



FEEDING EFFICIENCY OF PREDATORY SPIDERS ON *MYZUS PERSICAE* (SULZER)

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The present study focused on the feeding efficiency of predatory spiders on aphid *Myzus persicae* (Sulzer). Under laboratory conditions, tetragnathid spiders showed significantly higher consumption rate followed by oxyopids and the least was observed with salticids and linyphiids. A significantly high overall consumption of prey by tetragnathid, oxyopid, salticid and linyphiid spiders was noticed with the treatment @ 10 prey (aphids)/ spider. These results indicate that even if the prey density increased, the consumption rate did not increase. In vitro survivability of lycosid and phalangiid group of spiders was merely 2 days, whereas spiders of other families survived 7-14 days.

Key words: Predators, spiders, *Myzus persicae*, cabbage, prey, prey density, consumption rate, generalist predators, tetragnathids, oxyopids, salticids, linyphiids, survivability

India is in second position in the world in the production of cabbage *Brassica oleraceae* var. *capitata* L, but its productivity is far lower (FAOSTAT, 2019), and pests and diseases are the constraints. Aphids alone cause 9-96% reduction of yield (Singh and Sharma, 2012), and diamond back moth may cause 52% yield loss (Krishnamoorthy, 2004). Indiscriminate use of insecticides results in development of resistance and resurgence of insect pests, outbreak of secondary pests and decline in population of natural enemies, and also contamination. A possible alternative to pesticides in the development of an IPM strategy against insect pests is biological conservation and augmentation of natural enemies.

Exploring new predators within various classes of phylum Arthropoda is important. Raworth et al. (1984) opined these predators and parasites have been the major determining factor. Cosmopolitan and solitary braconid parasitoid wasp *Diaeretiella rapae* (McIntosh) and specialist cecidomyiid predator, *Aphidoletes aphidimyza* (Rond.) contribute immensely in controlling aphids during mid and heading stage of crop growth. However, generalist predators like spiders, coccinellids, rove beetles and chrysopids help prevent increase of aphids in the early stages of crop growth. Active spider predators tend to congregate in prey rich sites and affect indirectly by catching and killing without consuming it or trapping prey in abandoned webs (Gavish-Regev et al., 2009). Hence the present study evaluated the feeding efficiency of various predatory spiders on *Myzus persicae* (Sulzer) under laboratory conditions.

MATERIALS AND METHODS

Predatory spiders belonging to six families viz., Salticidae, Oxyopidae, Lycosidae, Tetragnathidae, Linyphiidae and Phalangiidae were found feeding on insect pests of cabbage. These were collected from the Jaguli Instruction Farm, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, West Bengal during 2019-20 during January-February. The dry pitfall trap and hand collection methods were followed. *Myzus persicae* aphids were collected manually using camel hair brush (size 0) from these fields. The spiders were maintained in vials individually at 25± 2°C, 70±10% RH, and 10 hr of darkness. These were starved for 48 hr to minimize the differences in individual hunger levels. Thereafter, these were introduced individually into petri plates with *M. persicae* nymphs and apterous adults, at three density levels i.e. 5, 10 and 15. The predatory spiders were assigned to these treatments randomly along with an untreated control treatment without spiders. The treatments were replicated thrice. After 48 hr, the number of preys consumed were counted from the surviving aphids, and mortality by non-predator factor was considered based on mean number of aphids surviving in the control treatment. Therefore, mean number of aphids consumed by each spider was standardized by using the equation given by Gavish-Regev et al. (2009).

The ANOVA of factorial completely randomized design for two factors was done and the critical difference (CD, p= 0.05) was worked out using OPSTAT software. Tukey's HSD test was conducted using R-studio to find the difference between families.

RESULTS AND DISCUSSION

Predatory spiders belonging to six families viz. Lycosidae (wolf spider), Oxyopidae (lynx spider), Salticidae (jumping spider), Tetragnathidae (long jawed spider), Linyphiidae (sheet weavers) and Phalangiidae were found feeding on insect pests of cabbage. Feeding efficiency of lycosid and phalangiid spiders could not be studied under laboratory conditions, because the spiders died within 24 hr of capture, while others survived for 7-14 days. In control, the live prey was 5 ± 0 , 9.67 ± 0.65 and 13.67 ± 1.72 at 5, 10 and 15 aphids/spider prey density, respectively. These results reflect both the birth and non-predator inflicted mortality of aphids. This value was used to standardize the number of aphids in the other treatments. After 48 hr of introduction of spiders into prey containing petri plates, at prey density of 5 aphids/spider, lowest feeding efficiency (4.67 ± 0.65) was noticed with salticids and linyphiids, followed by tetragnathids (4 ± 1.96). In contrast, maximum feeding efficiency (3.33 ± 1.72) was observed with oxyopids. However, at 10 and 15 aphids/spider density few aphids (1.72 ± 0.67) survived when tetragnathids were released. Least number of aphids (6.55 ± 1.78) was consumed by salticids at 10 and at 15 aphids/spider, and by linyphiids (15.73 ± 0.71) (Table 1). Tukey's HSD test ($p=0.05$) revealed a significant mean difference of 3.55, 4.51 and 5.08 between feeding efficiency of tetragnathids vs oxyopids, salticids and linyphiids, respectively. No significant mean difference was observed between oxyopids, salticids, and linyphiids. These indicate a significant superiority of the tetragnathids as a promising predator of *M. persicae*. Low survival rate of aphid when tetragnathids were released indicates the better predation, showing its potential as biocontrol agent in cabbage.

The overall consumption of prey by oxyopids decreased as the prey density increased whereas, high consumption of prey by salticids and linyphiids was observed at density of 10 prey/spider and low at density

Table 1. Feeding efficiency of predatory spiders on aphids

Families	No. of aphids alive			Mean
	5 aphids/ spider	10 aphids/ spider	15 aphids/ spider	
Oxyopidae	3.33 ± 1.72	7.93 ± 0.67	12.80 ± 1.89	8.0
Salticidae	4.67 ± 0.65	6.55 ± 1.78	15.73 ± 1.43	9.0
Linyphiidae	4.67 ± 0.65	8.28 ± 2.02	15.73 ± 0.71	9.6
Tetragnathidae	4.00 ± 1.96	1.72 ± 0.67	7.68 ± 2.48	4.5
Control	5.00 ± 0.00	9.67 ± 0.65	13.67 ± 1.72	9.4
Mean	4.3	6.8	13.1	

of 15 prey/spider. The overall consumption of prey by tetragnathids was high at prey density of 10 aphids/spider and low at prey density of 5 aphids/spider. The combined (all spiders) prey survival rate at density of 5, 10 and 15 aphids/spider were 83.32, 61.20 and 86.60%, respectively (Fig. 1). A significantly more overall consumption of prey by all families of spiders was noticed at 10 prey/spider. These results indicated that even if the prey density increased, the consumption rate did not increase.

Toft and Wise (1999) reported that aphids are the poor host to generalist predators, qualitatively. Hence, they prefer other food source for surviving. Mayntz and Toft (2001) reported that nutritionally balanced spiders consumed more aphids than imbalanced spiders. Availability of aphids as prey to ground spiders like lycosids and phalangiids is low and aphids are not the major component of their diet. These may be the reasons attributing to the poor survivability of lycosids and phalangiids under in-vitro conditions. Sherawat and Butt (2014) found no significant difference between feeding efficiency and ability to catch prey with lycosids and oxyopids. They also stated that although aphid diet had no influence on growth and development of spiders, it helps to maintain predator population (linyphiids and lycosids) under starved conditions. Harwood et al. (2004), Gavish-Regev et al. (2009) and Khan (2013) found higher feeding efficiency in linyphiids and lycosids than other spiders, whereas in this study tetragnathids showed significant difference with other spiders. Butt and Xaaceph (2015) reported that as prey densities increased, total search time and search efficiency of oxyopids decreased but attack rate did not vary. They suggested that feeding strategy was affected by prey density and habitat which is in comparison with the present study i.e., different level

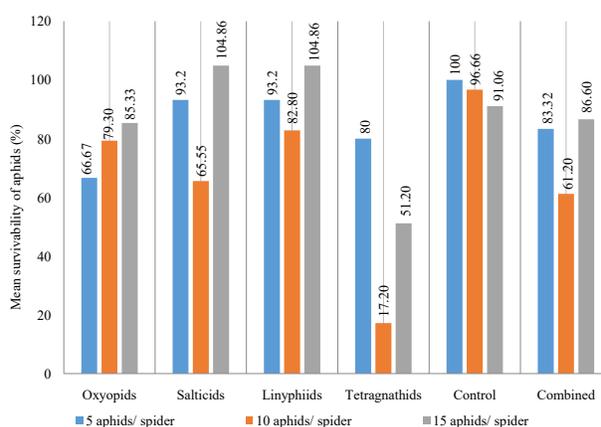


Fig. 1. Survival of aphids vs. prey density

of prey density had no effect on feeding efficiency of spiders of various families.

An in-vitro study can further be strengthened by rearing of the predatory spiders which may help in understanding the consumption behaviour and rate at various stages of spiders, difference between male and female in rate of consumption, and total feeding efficiency of prey during the entire life period. Apart from aphid, other insect pests such as lepidopteran larvae, whitefly, hoppers etc. can be adopted in feeding efficiency study. Combination or multiple pests can be given as prey which helps in determining the preference and behavioural changes in spiders. The present study brings our tetragnathids as a potential biocontrol agent of *M. persicae* in cabbage ecosystem. An increase in prey density did not impose any effect on consumption rate of predatory spiders. Survivability of lycosid and phalangiid group of spiders in captivity was merely 2 days, in contrast tetragnathids, oxyopids, salticids, and linyphiids could survive 7-14 days in captivity.

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