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# Influence of weather parameters on the incidence of natural enemies in the cauliflower ecosystem

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**Abstract**
Studies were carried out from November to February, during *Rabi*, 2017-18 in Agricultural College Farm, Naira, to study the influence of weather parameters on the occurrence of natural enemies in cauliflower. The populations of natural enemies were recorded at regular weekly (5 days) intervals from bud initiation stage to crop maturity and correlated with the corresponding meteorological data to understand the relationship between them during the season. Among the natural enemies of insect pests of cauliflower, coccinellid predator, *Coccinella septempunctata* L. was found predominant in the cauliflower ecosystem. Other natural enemies like *Cotesia* spp., and spiders were present but in traces only. The activity of predatory ladybird beetles was started during 49$^{th}$ standard week (8.6 beetles per 10 plants), gradually increased and reached its peak level on 4$^{th}$ standard week with 20.66 beetles per 10 plants. The co-efficient of determination ($R^2$) for coccinellids was 0.8614, which showed that the abiotic factors were able to explain the variation in the population of coccinellids to the extent of 86.14 out of 100.

**Keywords:** Cauliflower, coccinellids *Coccinella septempunctata* L., weather parameters

## 1. Introduction
Cauliflower (*Brassica oleracea* var. *botrytis* Linn.) is an economically important vegetable of the several vegetables in the species *Brassica oleracea.* It contains many nutrients particularly substantial amounts of vitamins (Vit. C, K, $B_6$) and minerals (Mn, P, K). In India, it is cultivated in an area of 4.26 lakh ha. with an average annual production of 8199 Mt and productivity of 19.2 Mt ha$^{-1}$ (*www.indiastat.com*) [1]. Cauliflower is a winter vegetable and requires cold and moist climate. It is grown mainly in Punjab, Uttar Pradesh, Bengal and Karnataka. The yield of cauliflower is adversely affected by many bottlenecks including insect pest, diseases, environmental stresses, nutritional imbalance *etc*. Insect pests are of prime importance as they cause serious economic damage to cauliflower crop. Natural enemies play a very important role in keeping pest populations under control. Insects can multiply very rapidly and in the absence of natural enemies, insect populations "explode". The wide spread use of insecticides has led to the elimination of natural enemies, thus paving the way to attain status of most noxious pests of various cole crops in India [4].
Hence, the latest knowledge of seasonal incidence of natural enemies at different growth stages of cauliflower crop will be helpful for improvement of research on biological control of pest management. The present investigation was consequently conducted to observe and monitor the seasonal incidence of natural enemies and determine the effects of maximum and minimum temperature, morning and evening relative humidity, rainfall, bright sunshine hours and wind velocity on population trend.

## 2. Materials and methods
### 2.1 Site and Location of Experiment
The present investigations were conducted at Agricultural College farm, Naira during Rabi, 2017-18 which is geographically situated at an altitude of 27 m above mean sea level, 83.84$^0$ E longitudes and 18.24$^0$ N latitude in the North Coastal Agro-climatic Zone of Andhra Pradesh.

### 2.2 Layout
A bulk plot of 200m$^2$ of local cauliflower variety Karthika was raised and maintained without any insecticidal application to study the seasonal incidence of natural enemies *viz.*, spiders,

coccinellids, *Cotesia* spp., in relation to abiotic factors such as maximum and minimum temperatures, morning and evening relative humidity, wind velocity and sunshine hours. The bulk plot area was divided into ridges and furrows at 60 x 45 $cm^2$ spacing. Thirty days old seedlings of cauliflower were transplanted at row to row and plant to plant distance of 60 cm x 45 cm, respectively and all the necessary package of practices *viz.*, fertilizer application, irrigation, inter cultivation and disease management were taken up.

### 2.3 Observation

The incidence of natural enemies was observed on ten randomly selected and tagged plants. The number of coccinellid predators, spiders and *Cotesia* spp., per head were recorded at weekly (5 days) interval from bud initiation stage and continued till the crop maturity. Data regarding the maximum and minimum temperature, morning and evening relative humidity, rainfall, bright sunshine hours and wind velocity was recorded from the meteorological observatory at Agricultural College Farm, Naira for correlating with the natural enemy population fluctuation phenomena.

### 2.4 Statistical Analysis

The influence of weather parameters on the occurrence of natural enemies on cauliflower was analyzed statistically by subjecting the population of natural enemies (coccinellids) and weather data to simple correlation and Multiple Linear Regression (MLR) analysis using XLSTAT software [2].

## 3. Results and Discussion

### 3.1 Influence of the weather parameters on the occurrence of coccinellids on cauliflower during 2017-18.

Among the natural enemies of insect pests of cauliflower, coccinellid predator, *Coccinella septempunctata* L. was found in the cauliflower ecosystem. Other natural enemies like *Cotesia* spp., and spiders were present but in traces only. The mean population of coccinellids significantly varied in different months from November to February.

The activity of predatory ladybird beetles was started during 49th standard week (8.6 beetles per 10 plants) with average maximum and minimum temperatures of 28.60 $^0$C and 17.42 $^0$C, respectively. The average morning and evening relative humidity noted during the same period were 85.14 and 46.71 per cent, respectively without any rainfall. The ladybird beetle population gradually increased and reached its peak level on 4th standard week with 20.66 beetles per 10 plants. During 4th standard week, the average maximum and minimum temperatures of 30.50$^0$C and 16.61$^0$C were recorded, respectively, with average morning and evening relative humidity of 92.00 and 45.42 per cent, respectively. Thereafter, the population reached the lowest level by 6th standard week (16 beetle per 10 plants). The average maximum and minimum temperatures prevailed during 6th standard week were 32.42$^0$C and 17.35$^0$C, respectively and average morning and evening relative humidity were 87.70 and 41.57 per cent, respectively (Table 1 and Fig. 1). Correlations were worked out to find out the relationship between coccinellid population and major weather parameters (Table 2). The results indicated a significant but negative association between the coccinellids and minimum temperature (r = -0.680) while it was positive non-significant correlation with maximum temperature (r = 0.232). Morning relative humidity (r = 0.553) and evening relative humidity (r = -0.242) depicted non-significant positive and negative correlations, respectively with the coccinellid population. While the bright sunshine hours (r = -0.163) and wind velocity (r = -0.078) showed non-significant negative correlation with coccinellids population. Venkateswarlu *et al.* [5] reported that coccinellid population showed positive influence with maximum temperature, negative correlation with relative humidity, however, contrary to the present results they reported positive correlation between minimum temperature and coccinellid population. The present findings of positive impact on coccinellid population with the maximum temperature (except minimum temperature), negative influence with relative humidity was also reported by Patra *et al.* [3]. The co-efficient of determination ($R^2$) for coccinellids was 0.8614, which showed that the abiotic factors were able to explain the variation in the population of coccinellids to the extent of 86.14 out of 100 (Fig. 2). The data on the incidence of coccinellids when subjected to multiple linear regression analysis (Table 3) the following equation was arrived.

$$Y = -33.0978 + 0.7965X_1 - 1.9472 X_2 + 0.7628X_3 - 0.1391 X_4 - 1.0339 X_5 - 1.5259 X_6$$

The results of the analysis revealed that the abiotic factors were able to cause variation in the population of coccinellids to the extent of 86.14 per cent ($R^2$= 0.8614). Out of which the minimum temperature (r= -0.680) showed significant negative influence on the population of coccinellid predators.

**Table 1:** Influence of weather parameters on the incidence of coccinellid predator, *Coccinella septempunctata* L. on cauliflower during *Rabi*, 2017-18.

| Standard week | Meteorological parameters | | | | | | Coccinellids |
|---|---|---|---|---|---|---|---|
| | Mean temp. (◦C) | | Mean relative humidity (%) | | Wind velocity (KMPH) | Mean bright sunshine hours | Mean beetles population / 10 plants |
| | Max. | Min. | Morning | Evening | | | |
| 47th week | 30.94 | 22.14 | 91.71 | 65.71 | 0.81 | 6.57 | 0 |
| 48th week | 30.21 | 17.08 | 74.80 | 39.14 | 0.91 | 7.71 | 0 |
| 49th week | 28.6 | 17.42 | 85.14 | 46.71 | 1.18 | 2.35 | 8.6 |
| 50th week | 30.85 | 18.35 | 82.57 | 47.85 | 0.50 | 2.85 | 10 |
| 51th week | 30.00 | 15.42 | 88.00 | 50.71 | 0.71 | 3.67 | 10.6 |
| 52th week | 33.94 | 17.14 | 85.87 | 61.50 | 0.85 | 3.65 | 11.33 |
| 1th week | 29.21 | 15.00 | 88.57 | 65.42 | 1.02 | 4.72 | 14 |
| 2th week | 30.6 | 15.77 | 87.71 | 41.28 | 0.70 | 4.8 | 16.33 |
| 3th week | 31.14 | 14.9 | 88.57 | 56.85 | 0.50 | 7.0 | 17.33 |
| 4th week | 30.50 | 16.61 | 92.00 | 45.42 | 1.20 | 3.57 | 20.66 |
| 5th week | 32.78 | 14.42 | 91.28 | 35.42 | 0.71 | 7.9 | 18 |
| 6th week | 32.42 | 17.35 | 87.70 | 41.57 | 0.64 | 4.62 | 16 |

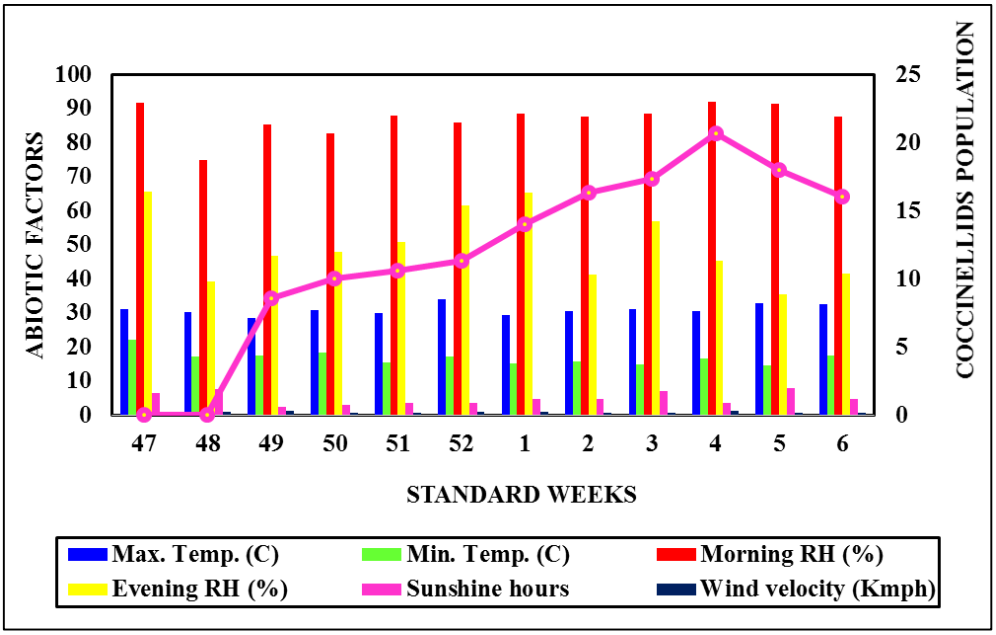


**Fig 1:** Influence of abiotic factors on the incidence of coccinellid population on cauliflower during *Rabi*, 2017-18

**Table 2:** Simple correlation between weather parameters and population of coccinellid predator, *Coccinella septempunctata* L. on cauliflower during *Rabi*, 2017-18.

| Weather parameters | Correlation coefficient (r) |
|---|---|
| $X_1$ – Maximum temperature ($^0$C) | 0.232 |
| $X_2$ – Minimum temperature ($^0$C) | -0.680* |
| $X_3$ – Morning relative humidity (%) | 0.553 |
| $X_4$ – Evening relative humidity (%) | -0.242 |
| $X_5$ – Bright sunshine hours | -0.163 |
| $X_6$ – Wind velocity (KMPH) | -0.078 |

* Significant at 5% level

**Table 3:** Multiple linear regression between abiotic factors and coccinellids population on cauliflower and during *Rabi*, 2017-2018.

| Variable | Partial regression coefficient | Standard error | t- value |
|---|---|---|---|
| $X_1$ – Maximum temperature ($^0$C) | 0.394 | 0.854 | 0.933 |
| $X_2$ – Minimum temperature ($^0$C) | 0.019 | 0.574 | -3.392 |
| $X_3$ – Morning relative humidity (%) | 0.030 | 0.253 | 3.011 |
| $X_4$ – Evening relative humidity (%) | 0.299 | 0.120 | -1.159 |
| $X_5$ – Bright sunshine hours | 0.156 | 0.619 | -1.670 |
| $X_6$ – Wind velocity (KMPH) | 0.790 | 5.431 | -0.281 |

Intercept: -33.0978 $R^2$ value: 0.861

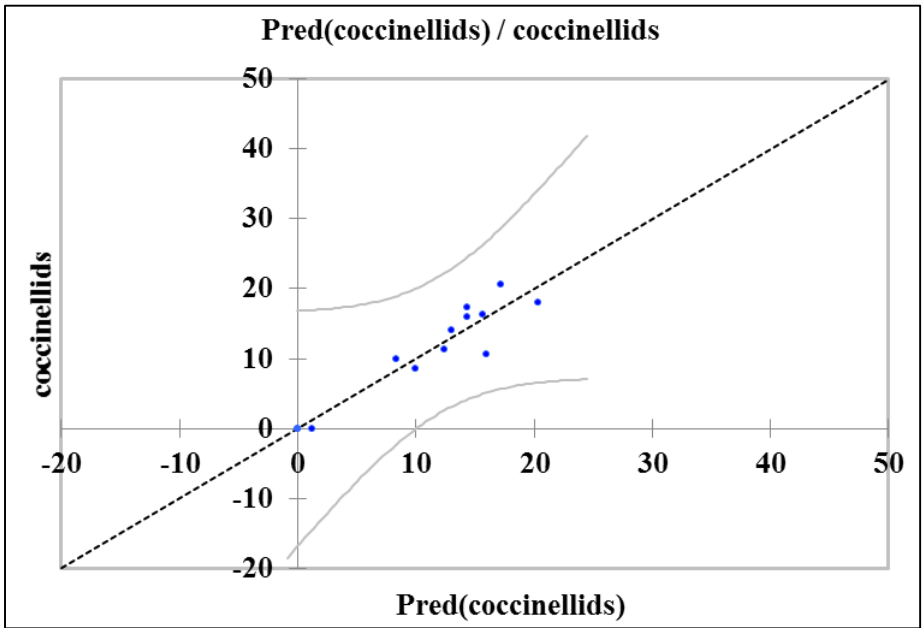


**Fig 2:** Distribution plots depicting the mean predicted coccinellid population in cauliflower

## 4. Conclusion

Attempts were made in the present study to investigate the seasonal incidence of natural enemies and among the natural enemies of insect pests of cauliflower, coccinellid predator, *Coccinella septempunctata* L. was appeared as the major natural enemy in cauliflower ecosystem. Other natural enemies like *Cotesia* and spiders were presented in limited numbers. The initial activity of coccinellids was recorded during 49$^{th}$ standard week after the transplantation of cauliflower seedlings and the highest numbers were recorded from 4$^{th}$ standard week *i.e.*, last week of January. Despite the intensive use of insecticides to control different insect pests on cole crops in large scale and smallholder farms, there is a rich faunal guild of natural enemies that attack the pests. The challenge therefore is to reduce pesticide usage on farms while enhancing biological control using natural enemies as bio-control agents if were once successfully established within agro-ecosystem, the effect could be continuous, which means less pest density and less effort will be needed to manage pests.

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