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Effect of alternate food sources on biological parameters of *Stethorus pauperculus* Weise (Coleoptera: Coccinellidae)

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ABSTRACT: The effect of different alternate food sources on survival, mating frequency, fecundity and egg hatchability of *Stethorus pauperculus* was tested under laboratory conditions. None of the alternative hosts was able to maintain fertility of the female *S. pauperculus*, except the primary hosts which included two spotted red spider mite (*Tetranychus urticae* Koch), sorghum mite (*Oligonychus indicus* (Hirst)) and yellow mite (*Polyphagotarsonemus latus* (Banks)). Although some eggs were laid when *S. pauperculus* was supplied with pollen and honey mixture, they did not hatch. The most effective food source for maintaining adult longevity was *T. urticae* (39.30±1.08 days), followed by sorghum mite, *O. indicus* (29.75±0.67 days) and yellow mite (25.25±0.78 days).

Key words: *Stethorus pauperculus,* alternate food sources, biological parameters

Several natural enemies of spider mites have been recorded all over the world (Granham, 1985). Among them the beetles belonging to family Coccinellidae are predators of spider mites specially *Stethorus* spp. are specialized mite predators in Coccinellidae (Felland and Hull, 1996; Hoy and Smith, 1982 and McMurty *et al.,* 1970). The ladybird beetles of the genus *Stethorus* (*Stethorus punctillum, S. gilvifrons*, *S. punctum picipes*) are the most effective natural enemies of the phytophagous mite species *Tetranychus piercei* McGregor, *Panonychus citri* McGregor, *Panonychus ulmi* (Koch) and *Tetranychus urticae* Koch (Lui and Lui, 1986; Lorenzato, 1987; Wen, 1988; Pasualini and Antropoli, 1994; Cakmak and Aksit, 2003; Gencer *et al.,* 2005; James *et al.,* 2001 and Perez *et al.,* 2004). *Stethorus pauperculus* Weise is one of the most effective coccinellid predators of the two-spotted spider mite. Their larval and adult stages feed on different stages of the two-spotted spider mites.

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Puttaswamy and ChannaBasavanna (1977) reported *S. pauperculus* as feeding on spider mites infesting papaya, castor, citrus, jasmine and various crops in Bangalore, India. The aim of the present work was to study the effects of different alternative food sources on some biological parameters of *S. pauperculus* in order to mass rear in case of the lack of natural food supply *viz.,* spider mite.

The experiments on rearing of *S. pauperculus* on alternative food sources were carried out at Acarology laboratory, Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari during March 2013 to May 2013 at room temperature. Twenty pairs of newly emerged beetles were randomly selected from the stock culture and paired in 20 replicates in each of the potential food source in modified Petri dishes. Parameters such as rate of predation, mating, fecundity, egg hatchability and adult longevity of paired adult *S. pauperculus* were measured in the laboratory on different hosts. The treatments details are as follows:

T_1- Starved (No food)

T_2- Water only

T_3- Honey and water

T_4- Pollen and honey

T_5- Groundnut aphid, *Aphis craccivora* Glover (mixed stages *i.e.* nymphs and adults)

T_6- Whitefly, *Bemisia tabaci* (Gennadius) (Eggs only)

T_7- Sorghum mite, *Oligonychus indicus* (Hirst) (All stages)

T_8-Two-spotted red spider mite, *Tetranychus urticae* (Koch) (All stages)

T_9-Yellow mite, *Polyphagotarsonemus latus* (Banks) (All stages)

The above diets were exposed to adult *S. pauperculus* inside modified Petri dishes. The base was covered with dry filter paper to absorb any excrement of host or predators, thereby preventing contamination. The number and quantity of each food type was consistent in each treatment except for Treatment-1 (Starved). In each dish an uninfested french bean leaf disc was supplied daily to the pair for oviposition. In Treatment-2, water was supplied constantly through a cotton roll placed on the mesh screen, and was renewed daily. In Treatment-3, honey diluted with water in a ratio of 3:1(v/v) was provided in the same manner as in Treatment-2. These cotton rolls were renewed every second day, to prevent the rolls from becoming dry and also to avoid any risk of contamination. In Treatment-4, castor pollen obtained by shaking the inflorescences on white papers was mixed thoroughly with honey and supplied in a small plastic lid (3 mm diameter)placed on the dry filter paper. The mixture of pollen and honey was replaced every two days, because it developed fungal growth if kept longer. The numbers of aphid, whitefly eggs, and sorghum mites were counted carefully under a stereo zoom binocular microscope on the host leaves before the predators were confined. After 24 hours feeding period the pairs of *S. pauperculus* were transferred to new containers and the remaining numbers of each host were counted and recorded. Mating, fecundity and longevity of *S.*

pauperculus were determined by observing all dishes at 12 hour interval. The number of eggs laid was counted and the period between adult emergence and death was calculated as longevity. Each treatment was repeated five times and in each repetition 15 pairs were placed. Thus, the data so obtained were calculated by using mean and SD.

The effect of alternate hosts on survival, mating, frequency, fecundity and egg hatchability of *S. pauperculus* is summarized in Table 1. Mating was not recorded on any host treatment except for sorghum mite, two-spotted red spider mite and yellow mite and hence no oviposition was recorded on these hosts. The mean mating frequency recorded was 12.40 times on two-spotted red spider mite was 6.85 times on yellow mite and 6.45 times on sorghum mite as compared to other alternative hosts. The fecundity was highest on two-spotted spider mite with 91.65 eggs per female followed by those on sorghum mite (71.60 eggs per female) and yellow mite (56.85 eggs per female). A few eggs were laid in pollen and honey mixture (5.0 eggs per female) while on other alternate hosts not a single egg was laid by the female beetles. The same pattern was also recorded in case of number of eggs laid per day where the beetles that fed upon the two-spotted red spider mite laid the maximum eggs per day, followed by those females feeding upon sorghum mite and yellow mite. The minimum eggs per day were laid by those females which fed on pollen and honey mixture as alternate food. The egg hatchability was also greater on primary hosts, *i.e.* two spotted red spider mite, sorghum mite and yellow mite (92.38±4.146, 86.19±3.360 and 74.59±7.651 per cent, respectively). A few eggs were laid in the pollen and honey mixture treatment, but they did not hatch and were considered to be non-viable. The adult longevity varied in all the treatments. In case of female it was highest in the two spotted red spider mite treatment (39.30±1.089 days) followed by the treatments on sorghum mite (29.75±1.069 days) and yellow mite (25.25±0.783 days). It was lowest in case of the treatment with starved beetles (3.94±0.841 days) and followed by the treatment with *A. craccivora* as food (4.45±0.514 days). In case of males, the same trends were observed. The longevity of male beetles was maximum when provided with the primary host, two spotted red spider mite (35.25±0.442 days), followed by sorghum mite (25.40±0.827 days) and yellow mite (23.45±0.514 days). The minimum male longevity was recorded in case of the treatment consisting of groundnut aphid, *A. craccivora* (3.25±0.442 days) and in the treatment with starved beetles (3.60±0.506 days).

In the present study no mating or oviposition was recorded for *S. pauperculus* on any hosts, except on its primary hosts like two spotted spider mite, sorghum mite and yellow mite and castor pollen and honey. The mean number of eggs laid by females fed on castor pollen and honey mixture was 5.0±1.129 per female which was very low as compared to its primary hosts, *viz.,* two-spotted spider mite (92.38±4.146), sorghum mite (86.19±3.360) and yellow mite (74.59±7.651). Further, eggs laid in pollen and honey mixture treatment did not hatch, whereas egg hatchability in case of treatments with primary host were very high. Adult longevity increased with the provision of alternative hosts such as water only, honey and water, castor pollen and honey, aphid and white fly eggs but no reproduction occurred on these hosts. The descending order of adult longevity in relation to hosts was two spotted spider mite > sorghum mite > yellow mite > castor pollen and honey > honey and water > water only > white fly

Table 1: Effect of alternative food hosts on biological parameters of *S. pauperculus*

Treatments	Mating	Total fecundity	Daily fecundity	% hatching	Adult longevity (Days)	
					Female	Male
T_1:No food (Starvation)	0.00	0.00	0.00	0.00	3.94±0.84	3.60±0.51
T_2:Water only	0.00	0.00	0.00	0.00	8.55±1.05	6.55±0.68
T_3:Honey and Water	0.00	0.00	0.00	0.00	17.95±0.83	16.35±0.58
T_4: Castor pollen and honey	0.00	5.00±1.13	0.50±0.11	0.00	21.45±1.35	19.30±0.47
T_5:Groundnut aphid (*A. craccivora*)	0.00	0.00	0.00	0.00	4.45±0.51	3.25±0.44
T_6: Whitefly (*B. tabaci*)	0.00	0.00	0.00	0.00	6.30±0.74	4.35±0.48
T_7:Sorghum mite (*O. indicus*)	6.45±1.44	71.60±6.46	7.16±0.65	86.19±3.36	29.75±1.07	25.40±0.83
T_8:Two spotted spider mite (*T. urticae*)	12.40±2.47	91.65±7.35	9.12±0.77	92.38±4.15	39.30±1.09	35.25±0.44
T_9: Yellow mite (*P. latus*)	6.85±1.65	56.85±6.56	5.68±0.66	74.59±7.65	25.25±0.78	23.45±0.51

Mean ±SD of 5 repetitions

(Eggs) > groundnut aphid (all stages) > starved (no food). The present results with *S. pauperculus* are similar to the reports of Putman (1955) and Kehat (1967) who also concluded that *S. punctillum* fed on aphid, phytoseiid mites and scale insects but these hosts were not sufficient for development or oviposition. Kamiya (1966) and Hoy *et al.* (1979) reported that *S. japonicas* fed on plant resins, sweet foliar secretions and honey and water, which increased the longevity but did not result in copulation or reproduction. Bakr and Genidy (2009) also found similar results in case of *S. punctillum* at Cairo, Egypt. Oviposition was not recorded when *S. punctillum* was reared on any alternate food but the adult longevity was highest when fed on a mixture of honey droplets, pollen grains and royal jelly, while the shortest period was recorded when the predator was starved or fed on aphid. Most of the coccinellids are predaceous on insects in the order Hemiptera, but species of *Stethorus* feed almost exclusively on spider mites. When primary prey is scarce, *Stethorus* are reported to eat other foods such as aphid, whiteflies, honeydew, pollen gains, nectar and sweet sap or may even elicit cannibalistic behaviour. While some species of *Stethorus* feed on a range of tetranychid species, others are more specific such as *S. pauperculus* as in the present case which do not readily feed or oviposit on other mite species. The present results will be useful for mass rearing and release of the predator under green house and open field conditions against spider mite pests in various high value crops.

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