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Mustard aphid (*Lipaphis erysimi* Kalt) incidence in raya in relation to crop phenology and growing degree-days

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ABSTRACT

Field experiments were conducted during *rabi* season 2003-04 and 2004-05 to study the phenology and mustard aphid incidence on raya crop. Raya variety PBR 91 was sown on two different dates viz. first week of November (D_1) and last week of November (D_2).The aphid population was usually maximum at the pod formation stage. The growing degree days, accumulated from January 1 showed that after 15 January the AGDD accumulation was slow during higher aphid incidence season of 2004-05 as compared to 2003-04. This concept can be used for prediction of peak aphid population occurring in the month of February.

Key words: Aphid incidence, growing degree days, phenology.

Oilseed crops occupy 13 per cent of the country's gross crop area and contribute around 5 per cent to the gross national product. Among all the oilseed crops, mustard (*Brassica juncea* L) ranks second in area and production after groundnut and contribute around 27 per cent of total oilseed production in the country. Mustard requires a definite amount of accumulated heat energy for the completion of its life cycle. Growing degree-days or heat unit requirement has often been used for characterizing thermal responses in crops (Shanker *et al*.1996). In India this concept has been applied to various crops like wheat, barley and mustard (Sastry and Chakravarty, 1982, Hundal *et al*, 1997, Kar and Chakravarty 2000), and was found to be useful as an input in crop modeling. Little work has been done to quantify the relationships between the thermal time and the incidence of mustard aphid in raya crop. Keeping this in view, the present study was conducted to develop a relationship between aphid population and thermal time.

MATERIALS AND METHODS

A field experiment was conducted at Ludhiana during the *rabi* seasons of 2003-04 and 2004-05. Raya cultivar PBR-91 was sown on two different dates viz. first week of November (D_1) and last week of November (D_2). Daily observations on weather parameters were recorded in the

Agrometeorological Observatory adjoining the field site and situated at (30° 54' N lat. and 74° 48' E long. at an altitude of 247 m amsl). Daily observations of cloudy and rainy days, foggy days from December to January were recorded. A day with sunshine hours less than 5 hours of bright sunshine hours was considered as cloudy day. Aphid population was recorded from top 10 cm portion of the central shoot of ten randomly selected plants at weekly interval. Days taken to the following phenological stages based on visible changes in morphological characteristics during life cycle of plant were recorded from sowing to physiological maturity,

P_1 - start emergence, P_2 - complete emergence, P_3 – first flower, P_4 - 50% flowering, P_5 - early siliqua development, P_6 -pod formation, P_7 - pod filling and P_8 – physiological maturity.

The Growing degree-days (GDD) were calculated as per Nuttonson (1955) using base temperature of 5.0 °C (Morrison *et al.*, 1990).The GDD were accumulated from January 1st onwards in all the dates of sowing during 2003-04 and 2004-05 except in D_1 during 2004-05, where accumulations were done from December 1st onwards due to early aphid appearance.

RESULTS AND DISCUSSION

Crop phenological stages

The number of days taken by the crop for completion of different phenophases varied with the date of sowing during both the crop years (Table 1). During 2004-05 D_1 took 38 days to reach flowering while it took 47 days in D_1 during 2003-04. Delayed sown crop took less number of days (111 and 120) to attain physiological maturity than the early sown crop (137 and 143) during 2003-04 and 2004-05 respectively. Similar results were also reported by Singh *et al* (1993) and Tyagi (1996).

Phenological stages and accumulated growing degree-days

The growing degree days (GDD) accumulated from sowing to different phenological stages are presented in Table 2. The highest GDD (1513 and 1540) were accumulated in D_1 during *rabi* 2003-04 and 2004-05 respectively. At flowering and early siliqua development stage heat unit accumulation was more in D_1 than D_2 during both seasons, whereas, at pod formation and pod filling stage heat unit accumulation was more in D_2 as compared to D_1 during both the years. Rao *et al.* (1999) also reported from Hisar that delay in sowing resulted in lower GDD irrespective of crop season.

Phenological stages and aphid infestation

The growth and multiplication of mustard aphid are related to the plant phenological events. An understanding of these interactions is more useful for developing forewarning systems. The results (Table 3) revealed that the aphid infestation started 75 and 71 DAS in D_1 and

Table 1: Days taken to attain diffrent phenological stages

Stages	Days after sowing			
	2003-04		2004-05	
	D_1	D_2	D_1	D_2
P_1	3	6	4	6
P_2	7	9	12	16
P_3	47	57	38	58
P_4	63	70	47	68
P_5	74	79	60	79
P_6	84	90	72	96
P_7	98	98	89	102
P_8	137	111	143	120

Table 2: Accumulated growing degree- days at different phenological stages during *rabi* 2003-04 and 2004-05

Phenological stages	Accumulated growing degree- days			
	2003-04		2004-05	
	D_1	D_2	D_1	D_2
P_1	69	71	71	93
P_2	127	113	186	197
P_3	552	488	535	524
P_4	634	586	627	586
P_5	738	683	732	694
P_6	814	831	823	841
P_7	924	942	926	928
P_8	1513	1180	1540	1205

D_2 during 2003-04, however during 2004-05 its infestation started earlier i.e. 55 DAS in D_1 and 58 DAS in D_2. The aphid appeared at the flowering stage during both the years which is the most vulnerable one for aphid infestation as reported by Sharma and Kashyap (1998). The aphid population reached its peak after 96 and 91 DAS in both D_1 and D_2 (pod initiation during 2003-04) but during 2004-05 peak infestation was at pod formation stage in D_1 (83 DAS) and at early siliqua development stage in D_2 (81 DAS). Singh *et al* (1984) also reported that the most sensitive stage for aphid incidence is from flowering to pod initiation stage. The aphid population disappeared at pod filling stage in both dates of sowing during both the years.

Table 3. Phenological stages, accumulated GDD and aphid incidence under different sowing dates

Aphid Incidence	2003-04				2004-05			
	D_1		D_2		D_1		D_2	
	Phenological stage	DAS	Phenological stage	DAS	Phenological stage	DAS	Phenological stage	DAS
Aphid appearance	Early siliqua development	75 (744)	Flowering (50%)	71 (594)	Flowering (50%)	55 (699)	Flowering starts	58 (524)
Maximum aphid population	Pod formation start	96 (904)	Pod formation start	91 (844)	Pod formation start	83 (895)	Early siliqua development	81 (747)
Aphid disappearance	Pod filling complete	124 (1271)	Pod filling complete	106 (1081)	Pod filling complete	111 (1081)	Pod filling complete	100 (899)

*Values in parenthesis are accumulated growing degree-days

Aphid population and accumulated growing degree-days

In Punjab state, first appearance of mustard aphid is noticed in late December or first week of January. So the meteorological conditions during January are significant for aphid growth and multiplication. Keeping this in view the GDD were accumulated from 1st January during both the seasons (Table 4). This data reveals that accumulated degree-days were almost similar up to 15 January but after that it gradually increased in 2003-04 as compared to 2004-05. By 25th February the accumulated degree days were 487 in 2003-04 compared to 426 in 2004-05. The aphid population was also low in 2003-04 as compared to 2004-05. Similar trends were noted when the heat units were accumulated from the month of aphid appearance which indicated that the GDD was more in D_1 and D_2 during crop season 2003-04 as compared to 2004-05 crop season. The aphid population is low when GDD accumulation is high and vice versa. Similar results were also reported by Chakravarty and Gautam (2002). They observed that the GDD accumulation was inversely proportional to aphid population. The incidence and multiplication of mustard aphid is largely influenced by meteorological parameters like rainfall, cloudiness and foggy days. There were 30 cloudy days during 2004-05 but 22 during 2003-04. Dhaliwal (2002) also reported that more number of cloudy days favour the aphid population. The number of rainy days were more during 2004-05 but the rainfall was

Table 4: Comparison of accumulated growing degree-days during 2003-04 and 2004-05

Date	Accumulated degree-Days	
	2003-04(L)	2004-05(H)
15-Jan	108	108
20-Jan	150	139
25-Jan	189	165
30-Jan	228	198
5-Feb	265	246
10-Feb	310	295
15-Feb	361	352
20-Feb	424	387
25-Feb	487	426

L - Low aphid infestation year, H- High aphid infestation year

Table 5: Comparison of meteorological parameters from December to January during *rabi* 2003-04 and 2004-05

Parameters	*Rabi* 2003-04	*Rabi* 2004-05
Fog & mist days	13	20
Cloudy days	22	30
Rainfall (mm)	43	30
Rainy days	3	4
Aphid incidence	Low	High

more (43 mm) during 2003-04. Pandey *et al.* (1986) also observed that high rainfall decreased the population by dislodging aphid colonies.

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