populations, natural enemies and plant growth.

3. **RESULTS AND DISCUSSION**

**Comp****osition of the insect fauna in safflower**

During the study period a total of 5929 and 6751individuals from 50 families under 12 orders were collected at IIOR-Rajendranagar farm and IIOR-Narkhoda farm. In terms of total families in insect orders the line of sequence in all the locations recorded as follows: Diptera (12 families), Hymenoptera (11 families), Hemiptera (8 families), Coleoptera (6 families), Orthoptera (4 families), Odonata and Lepidoptera each with two families, whereas Dermaptera, Collembola, Thysanoptera, Ephemeroptera and Neuroptera with one family each. Among all the families reported in different insect orders Aphididae has reported the highest population, causing significant damage to the crop, leading to the formation of black sooty mould, which interrupts photosynthesis.

Saeidi *et al*. (2015) investigated safflower similarly, documenting 4,261 specimens grouped into 31 families and 92 species. Baisame *et al*. (2021) observed the diversity of insect pests and their natural enemies, reporting 13 insect species belonging to 8 orders. Similarly, More *et al*. (2022) examined the diversity of safflower insects and found a visit of 12 insect species.

**Correlation of insect pests and natural enemies with weather parameters in safflower at IIOR- Rajendranagar farm and IIOR-Narkhoda farm**

Safflower aphid during the Rabi season of 2023-2024 at the IIOR-Rajendranagar farm, the seasonal incidence of safflower aphid (*Uroleucan compositae*) on safflower was observed. The aphid population was first recorded in the 48thStandard Meteorological Week (SMW) with a count of 18 aphids/5 cm twigs. The population reached its peak during the 5th SMW, with 158 aphids/5 cm twigs, then gradually decreased to 86 aphids/5 cm twig by the 9th SMW (Table 1 and Fig 1).

The aphid population showed a significant positive correlation with sunshine hours but non-significant correlations with maximum temperature (r=0.316NS), wind speed (r=0.215NS), and evaporation (r=0.391NS). Conversely, there was a significant negative correlation between minimum temperature (r=-0.701\*\*) and evening relative humidity (r=-0.697\*\*). Morning relative humidity (r=-0.102NS) and rainfall (r=-0.406NS) showed non-significant correlations (Table 2). These findings were in contrast with those of Kumbhar *et al*. (2018), who reported that low temperatures, cloudy weather, increased relative humidity, and maximum temperature were conducive to aphid multiplication.

The coccinellids and chrysoperla spp at IIOR Rajendranagar farm has recorded from 21 days after germination with a population of 0.3 coccinellids /5cm/plant,0.2chrysopa per plant of 48th SMW and reached the highest population of 4.2 coccinellids /5cm/plant of 5th SMW, 1.9 chrysopa/plant of 4th SMW and continued upto 9th SMW with a population of 1.6lady bird beetles/5cm/plant, 0.2 chrysopa per plant (Table1). The relationship between natural enemies and various environmental factors is as follows:

For Coccinellids, the correlation with Tmax is **0.395NS,** while Tmin shows a significant negative correlation at **-0.554\*.** The relationship with RH I is **-0.119NS,** whereas RH II exhibits a highly significant negative correlation at **-0.655\*\*. Sunshine has a strong positive correlation of 0.640,** while wind speed shows a non-significant correlation of **0.195NS.** Evaporation has a non-significant positive correlation of **0.481NS,** and rainfall is negatively correlated at **-0.330NS.**

For Chrysopa spp., Tmax has a non-significant correlation of **0.030NS,** whereas Tmin has a significant negative correlation of **-0.604\*.** The correlation with RH I is **0.138NS,** and RH II has a non-significant negative correlation of **-0.409NS.** Sunshine shows a positive correlation of **0.351NS**, while wind speed remains almost neutral at **0.008NS.** Evaporation has a non-significant correlation of **0.0887NS**, and rainfall is negatively correlated at **-0.311NS**.

Similarly, at IIOR Narkhoda, the aphid population was first recorded in the 48th SMW with a mean population of 26 aphids per 5 cm twig (Plate 1). The population reached peak during the 5th SMW with a mean of 172 aphids per 5 cm twig, then gradually decreased to 82 aphids per 5 cm twig by the 9th SMW (Table 3 and Fig 2).

At IIOR-Narkhoda, the aphid population showed significant positive correlations with maximum (0.605\*\*) and minimum temperature (0.447\*), morning relative humidity (0.564\*\*), sunshine hours (0.745\*\*) these are in contrast with the findings of kadam *et al* 2024,wind speed (0.548\*), and evaporation (0.613\*\*). There were positively non-significant correlations with evening relative humidity (0.228NS) this is on par with the findings of kadam*et al* 2024 and negatively non-significant correlations with rainfall (-0.268NS) (Table 4). These findings were in alignment with Javed*et al*. (2013), who reported a positive correlation between aphid population and temperature, but contrast findings were found with relative humidity, as it was negatively correlated in their study.

The coccinellids and chrysoperla spp at IIOR Narkhoda farm has recorded from 21 days after germination with a population of 0.4 coccinellids/5cm/plant, 0.1 chrysopa per plant of 48th SMW and reached the highest population of 4.5 coccinellids/5cm/plant of 5th SMW, 2.0 chrysopa per plant during 4th SMW and continued upto 9th SMW with a population of 1.8lady bird beetles/5cm/plant, 0.3 chrysopa per plant (Table3).

The correlation between natural enemies and various environmental factors is as follows:For Coccinellids, Tmax shows a non-significant positive correlation of **0.355NS**, while Tmin has a non-significant negative correlation of **-0.309NS**. The correlation with RH I is **-0.198NS**, whereas RH II exhibits a highly significant negative correlation of **-0.698**\*\*. Sunshine has a significant positive correlation of **0.585\***, while wind speed remains neutral at **0.009NS**. Evaporation has a non-significant positive correlation of **0.311NS**, and rainfall shows a non-significant negative correlation of **-0.340NS**.

For Chrysopa spp., Tmax has a non-significant positive correlation of **0.157NS**, whereas Tmin shows a non-significant negative correlation of **-0.379NS**. The relationship with RH I is almost neutral at **0.005NS**, while RH II has a significant negative correlation of **-0.580\***. Sunshine is positively correlated at **0.437NS**, while wind speed shows a non-significant negative correlation of **-0.122NS**. Evaporation has a nearly neutral correlation of **0.040NS**, and rainfall shows a non-significant negative correlation of **-0.306NS (Table 4)**.

**Table 1. Seasonal incidence of safflower aphids and natural enemies observed in Rabi 2023-2024 at IIOR-Rajendranagar**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SMW** | **Age of crop (DAS)** | **Number of aphids/5cm twig** | **Coccinellids/Plant** | **Chrysopa/plant** |
| 45 | 4 | 0 | 0 | 0 |
| 46 | 11 | 0 | 0 | 0 |
| 47 | 18 | 0 | 0 | 0 |
| 48 | 25 | 18 | 0.3 | 0.2 |
| 49 | 32 | 45 | 0.6 | 0.4 |
| 50 | 39 | 69 | 0.9 | 0.6 |
| 51 | 46 | 92 | 1.2 | 0.5 |
| 52 | 53 | 109 | 1.4 | 0.7 |
| 1 | 60 | 115 | 1.9 | 0.9 |
| 2 | 67 | 127 | 2.2 | 1.2 |
| 3 | 74 | 139 | 2.5 | 1.4 |
| 4 | 81 | 146 | 3.6 | 1.9 |
| 5 | 88 | 158 | 4.2 | 1.6 |
| 6 | 95 | 142 | 3.4 | 1.2 |
| 7 | 102 | 126 | 2.8 | 0.8 |
| 8 | 109 | 104 | 2.2 | 0.4 |
| 9 | 116 | 86 | 1.6 | 0.2 |

**Table 2. Correlation of safflower aphids and natural enemies with weather parameters during Rabi 2023-2024 at IIOR-Rajendranagar**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pests | Tmax | Tmin | RH I | RH II | Sunshine | Wind speed | Evaporation | Rainfall |
| Aphids | 0.316NS | -0.701\*\* | -0.102NS | -0.697\*\* | 0.631\*\* | 0.215NS | 0.391NS | -0.406NS |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Natural enemies | Tmax | Tmin | RH I | RH II | Sunshine | Wind speed | Evaporation | Rainfall |
| Coccinellids | 0.395NS | -0.554\* | -0.119NS | -0.655\*\* | 0.640\*\* | 0.195NS | 0.481NS | -0.330NS |
| Chrysopa spp. | 0.030NS | -0.604\* | 0.138NS | -0.409NS | 0.351NS | 0.008 NS | 0.0887NS | -0.311NS |

nS: Non Significant, \*\* indicates significant at 0.01 level (1%), \*indicates significant at 0.05 (5%) in statistical analysis.

**Fig 1. Correlation of safflower aphid with weather parameters at IIOR- Rajendranagar**

**Table 3. Seasonal incidence of safflower aphids and natural enemies observed in Rabi 2023-2024 at IIOR-Narkhoda**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SMW** | **Age of crop (DAS)** | **Number of Aphids/5cm twig** | **Coccinellids/Plant** | **Chrysopa/plant** |
| 45 | 4 | 0 | 0 | 0 |
| 46 | 11 | 0 | 0 | 0 |
| 47 | 18 | 0 | 0 | 0 |
| 48 | 25 | 26 | 0.4 | 0.1 |
| 49 | 32 | 49 | 0.7 | 0.2 |
| 50 | 39 | 78 | 1.0 | 0.5 |
| 51 | 46 | 96 | 1.5 | 0.6 |
| 52 | 53 | 108 | 1.7 | 0.9 |
| 1 | 60 | 119 | 2.1 | 1.0 |
| 2 | 67 | 125 | 2.4 | 1.3 |
| 3 | 74 | 142 | 2.7 | 1.6 |
| 4 | 81 | 156 | 3.8 | 2.0 |
| 5 | 88 | 172 | 4.5 | 1.8 |
| 6 | 95 | 148 | 3.6 | 1.3 |
| 7 | 102 | 116 | 2.4 | 1.0 |
| 8 | 109 | 98 | 2.0 | 0.6 |
| 9 | 116 | 82 | 1.8 | 0.3 |

**Table 4. Correlation of safflower aphids and natural enemies with weather parameters during Rabi 2023-2024 at IIOR Narkhoda**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pests | Tmax | Tmin | RH I | RH II | Rainfall | Sunshine hours | Wind  speed | Evaporation |
| Aphids | 0.605\*\* | 0.447\* | 0.564\*\* | 0.228NS | -0.268NS | 0.745\*\* | 0.548\* | 0.613\*\* |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Natural enemies | Tmax | Tmin | RH I | RH II | Sunshine | Wind speed | Evaporation | Rainfall |
| Coccinellids | 0.355NS | -0.309NS | -0.198NS | -0.698\*\* | 0.585\* | 0.009NS | 0.311NS | -0.340NS |
| Chrysopa spp. | 0.157NS | -0.379 NS | 0.005NS | -0.580\* | 0.437 NS | -0.122NS | 0.040 NS | -0.306 NS |

nS: Non Significant, \*\* indicates significant at 0.01 level (1%), \*indicates significant at 0.05 (5%) in statistical analysis.

**Fig 2. Correlation of safflower aphids with weather parameters at IIOR-Narkhoda**



**Plate 1. Safflower aphid (*Carthamus tinctorius* L.)**

4. Conclusion

Seasonal incidence of safflower aphid and natural enemies shown fluctuation in the population due to the influence of abiotic factors viz., maximum temperature, minimum temperature, morning and evening relative humidity, rainfall, wind speed, evaporation and bright sunshine hours. Correlation between aphid population and weather parameters indicated that significant positive correlation with maximum, minimum temperature, morning relative humidity, sunshine hours, wind speed and evaporation and non significant with evening relative humidity and rainfall. Correlation between Coccinellids, Chrysopa and weather parameters indicated that non significant positive correlation with maximum temperature and evaporation, negative correlation with minimum temperature and rainfall, negatively significant with evening relative humidity. Where the population of natural enemies increases with increase in the pest population.

These findings emphasize the role of weather parameters in influencing aphid population dynamics and highlight the need for climate-based pest management strategies. The study contributes to understanding insect biodiversity in safflower and aids in developing targeted pest control measures to enhance crop productivity. Further research incorporating long-term monitoring and predictive modeling could enhance pest forecasting and management efforts in safflower cultivation.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that nogenerative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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