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COMPARATIVE STUDY ON POPULATION DYNAMICS OF *MYZUS PERSICAE* SULZER AND ITS NATURAL ENEMIES ON BROCCOLI UNDER PROTECTED AND OPEN FIELD CULTIVATION

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ABSTRACT

Myzus persicae Sulzer (1776) (Hemiptera: Aphididae) is the most economically important aphid crop pest worldwide. Comparative study of population dynamics of aphid *M. persicae* Sulzer and its natural enemies in relation to weather conditions was studied on broccoli crop at University of Agricultural Sciences, Dharwad. Results revealed that higher aphid population was observed under net house (18.12/plant) than under open field (4.1/plant). This variation could be due to increased temperature and less activity of natural enemies which favored higher aphid population under net house whereas, under open field higher activity of natural enemies and abiotic factors kept the aphid population under control.
Keywords: *Myzus persicae,* net house, open field, population dynamics, natural enemies.

Introduction

Broccoli or sprouting broccoli (*Brassica oleracea* var. *italica* L.) is an important cole crop belonging to the family Cruciferae. The word "broccoli" is an Italian word taken from the Latin 'brachcum', meaning an arm or branch. Broccoli is native to Italy but China is the leading producer followed by India. Broccoli is consumed before the opening of inflorescence. It has clusters of flowering buds and is available in green, white and purple colour. Broccoli contains antioxidants that may reduce the incidence of coronary heart disease and cancer. Broccoli is highly nutrient rich exotic vegetable in cole crops and rich source of antioxidants, vitamins and minerals. It contains protein (3.3 %), carbohydrates (5.5 %), calcium (0.80 mg/100 g), phosphorus (0.79 mg/100 g), vitamin A (3500 IU), vitamin C (137 mg/100 g), vitamin B1 (0.05 mg/100 g) and vitamin B2 (0.12 mg/100 g) (Hazra and Som, 1999).

Myzus persicae Sulzer (1776) (Hemiptera: Aphididae) is the most economically important aphid crop pest worldwide (Emden and Harrington, 2017). It is highly polyphagous and cosmopolitan pest which is distributed globally (Ali *et al*., 2021). In terms of damage *M. persicae* causes direct and indirect damage to a wide range of crop plants (Van Emden *et al.*, 1969). It is considered as one of the most destructive agricultural pests that feeds on over 40 plant families including Brassicaceae (broccoli, *Brassica oleracea* var. *italica* (L.); brussels sprouts, *Brassica oleracea* var. *gemmifera*; cabbage, *Brassica oleracea* var. *capitata* (L.); cauliflower, *Brassica oleracea* var. *botrytis* (L.); kale, *Brassica oleracea* var. *acephala* (L.); mustard, *Brassica juncea* (L.); radish, *Raphanus raphanistrum* (L.); and turnip, *Brassica rapa* (L.) Apiaceae, Asteraceae, Cucurbitaceae, Poaceae and Solanaceae (Edde, 2021).

The micro environment of net house/poly house/low tunnel grown plants is generally found congenial for growth and development of sucking insect pests. Higher temperature, higher relative humidity levels and diffused sunlight under protected structure result in more succulent plant growth to which insect pests like aphids, whiteflies, leaf miners, thrips and mites get attracted. These insect pests have more preference for such environment. During hot months sucking insect pests multiply very fast under net/poly house. Once they get chance to enter the net house, the population buildup is at higher rate in shorter span due to the favourable conditions. Study on population dynamics helps to take timely management actions against insect pests and to prevent their further spread.

Material and Methods

The present investigation on population dynamics of *M. persicae* on broccoli (*Brassica oleracea* var. *italica* L.) was carried out at Hi-tech Horticulture Unit under net house and in Saidapur farm under open field condition at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *rabi* 2022-23. Five plants were selected randomly from each quadrate and were tagged to record observations. Incidence of *M. persicae* at weekly interval was recorded from 7 days after transplanting till the harvest of the curd. Aphid count was made by selecting 1 cm^2 leaf area from 3 leaves from each plant. The data collected on pest at weekly interval is statistically analysed to determine its correlation with the prevailing climate factors including maximum temperature, minimum temperature and relative humidity using the correlation coefficient (r).

Table 1 : Population dynamics of *Myzus persicae* under net house and open field condition

SMW		46	47	48	49	50	51	52	1	2	3	4	5	6	7	8
Myzus persicae	Net house	0	1.31	5.87	7.82	12.38	18.12	16.01	17.84	13.83	16.76	17.59	15.17	13.11	12.23	9.2
	Open field	0	0	0	0.98	1.58	4.91	3.47	4.56	4.01	3.89	4.43	3.67	3.1	2.87	2.35

*SMW- Standard Meteorological Week

Table 2 : Population of natural enemies both under net house and open field cultivation

SMW	Number of Natural enemies/plants						
	Net house		Open field				
	Diaeretiella raphae (Adults)	Spiders (Nymphs and adults)	Syrphid (grubs)	Spiders (Nymphs and adults)	*Dortus* sp. (Nymphs and adults)	*Diaeretiella raphae* (Adults)	Coccinellids (Grubs and Adults)
47	0	0	0	0	0	0	0
48	0	0.12	0	0	0	0	0
49	0	0.1	0.21	0.18	0	0	0
50	0.49	0.17	0.23	0.23	0.24	0	0
51	0.97	0.19	0.37	0.68	0.38	0.21	0.18
52	4.52	0.43	1.19	1.12	0.46	0.56	0.59
1	2.12	0.32	0.91	1.04	0.53	0.34	0.43
2	3.24	0.37	1.03	1.24	0.35	0.56	0.37
3	2.47	0.22	0.74	0.88	0.27	0.78	0.28
4	2.91	0.29	0.58	1	0.11	0.61	0.34
5	2.03	0.14	0.29	0.76	0	0.52	0.19
6	1	0	0.22	0.51	0	0.23	0.15
7	0.51	0	0	0	0	0.09	0.12
8	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-

*SMW- Standard Meteorological Week

Table 3 : Correlation of aphid population with weather parameters

Myzus persicae	Temperature (°C)		Relative humidity (%)	Rainfall (mm)
	Maximum	Minimum		
Net house	**0.688****	**-0.294**	**-0.687****	**-**
Open field	**0.684****	**-0.446**	**-0.613***	**-0.451**

*Correlation significance at the 0.05 level

** Correlation significance at the 0.01 level

Results

Throughout the study, the only pest observed under the net house condition was the aphid, *M. persicae*. The aphid infestation commenced during the 47th SMW with an incidence of 1.31 per cm², reaching its peak at 18.12 per cm² in the 51st SMW. Subsequently, a gradual decline in population occurred with the minimum recorded population of 9.20 per cm² in the 8th SMW. On the other hand, in the open field, the aphid population appeared during the 4th SMW with 0.98 per cm² and peaked at 4.91 per cm² in the 51st SMW (Table 1).

The appearance of *Diaeretiella raphae* on aphids under net house was first noticed from 2nd week of December and reached its peak during last week of December with population of 4.52 per plant and thereafter population declined gradually and spider population commenced from last week of November with a population of 0.12 per plant and the population gradually increased to peak of 0.43 per plant last week of December (Table 2).

The observations on syrphids and spiders under open field situation was recorded with initial population of 0.21 and 0.18 respectively per plant in the 1st week of December and reached their peak incidence of 1.19 and 1.12 per plant in the 4th week of December respectively. Mirid bug, *Dortus* sp. appeared with an intensity of 0.24 bugs per plant initially and later increased gradually reaching its peak (0.53/plant) in the 1st week of January. The activity of hymenopteran parasitoid, *D. raphae* and coccinellids were observed during 3rd week of December with population of 0.21 and 0.18 respectively reaching peak level with population of 0.78 and 0.59 per plant, respectively (Table 2).

Aphid population showed significant positive relationship with maximum temperature (0.668 and 0.684), negative relationship with minimum temperature (-0.24 and -0.446) and rain fall (-0.451) and significant negative relationship with relative humidity (-0.687 and -0.613) under both net house and open field cultivation respectively (Table 3).

Discussion

The population of *M. persicae* was more pronounced within the net house environment in contrast to the open field. This difference could be attributed to conducive biotic and abiotic factors. The greenhouse effect within the net house, resulting in elevated temperatures, likely enhanced the parthenogenetic reproduction, leading to higher rate of reproduction and more number of generations, with shorter life cycle. Additionally, the diversity and activity of natural enemies were comparatively diminished within the net house. Visual observations revealed the presence of a thin waxy coating on leaves in the net house, while leaves in the open field exhibited a thicker waxy coat. Under the open field ambient temperature conditions, the population of natural enemies also could control aphid numbers, consequently resulting in a lower aphid count than in the net house. Present findings are in line with (Ingwell *et al.*, 2017) reported that greenhouse pests (e.g. aphids, whiteflies) were more prevalent in high tunnels, compared to field plots. The common assumption that high tunnels offer protection from field pests was not supported. Instead, high tunnel growing conditions may facilitate higher pest populations. (Shalini *et al.*, 2016) recorded 332 aphids per plant in 9th SMW in year 2014-15 when the temperature ranged 10.1 to 25.8°C and RH 40 to 80 per cent under field cultivation. Shonga and Getu, 2021 conducted experiment at DZARC, Ethiopia on population dynamics and reported that pest population is highly influenced by weather factors. The maximum aphid population of 164.7 ± 2.93 and 70.2 ± 2.64 aphid were recorded from square inch leaf area and correlation analysis showed that, the maximum temperature had a significant influence on aphid population specifically on kale crops ($r = 0.676$, $p = 0.032$). (Fidelis *et al.*, 2019) observed the population peaks of *Brevicoryne. brassicae*, *Lipaphis erysimi* and *Myzus persicae* during periods of relative humidity drop and reported that relative humidity (RH) showed a significantly negative relationship with the density of aphid population. Three species of lady bird beetle were found to predate upon aphids. Both the grubs and adults were found abundantly during later stage of crop growth. Syrphid maggots were also found within aphid colony Boopathi and Pathak (2012). A wide variety of natural enemies have been identified from *M. persicae* infested crop fields, including *D. rapae, Aphidius ervi* (Haliday), *Aphidius colemani* (Dalman), and *Coccinella septempunctata* (L.), providing a long list of potential biocontrol agents for *M. persicae* (Ali *et al.*, 2023). Predators *viz.*, coccinellids, syrphids, spiders and the parasitoid *Diaeretiella raphae* (McIntosh) (Hymenoptera: Braconidae) were found most abundant. Biotic factors such as natural enemies, competing organisms and host plants; and abiotic factors such as weather conditions, can affect the population densities of insect pests (Fidelis *et al.*, 2018). (Isaq *et al.*, 2023) reported that cabbage aphid was positively correlated with maximum temperature ($r = 0.275$).

Conclusion

The population dynamics of *Myzus persicae* and its natural enemies on broccoli was studied both under net house and open field cultivation. Aphid population was comparatively higher under net house cultivation than open cultivation. The natural enemies *viz*., syrphids, spiders, coccinellids, *D. raphae* and *Dortus sp*. were observed under open field whereas, under net house only *D. raphae* and spiders were noticed. *M. persicae* showed significant positive correlation with maximum temperature, negative correlation with minimum temperature and relative humidity.

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