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Relationship between the population of mustard aphid, *Lipaphis erysimi* (Kaltenbach) and weather parameters on different cultivars of Indian mustard (*Brassica juncea* L.)

[1]Wajid Hasan and [2]C. P. Singh

[1]*Department of Plant Protection, Faculty of Agri. Science, A.M.U., Aligarh 202 002*

[2]*Department of Entomology, G. B. Pant University of Agriculture & Technology, Pantnagar-263145, Uttarakhand (India),Email: entowajid@gmail.com*

A B S T R A C T

The experiments were conducted during *rabi* season (2007-08 & 2008-09) at Crop Research Centre of G.B. Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar, Uttarakhand to investigate the population dynamics of the mustard aphid, *Lipaphis erysimi* Kalt. on different 42 cultivars of Indian mustard (*B. juncea*). The results revealed that the population of *L. erysimi* exhibited negative correlation with maximum and minimum temperature, rainfall, wind velocity, evaporation and positive with afternoon and morning relative humidity. The values of coefficient of determination (R^2) were high (0.92 to 0.99), indicated that the population of *L. erysimi* governed significantly with the weather parameters. It concluded that the temperature (max. 18.7 and min. 5.0 ^{0}C), relative humidity (morning 91.5 and afternoon 50.5 percent), rainfall (000.0 mm), evaporation (below 1.55 mm), bright sun shine hours (below 5.8 hr) along with wind velocity below 3.4 km/hr were found very conductive for this pest.

Keywords: **:** Correlation, regression, *B. juncea*, *Lipaphis erysimi*, weather parameters

Introduction

The mustard aphid, *Lipaphis erysimi* (Kaltenbach) (Homoptera: Aphididae) is the key pests of rapeseed mustard and damage to the crop ranging from 9 to 96% in different agro climatic conditions of India (Phadke 1980; Singh & Sharma 2002; Bakhetia 1984; Chorbandi & Bakhetia 1987; Singh & Sachan 1994; Jadhav & Singh 1992; Buntin & Raymer 1994; Singh & Sachan 1995; Sekhon *et al*. 1996; Parmar *et al*. 2007). Such loss may go upto 100% in certain mustard growing regions (Singh and Sachan, 1999). The turnip aphid is also a known vector of about 10 non persistant plant viruses (Blackman & Estop 1984). Temperature is a key abiotic factor that regulates insect population dynamics, developmental rates, and seasonal occurrence (Campbell *et al.* 1974; Logan *et al.* 1976; Schowalter 2000). By computing population trends with meteorological records, it possible to know the occurrence of outbreaks in the area under study and would certainly help in formulating sound pest management strategies against *L. erysimi*.

Materials and Methods

The present investigations were carried out during rabi season (2007-08 & 2008-09) at Crop Research Centre (CRC) of G.B. Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar, situated in the Tarai region of Uttarakhand, South of foothills of Shivalik range, Himalayas. Geographically it is located

at 29°N latitude and 79.3°E longitude and at an altitude of 243.84 meters above the mean sea level. The soil of experimental field was sandy loam. Pantnagar is having of sub humid, subtropical climate with hot dry summers and cool winters. The summer temperature rises upto 40^{0}C while the winter temperature falls to 2 ^{0}C. The mean annual rainfall is 171 mm and relative humidity fluctuates around 90±5 percent (0712AM) during rainy season and remains high at above 85 per cent upto February after which it decrease upto 50 percent in May. Daily and weekly average data on maximum temperature, rainfall, relative humidity, sunshine hours and evaporation prevailing during experimental period were recorded at meteorological observatory located at the Crop Research Centre (CRC) of University.

Experiments were laid out in Randomized Block Design (RBD) with three replications. Different 42 cultivars of Indian mustard were sown on 10th November of 2007 and 2008 with three rows of each cultivar in each replication. The row to row and plant to plant distances were 30 and 10cm respectively. During experimentation all the recommended cultural operations were followed except the plant protection measurers.

Three plants one from each row were selected randomly and tagged in each replication. The total nine plants were tagged for each cultivar / advanced lines. Observations were taken on those tagged plants at weekly intervals. The number of aphids was counted on 10cm apical central shoot of inflorescence. The population of mustard aphid was estimated by counting the number of aphid (nymphs and adults) as described method by Singh and Singh (1994). The correlation was worked out between environmental parameters i.e., Temperature Minimum (^{0}C), Temperature Maximum (^{0}C), Relative Humidity at 0712 A.M., Relative Humidity at 1412 P.M., Rainfall (mm), Wind Velocity (Km/h), Sunshine Hours, Evaporation (mm) and population fluctuation of aphids per 10 cm central inflorescence under field conditions.

Results and Discussion

The population of *L. erysimi* was studied on the 42 cultivars of Indian mustard at fixed interval of weeks along with metrological observations for consecutive years 2007-08 and 2008-09 crop seasons. The results depicted in Figure 1 (a & b) revealed that the incidence of *L. erysimi* appeared on different cultivars of Indian mustard commenced from 51th standard week and gradually increase and reached its peak in the 5th standard week. Thereafter population gradually decline during both of the crop season i.e. 2007-08 and 2008-09. The flowering stage of mustard had been reported to be most vulnerable stage to *L. erysimi* (Kundu & Pant 1968; Brar *et al*. 1976; Singh & Sachan 1995).

Correlation among the population of L. erysimi and weather parameters on cultivars of Indian mustard (B. juncea L.) :

Correlation of the pest population with weather parameters revealed that the population of *L. erysimi* exhibited negative correlation with maximum and minimum temperature among all the cultivars of Indian mustard, except PBC-2005-6, Kiran E, Kiran B, PRB-2004-4-1, PRB-

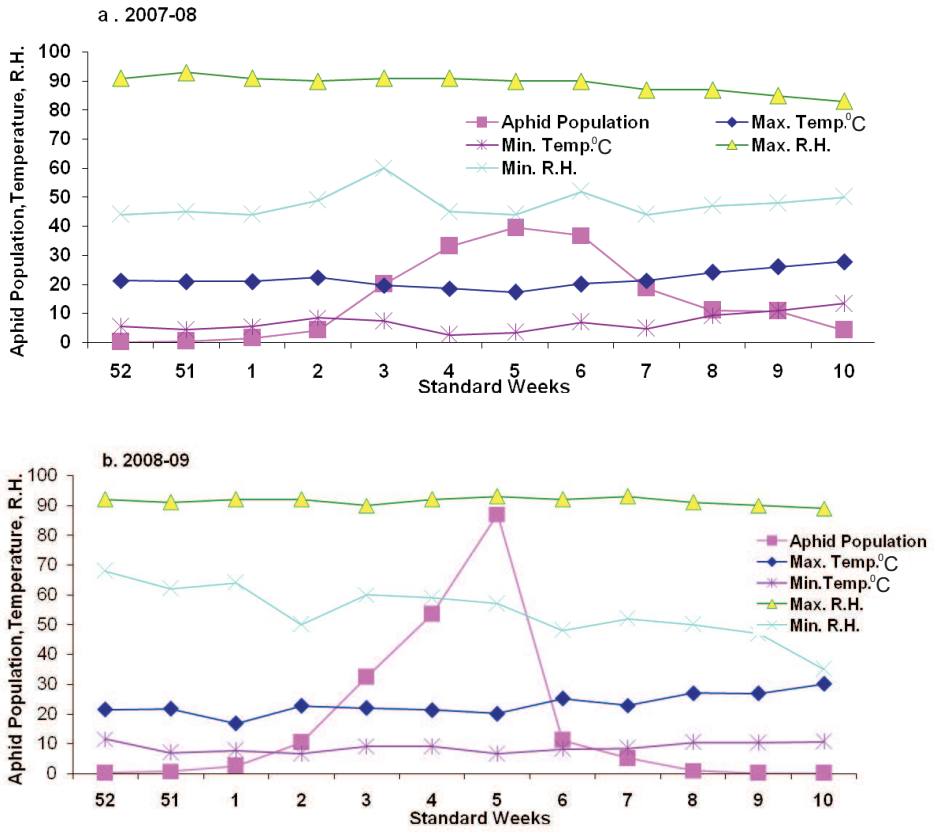

Fig.1a. & b. Aphid population (Pooled) on different standard weeks corresponding to weather

2006-3, PRB-2006-6, these showed positive correlation with temperature during 2007-08 crop season. Afternoon and morning relative humidity showed positive correlation with the population of *L. erysimi* on all the cultivar / advanced lines of mustard during both of the crop season 2007-08 and 2008-09, except PBC-2005-6, Kiran E, Kiran B, PRB-2004-4-1, PRB-2004-4-3, PRB-2006-9, PRB-2006-6, PBC-2005-3, PRB-2004-4-3, PR-2006-14, Kranti, PRKS-14, PRKS-1, Vardan, PRB-2004-6-8 during 2007-08 and PRKS-28, PRB-2004-3-4 during 2008-09, these showed positive correlation. Jat *et al*. (2006) reported the aphid population was significantly and positively correlated with both morning and evening relative humidity. The afternoon relative humidity showed significant positive correlation with the aphid population, whereas the correlation with wind velocity was not significant (Gami *et al.* 2004). Temperature has positive effect on *L. erysimi* (Singh *et al.* 1986). Temperature of 10-13.5 ^{0}C and 72-855 R. H. were optimal for population buildup (Bishnoi *et al.*1992). Maximum reproductive rate was found at 16-18 ^{0}C than at 24-25 ^{0}C (Wu & Liu 1993). The range of maximum temperature 15.8-27.7 ^{0}C, minimum temperature 10.2-10.0 ^{0}C and R.H. 61-65% is conductive for the rapid multiplication of the aphid (Srivastava *et al.*

1995). According to Jaglan *et al.* (1998) Peak activity of *L. erysimi* was observed at an average temperature range of 12.1 to 29.7 ^{0}C and R. H. of 40.3-86.7%. Rain had deleterious effect on populations. Whereas the correlation of population of *L. erysimi* with rainfall, wind velocity and evaporation was negative and non significant in most of the cultivars during both of the crop season 2007-08 and 2008-09. According to Narang *et al*. (1994) rainfall can cause reduction in aphid population significantly and suddenly. Simulated rainfall of 1.0 to 2.0 cm reduced population by 45.47-66.43%. Maximum relative humidity three days prier to observation was the most important function in increasing the aphid population (Singh & Rai, 1994). Similar results were also obtained by Singh *et al.* (1986), Jaglan *et al.* (1988) and Rossi (1990). The correlation of the population of *L. erysimi* with bright sun shine hours was non significant and negative during 2008-09 on all cultivars while it showed positive correlation during 2007-08 except Ashirvad, PRKS-31, PRKS-1, Vardan, PR-2006-18, PBC-2005-3, PRKS-28 had negative correlation. The aphid population was negatively correlated with mean maximum and minimum temperatures and sunshine, and positively correlated with humidity (Ahuja 1990).

The values of coefficient of determination (R^2) were high (0.92 to 0.99), it indicated that the population of *L. erysimi* governed significantly with the weather parameters in both of the crop season 2007-08 and 2008-09 on all cultivars except PRB-2006-7, PRKS-45, PRKS-38, PRB-2006-9, PR-2006-18, PRKS-28 and Kranti during the crop season 2007-08. It was also noticed that the correlation of the population of *L. erysimi* with all weather parameters was non significant in most of the cultivars of Indian mustard during both of the crop season 2007-08 and 2008-09. Thus the studies indicated that the population of *L. erysimi* decreased with increase temperature, rainfall, wind velocity (km/h), bright sun shine hours and evaporation. Whereas, it increased with the increase in relative humidity.

The aphid multiplication is positively governed by temperature whereas relative humidity and wind velocity show negative effect (Jitendra Kumar *et al* 2000). Samdur *et al*. (1997) observed that the conditions of an average-maximum temperature around 23°C, minimum temperature around 10°C, maximum RH from 85-88%, minimum RH from 30-35%, sunshine for 4-7 h per day, evaporation from 2-3 mm per day and wind velocity from 3.0-4.5 km h^{-1} day^{-1} were optimum for aphid population increase in the field. Positive and non-significant correlation existed between maximum temperature and aphid population during both the years while negative and non-significant correlation observed with minimum temperature, morning and evening relative humidity (Jandial & Anil Kumar 2007).

Therefore it could be concluded that the temperature (max. 18.7 and min. 5.0^{0}C), relative humidity (morning 91.5 and afternoon 50.5 percent), rainfall (000.0mm), evaporation (below 1.55 mm), bright sun shine hours (below 5.8 hr) along with wind velocity below 3.4 km/hr were found very conductive for this pest.

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