Population dynamics, incidence and damage of *Myzus persicae* Sulzer on Capsicum (*Capsicum annum*) under polyhouse condition in Kashmir Valley

Abstract

An experiment was conducted to assess the status of green peach aphid (*M. persicae*) infesting on capsicum (*Capsicum annum*) under protected cultivation in Kashmir valley. The data on population density of *M. persicae* revealed that infestation commenced during the 24th SMW (0.81 aphid forms/leaf); which increased up to 32nd SMW (24.46 aphid forms/leaf) thereafter, the aphid population declined from 33rd SMW up to 39th SMW (0.03 forms/leaf). However, the aphid pest incidence initiated from 24th SMW (7.41 per cent) which was increased up to 32nd SMW (77.78 per cent) and then decreased from 33rd SMW up to 39th SMW (3.70 per cent). Similarly, the leaf damage due to *M. persicae* infestation was recorded during 24th SMW (14.81 %) and increased up to 32nd SMW (81.48 %); and altogether declined from 33rd SMW up to 39th SMW (7.40 %). The pest severity observed the similar trend as recorded for incidence and leaf damage. Severity of *M. persicae* was calculated from 24th SMW (0.50) which increased up to 32nd SMW (7.00) and then a decline was observed from 33rd SMW up to 39th SMW (2.33). Further correlation studies revealed that population of *M. persicae* exhibited statistically significant positive correlation with temperature (r = 0.656) and a non-significant negative correlation with Relative humidity (r = -0.405).

Key words: Capsicum, *Myzus persicae*, population dynamics, leaf damage, pest severity, protection cultivation.

Introduction

Capsicum is indeed a globally cultivated Solanaceous vegetable crop and due to high market demand in both fresh and processed forms, with major producers being China, India, Indonesia and Mexico, which together contribute significantly to the Capsicum

production (FAO, 2021, Kumar *et al.*, 2021). It is rich in essential vitamins and antioxidants, making it beneficial for human health (Wahyuni *et al.,* 2020) and also help in reducing the risk of chronic diseases such as cardiovascular disorders and certain cancers (Kim *et al.,* 2021). In Jammu & Kashmir, the cultivation area for *Capsicum* is estimated at around 1,500 hectares, with a production volume of approximately 12,000 metric tons annually (Mir *et al.,* 2021). The pests causing significant damage to capsicum crops are diverse, comprising more than 39 genera and 51 species of insects and mites and among these pests that can cause significant damage to capsicum crops, particularly under protected cultivation are green peach aphid (*Myzus persicae* Sulzer), melon aphid (*Aphis gossypii* Glover), whiteflies (*Bemisia tabaci* Genn), thrips (*Scirtothrips dorsalis* Hood), Mites (*Polyphagotarsonemus latus* Banks) and Fruit borers (*Spodoptera litura* Fabricius and *Helicoverpa armigera* Hubner). These pests collectively pose a significant threat to capsicum crops, affecting both the quality and quantity of the yield (Hosamani *et al*., 2005).

The presence of vectors for viral diseases adds an additional layer of complexity to pest management (Khan and Parvaiz, 2024). Integrated pest management strategies that consider the specific characteristics of each pest and their interactions are essential for effectively mitigating the impact on capsicum cultivation, particularly in protected environments (Kandasamy *et al*., 1990). The green peach aphid (*Myzus persicae*) is an important pest of capsicum primarily because it transmits viral diseases that impact plant growth and yield (Blackman and Eastop, 2021). The information emphasizes the dual role of *Myzus persicae* acting not only as direct damaging agent but also as vector for the transmission of viral diseases in capsicum crops (Khan and Shah, 2017). The transmission of viral diseases by these pests' results in various symptoms, including Necrosis (cell death), wilting, chlorosis, stunted growth, defoliation (loss of leaves), flower abortion and fruit abortion (Sayed *et al.,* 2019). The secretion of honeydew by pests, including aphids, leads to the development of sooty mold which negatively affects the rate of photosynthesis in the crop (Shah, 2015; Parvaiz and Khan, 2022.).

In greenhouse conditions, however, aphid populations may persist year-round due to controlled temperatures, leading to continuous infestations and increased viral transmission risks (Tang *et al.*, 2019). Keeping in view the significance of this particular crop and the occurrence of green peach aphids under protected cultivation, the present investigation has been projected on population dynamics, incidence and damage of *Myzus persicae* infesting on capsicum which is a prerequisite for the management of these aphid pests under protected cultivation.

Material and methods

Polyhouse and plant materials: An experiment was carried out on aphid infestation on capsicum under protected cultivation at Experimental farm, Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar Campus, Srinagar-190025, Jammu and Kashmir,India during year 2020-21. Seedlings of different varieties of capsicum *viz*., Sp-461 Ly, California wonder red and Nishat-1 were raised in the nursery, and were transplanted in vegetable poly houses as per the package of practice recommended by Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar Campus, Srinagar-190025, Jammu and Kashmir, India in the month of May, 2020. The distance from row to row and plant to plant was maintained at 50cm × 45cm respectively. The purpose of the study was to determine the status of the aphid pest infesting capsicum under protected cultivation.

Population dynamics: Population density of aphid was recorded using standard procedures on randomly selected nine (09) plants from each plot and replicated thrice (Three times) (03). Observations were recorded at weekly intervals throughout the growing season, during the morning hours on a specific day (s). Different stages of the green peach aphid (*M. persicae*) *viz*., nymph, apterous and alate populations were recorded from three leaves per plant from the upper, middle and lower portions. The correlation between weather parameters (Temperature and Relative humidity) and population density of aphid pest was worked out to study the impact of abiotic factors in population build-up of the pest.

Pest incidence: It was observed by examining nine randomly selected plants per plot.

The per cent incidence was calculated by using the formula:

$$\text{Per cent incidence} = \frac{\text{Number of damaged plants}}{\text{Total number of plants examined}} \times 100$$

Leaf damage: It was observed in similar manner by examining 27 leaves from upper, middle, lower strata of the plant in each plot. The per cent leaf damage was calculated by the following formula:

$$\text{Per cent leaf damage} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves examined}} \times 100$$

Pest severity: The severity of aphid was estimated by a visual rating method and was calculated as per infestation scale advocated by Nagrare *et al*. (2011):

Grade 1 : Scattered appearance of few aphids on the plant leaves;

Grade 2 : Severe infestation of aphids on any one leaves of the plant;

Grade 3 : Severe infestation of aphids on more than one leaf or half portion of the plant;

Grade 4 : Severe infestation of aphids on the whole plant.

$$\text{Severity Index (SI)} = \frac{\text{Sum of total grade points (1-4 infestation grade) of the infested plants)}}{\text{Total number of infested plants observed}}$$

Results and discussion

Population dynamics: The population density of green peach aphid *M. persicae* nymphs commenced from 24th SMW whereas, both apterous and alate forms started from 25th SMW with mean population of 0.81, 0.86 and 0.20 aphid forms/leaf; respectively. Thereafter, the population of aphid nymphs, apterous and alate forms gradually increased up to 32nd SMW and peaked to 10.36, 7.44 and 6.66 aphid forms/leaf (Table 1). Aphid population subsequently declined to 0.03 aphids/leaf during 39th SMW. The present findings are in conformity with the results of Roopa and Kumar (2014) who observed the peak population of *M. persicae* during fourth week of October (2.21aphids/leaf). The results are in agreement with the findings of Rafee and Havanoor (2018) who too confirmed initiation of aphid, *M. persicae* population in 33rd

SMW and its density ranged from 0.29 to 2.48 aphids per leaf; with peak population as 2.48 per leaf during 43rd SMW (Figure 1). The variation in the peak activity might be due to change in sowing dates and change in climatic condition. The results are also in congruence with the findings of Choudhary *et al.* (2021) and Karami *et al.* (2018).

The mean population of aphid exhibited statistically significant positive correlation with temperature (r = 0.656) and a non- significant but negative correlation with relative humidity (r = -0.405). Regression equation too revealed a variability of 55 per cent (R^2= 0.55) in aphid population (Table 2). The present findings are in agreement with the results of Yaqoob *et al*. (2019) who too reported statistically significant positive correlation with temperature (r = 0.331) and a non-significant but negative correlation with relative humidity (r = -0.323). The studies are also in accordance with findings of Sri *et al*. (2017) and Hosseini *et al* (2020) who reported a significant and positive correlation of major sucking pests with temperature and negative association with relative humidity.

Pest incidence and leaf damage: Perusal of data presented in Table 3 revealed that the incidence of *M. persicae* initiated from 24th SMW as 7.41 per cent and gradually increased to 11.11, 22.22, 37.04, 48.15, 59.26, 66.67, 70.37 per cent during 25th, 26th, 27th, 28th, 29th, 30th and 31st SMW respectively. The maximum pest incidence as 77.78 per cent recorded during 32nd SMW decreased to 74.07, 62.96, 40.74, 33.33, 18.51, 14.81 per cent in 33rd, 34th, 35th, 36th, 37th and 38th SMW, respectively. However, the minimum aphid pest incidence as 3.70 per cent was recorded during 39th SMW corresponding to last week of September. The results are in agreement with the findings of Mdellel and Kamel, (2014) who confirmed that maximum incidence of 92.93 per cent and minimum incidence of 51.4 per cent of aphid, *M. persicae* on different varieties of capsicum. The results are also in agreement with the findings of Kumar and Gavkare (2014) who recorded pest incidence *of M. persicae* at different stages of the crop which varied from 19.25 to 68.95, 42.25 to 73.25, 37.58 to 74.85 and 30.56 to 88.54 per cent at four locations from July to September. The peak incidence of aphids was also noticed in 3rd week of July by Dugger and Richer, 1998. Further, the results are also in line with Dhamdhere *et al*. (1984) who reported peak population of *A. gossypii* during last week of June. Though, Pareek and Kavadia (1986) too observed

aphid attacking bottle gourd from third week of July till end of November with peak population in first fortnight of September while as the leaf damage caused due to aphid, *M. persicae* initiated from 24th SMW as 14.81 per cent, which gradually increased to 25.92, 29.62, 40.74, 55.55, 62.96, 70.37 and 74.07 per cent during 25th, 26th, 27th, 28th, 29th, 30th and 31st SMW respectively. The maximum leaf damage as 81.48 per cent during 32nd SMW and minimum as 7.40 per cent was recorded during 39th SMW. Present findings are in confirmation with the results of Nemade *et al*. (2018) who observed maximum aphid population (43.56 per cent) in 33rd SMW. The results are also in agreement with the findings of Chaudhary and Pandya, (2019) who revealed that aphid population started from 41st SMW (1.36/3 leaves) and gradually increased to peak population (10.05/3 leaves) during 45th SMW.

Pest severity: The severity of *M. persicae* as 0.50 which was recorded during second week of June (24th SMW), thereafter aphid pest severity increased in subsequent weeks and was highest as 7.00 during 32nd SMW and thereafter decreased to lowest as 2.33 during 39th SMW corresponding to last week of September (Table 3). The present findings are in consonance with the results of Kataria and Kumar (2012) who determined pest severity of aphid, *A.gossypii* infesting cotton using 1-4 scale as given by Nagrare *et al.* (2011) who revealed that infestation was observed from September till April and infestation level of *M. persicae* was grade 3 and grade 2 in case of field crops and vegetable respectively as per the infestation scale.

In conclusion, the present studies revealed that *M. persicae* was associated with the Capsicum crop throughout the growing season with significant crop damage by the pest. Infestations including pest incidence, damage and severity of aphid forms commenced from early crop stage and thereafter, the population of aphid nymphs, apterous and alate forms gradually increased and decline at the time of maturely of crop. The population of aphid exhibited statistically significant positive correlation with temperature and a non- significant but negative correlation with relative humidity.

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Table 1: Population density of green peach aphid, *M. persicae* on capsicum under protected cultivation

Standard Meteorological Week (SMW)	Temperature (°C)	Relative Humidity (%)	Mean aphid population density / leaf			Total aphid population
			Nymphs	Apterous	Alate	
23	24.97	59.86	0.00	0.00	0.00	0.00
24	25.65	59.83	0.81	0.00	0.00	0.81
25	25.36	60.03	1.67	0.86	0.20	2.73
26	24.05	58.22	2.41	1.88	1.03	5.32
27	25.18	56.79	3.25	2.41	2.02	7.68
28	26.26	60.48	4.25	3.58	2.92	10.75
29	26.30	57.67	06	4.18	3.58	13.76
30	26.14	61.89	6.39	5.55	4.44	16.4
31	26.71	57.65	7.53	6.28	5.55	19.4
32	27.44	55.46	10.36	7.44	6.66	24.46
33	26.85	56.56	7.03	6.07	5.44	18.54
34	24.26	66.96	4.86	3.83	5.89	14.58
35	22.64	74.46	4.71	3.55	1.96	10.22
36	22.60	78.81	2.81	3.51	2.12	8.44
37	21.75	70.62	2.51	1.25	0.71	4.47
38	20.90	73.08	0.14	0.09	0.09	0.33
39	19.96	74.85	0.00	0.03	0.00	0.03

Mean of 3 replication

Table 2: Correlation and regression co-efficient between population density of *M. persicae* and abiotic factors on capsicum under protected cultivation

Abiotic factors	Correlation co-efficient (r)	p-value	Regression equation	Co-efficient of determination (R^2)
Temperature (^{0}C)	0.656	0.002	$Y= \beta_{O+} \beta_1 X_{1+} \beta_2 X_{2+} \varepsilon$	$R^2= 0.55$
Relative humidity (%)	-0.40	0.054	$Y=142.88+4.37X_1+0.70X_2$	

Significant at $p< 0.05$

Table 3: Pest incidence, leaf damage and severity index of green peach aphid, *M. persicae* on capsicum under protected cultivation

Standard Meteorological Week (SMW)	Pest incidence (per cent)	Leaf damage (per cent)	Severity index
23	0.00	0.00	0.00
24	7.41	14.81	0.50
25	11.11	25.92	1.79
26	22.22	29.62	2.00
27	37.04	40.74	2.00
28	48.15	55.55	2.06
29	59.26	62.96	2.17
30	66.67	70.37	2.20
31	70.37	74.07	2.23
32	77.78	81.48	7.00
33	74.07	74.07	5.50
34	62.96	59.25	5.33
35	40.74	44.44	4.83
36	33.33	29.62	4.82
37	18.51	18.51	2.82
38	14.81	11.11	2.50
39	3.70	7.40	2.33

* Incidence: 3 leaves per plant (9 plants/plot)

* Leaf damage: 3 leaves per plant (27 leaves/plot)

Figure 1: Population density of green peach aphid, *M. persicae* in relation to temperature (^{0}C) and relative humidity (%) on capsicum under protected cultivation