Journal of Crop and Weed, 14(3): 149-152 (2018)

Monitoring of alate mustard aphid (*Lipaphis erysimi* Kaltenbach) by using yellow sticky trap in West Bengal

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Received : 29-07-17 ; Revised: 20-11-18 ; Accepted : 25-11-18

ABSTRACT

The mustard aphid is a serious pest of mustard in India and other tropical regions in the world. The population dynamics of the pest is highly influenced by immigrant alate which migrate to the mustard crop from the off-season shelter. The results indicated that initial appearance of the alate aphid was noticed during 50th Standard Meteorological Week (first fortnight of December), then it gradually increased with slight fluctuation and finally declined after 10th Standard Meteorological Week (5th March – 11th March). Maximum trapping of alate mustard aphid (305 – 457 alate aphid trap^{-1}) was recorded during the end of February (8th and 9thStandard Meteorological Week) might be because of maturity of the crop and increasing temperature at that period which influenced the formation of alate aphid for migration. Weather factors like temperature (maximum and minimum), relative humidity (maximum & minimum) and wind speed were significantly correlated with the incidence of alate aphid particularly, maximum temperature resulted highest positive correlation (r = 0.698). In general during the experiment higher population of alate aphid were observed when maximum temperature was <30°C and minimum temperature was <16°C. It was found from the regression analysis, that combined influence of weather parameters had more influence on incidence of alate aphid than the single weather parameter.*

Keywords **:** Alate mustard aphid, correlation, regression, weather factors and yellow sticky trap

Rapeseed-mustard is the second most important edible oilseed after groundnut in India, sharing 27.8 per cent in the national oilseed economy. In India during 2013-14, 8.03 million tones of rapeseed-mustard was produced from the 6.36 million ha area with an annual productivity of 1262 kg ha^{-1} (Anon., 2014). In West Bengal rapeseed-mustard production was 4.78 lakh tones from 4.48 lakh ha area with an average productivity of 1066 kg ha^{-1} during 2013-14 (Anon., 2015).

While the availability of this edible oilseed are taken into consideration it is found that there is a huge gap between the demand and supply over the years in India as well as in our state, therefore increasing trend of import to meet the domestic demand is great concern to us. The productivity of rapeseed-mustard in West Bengal is comparatively low than the national annual productivity though West Bengal holds an important position in rapeseed-mustard cultivation nationally. This problem of low productivity over the years continues to be a major issue for agricultural planners and researchers. Several factors responsible for this low productivity, out of them insect-pests problem particularly regular damage due to mustard aphid (*Lipaphis erysimi* Kalt.) is very important not only in West Bengal but also throughout the mustard growing areas of the country.

The nymphs and adults of the aphid suck sap from leaves, tender stems, inflorescences and pods, as a result the plant shows stunted growth, withered flower and deformed pod, thereby causing 30-96 per cent yield loss (Sahoo, 2012). The alate reproductive forms of mustard aphid migrate from the hills to plains during the onset of winter and settle on the mustard crop in plains for their survival, growth and development. These are mostly attracted towards yellow colour of mustard flower (Dilwari and Atwal, 1989). Near the end of winter season when the crop attains maturity as well as due to unfavourable weather again alate form arises for migration. The initiation and cessation of infestation takes place through winged forms (alate) of the aphid. Thus alate forms determine the initiation of the infestation and intensity of aphid attack on the *Brassica* crops. Generally, insect traps are useful tools for monitoring insect populations to determine the need for control or the timing of control practices and for assessing their effects (Gillespie and Quiring, 1987). The most widely used and acceptable approach to record aphid population densities is the counting of apterous population on the host plants. However, this method is very laborious and time consuming. The population dynamics of the aphid is highly influenced by immigrant alate which migrate to the mustard crop from the off-season shelter. Thus, in general aerial trap catches can be used to monitor the arrival and departure of alate aphid which may prove useful in decision making for execution of pest management strategies. Keeping these in consideration, the experiment was conducted to study

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the incidence of the alate form of mustard aphid with the help of yellow sticky trap.

MATERIALS AND METHODS

The research work was done at the Pulses and Oilseeds Research Station, Government of West Bengal, Berhampore, Murshidabad for three consecutive *rabi* seasons during 2009-12. To study the incidence of alate aphid, yellow sticky traps were made by the empty round tin of 1 kg capacity and painted with yellow colour because mustard aphid mostly attracted to the yellow colour. These traps were set on a 1.5 meter long iron rod so that the height of the trap was similar with the mustard crop and four such traps were installed around the rapeseed-mustard field at uniform distance. Then a coating of low cost petroleum grease was smeared around the yellow painted surface of the empty round tin so that it becomes sticky. The petroleum grease was changed twice in a week after recording the observation on alate mustard aphid for better stickiness.

The observation on the adhered alate aphid was recorded every day morning with the help of a needle and after taking observation these aphids was removed. Daily meteorological data on maximum temperature (Tmax) and minimum temperature (Tmin); morning relative humidity (RHmax) and afternoon relative humidity (RHmin); rainfall (RF) and wind speed (WS) were collected from the Meteorological Observatory situated at the Pulses and Oilseeds Research Station, Government of West Bengal, Berhampore, Murshidabad. Daily data of aphid as well as weather were then aggregated into weekly mean values for statistical analysis as per the procedure of Panse and Sukhatme (1967). Correlation calculation was done to ascertainthe relationship between the incidence of alate aphids and weather parameters. Besides regression analysis was also performed to study the influence of the weather on the aphid incidence.

RESULTS AND DISCUSSION

Monitoring of alate mustard aphid (Fig.1) revealed that initial appearance of the alate aphid was noticed during 50th Standard Meteorological Week (first fortnight of December), then it gradually increased with slight fluctuation and finally declined after 10th SMW (5th March – 11th March) over the period of experimentation. During 2009-10, maximum alate aphid was trapped in the sticky trap at 8th SMW (305 alate aphid sticky trap^{-1}). Whereas, during 2010-11 and 2011-12, the peak catches was recorded during 9th SMW with 395 and 457alate aphid/ trap, respectively. After the arrival of alate mustard aphid in the plains of West Bengal during second week of December, reproduce parthenogenitically and produce apterous forms in mustard crop. This observation is in conformity with the findings of Sahoo, 2013 who recorded the first appearance of apterous aphids on the mustard crop in West Bengal during the last week of December. Maximum trapping of alate mustard aphid during present studycould be supported by the observation of Chaudhury and Pal (2009) who reported that apterous form of the aphid in 'Binay' variety of rapeseed-mustard declined after 7th SMW in West Bengal that means maturity of the crop and prevailing weather during the end of February induced the formation of alate aphid for migration.

Meteorological factors, particularly temperature showed the positive correlation with the incidence of alate mustard aphid (Table 1) is presented graphically in the fig.1. It is revealed from the figure that maximum and minimum temperatures during maximum trapping of the alate mustard aphid were 28.75 ºC and 15.42 °C, 29.74 ºC and 15.35 °C during 2009-10 and 2010-12, respectively. Population of alate mustard aphid increased with the increasing trend of temperature upto a certain period after that the alate aphid population declined. In general during the experiment more population of alate aphid were observed when maximum temperature was <30°C and minimum temperature was <16°C. The findings of the present authors are in conformity with Khan and Jha (2009) who reported the Tmax and Tmin during the critical period of mustard aphid infestation as 21.7-28.9 ºC and 7.3-17.8 ºC from West Bengal. Besides temperature, other factors like neuro-secretory products, population density, quality of food also governs the production of alate aphid (Behura, 1994).

The correlation between alate aphid population and temperature (maximum and minimum), relative humidity (maximum and minimum) and wind speed showed significant values. Rainfall was negatively correlated with population of alate mustard aphid might be due to the washing effect which reduced the growth and development of aphid. Generally, wind may influence the migration of alate mustard aphid from hill to the plain regions but in the present study negative correlation with the wind was found which might be because of the fact that wind in the experimental site could reduce the trapping of alate aphid on the yellow sticky trap. It is also revealed from the table 1 that except maximum and minimum temperature all the weather parameters had negative correlation on the incidence of the aphid. Among all the meteorological factors maximum temperature resulted higher positive correlation (r = 0.698*). This might be due to the fact that the rate of development of pests will enable a more rapid response to a change in temperature (Karuppaiah and Sujayanad,

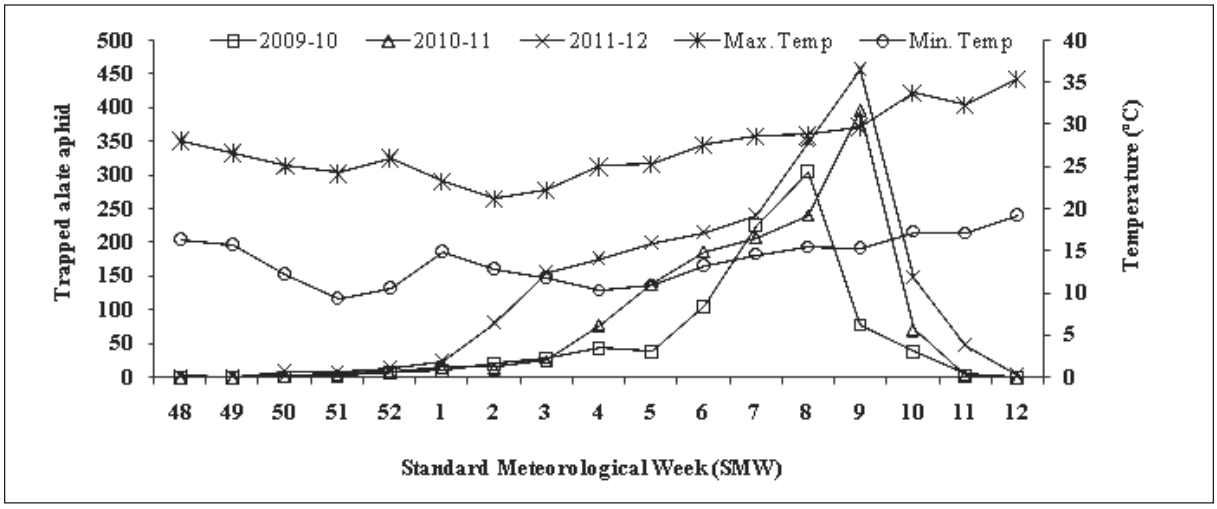

Fig.1: Monitoring of alate mustard aphid using yellow sticky trap in relation to temperature during 2009-12

Table 1: Correlation values (r) between incidence of alate mustard aphid and weather parameters during 2009-12 (pooled)

Trapped alate aphid	Temperature (°C)		RH (%)		Wind speed (km hr^{-1})	Rainfall (mm)
	Max.	Min.	Max.	Min.		
	0.698**	0.471**	-0.525**	-0.393**	-0.215*	-0.027

*Note: *Significant at (p = 0.05), df=125 **Significant at p = 0.01*

Table 2: Stepwise regression equations for estimating the influence of weather parameters on the incidence of alate mustard aphid during 2009-12 (pooled)

Regression equation	R^2
$Y= 132.59 + 30.79X_1 + 18.16X_2 + 1.07X_3 – 4.59X_4 -0.88X_5 – 23.72\ X_6$	0.540
$Y= 58.09 + 26.75X_1 + 18.66X_2 + 1.10X_3 – 4.21X_4 - 1.27X_5$	0.527
$Y= 38.69 + 22.92X_1 + 20.05X_2 + 0.03X_3 – 4.86X_4$	0.522
$Y= - 497.63 + 17.19X_1 + 25.39X_2 – 1.97X_3$	0.491
$Y= -487.87 + 15.53X_1 + 24.01X_2$	0.489
$Y= 175.08 – 11.53X_1$	0.001

Note : *X_1= Rainfall (mm); X_2= Maximum Temperature (°C); X_3= Minimum Temperature (°C); X_4= RHmax. (%); X_5= RHmin. (%); X_6= Wind speed (km hr^{-1})*

2012). This observation corroborate with the findings of Rashid *et al*. (2009), Singh and Lal (2012); Asin and Pons (2001).

The influences of rainfall, temperature, relative humidity and wind speed on incidence of alate aphid were evaluated through stepwise regression analysis. It was observed that the combined influence of these weather parameters had more influence on incidence of alate aphid (R^2 = 0.540) than the single weather parameter as the R^2 value was only 0.001 (Table 2). The combined effect of rainfall and maximum temperature with R^2 value of 0.484 and when maximum temperature was deleted the R^2 value comes down to 0.001. This shows that maximum temperature had 48.8 per cent influences. Similar observations were also reported by Sahoo (2016) and Choudhury and Pal (2009).

It could be inferred from the above study that maximum trapping of alate mustard aphid was recorded during the end of February might be because of maturity of the crop and increasing temperature at that period which influenced the formation of alate aphid for migration. Beside these, other factors like juvenile

hormone and population density may also govern the production of alate aphid. First trapping of alate aphid was found during second week of December. So, after arrival in the plains the alateform reproduces parthenogenetically and produces apterous form in the mustard crop which is prevalent from the last week of December.Weather factors like temperature (maximum and minimum), relative humidity (maximum & minimum) and wind speed were significantly correlated with the incidence of alate aphid particularly, maximum temperature resulted higher positive correlation. From regression analysis, it was found that combined influence of weather parameters had more influence on incidence of alate aphid than the single weather parameter. This migration information may be utilized for forewarning so that farmers could take proper decision for execution of future pest management strategies.

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