EFFECT OF FOOD AND TEMPERATURE ON THE DEVELOPMENT, LONGEVITY AND FECUNDITY OF SUGARCANE RED SPIDER MITE, *OLIGONYCHUS INDICUS* (HIRST)

BY

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ABSTRACT

Studies were made on the rate of development, longevity and fecundity of sugarcane red spider mite, *Oligonychus indicus* (Hirst) on three food, viz. sugarcane (*Saccharum officinarum* Linn.), sorghum (*Sorghum vulgare* Pers.) and maize (*Zea mays* Linn.) at five constant temperatures, viz. 25°, 27.5°, 30°, 32.5° and 35° C. It was found that maize was the best food and 30° C was the most favoured temperature because of the minimum time taken to complete the life cycle and high fecundity of both fertilized and unfertilized females. Sorghum was the second best food as the rate of development and fecundity were also fairly high on this food.

Sugarcane red spider mite, (*Oligonychus indicus* Hirst) is one of the serious pests of sugarcane in India and besides sugarcane it has been reported to attack maize, sorghum and a number of grasses. A lot of studies were made on this species but these were mostly concentrated on the development of control measures against this mite and excepting the only information available on its biology under field condition, (Rahman and Sapra, 1940) no attempt was made to study the effects of various food and temperature on the biology of this species. As this pest is polyphagous and occurs in the field almost throughout the year such studies were felt necessary with an ultimate object to forecast the pest outbreak. With this view in mind a laboratory study was taken up to find out the effects of three food, viz. sugarcane, sorghum and maize and five temperatures, viz. 25°, 27.5°, 30°, 32.5° and 35° C on the rate of development, longevity and fecundity of this mite and the results thereof are presented in this paper.

MATERIAL AND METHODS

Pure culture of this mite was maintained in field cage on three food, viz. sugarcane, sorghum and maize. These mites were reared in the laboratory on small excised leaves which were kept on wet cotton swab in a small Petridish (6 cm. dia.). Water was added periodically so as to keep the cotton supersaturated and a thin film of water was maintained on the margin which

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acted as barrier and thus prevented the escape of mites. These Petridishes were kept in incubators where five constant temperatures, viz. 25°, 27.5°, 30°, 32.5° and 35° C were maintained.

Adult females were taken from the field cage and released on the under surface of the well cleaned and freshly excised leaf of each food which was placed on Petridish. Adults were allowed to lay eggs throughout the night and were removed on the next day. This helped in obtaining freshly laid eggs. All such eggs were counted and from that stage observations on its life history with special reference to the incubation period, larval period, proto-, deutonymphal periods, preoviposition, oviposition and postoviposition periods and fecundity of fertilized and unfertilized females were recorded. Whenever it was found necessary mites were transferred to fresh food which was taken from same variety and source and in this way as many as 8-10 changes were required to complete a life cycle. Observations were taken daily after every 24 hours under binocular microscope.

Results and discussion

Relevant informations regarding the duration of the different stages are given in Table 1 and are discussed below.

Copulation : As soon as the male emerged, it was found wandering in search of quiescent female deutonymphs and on coming across one such dentonymph it placed the anterior pair of legs on it and awaited its emergence. When the female deutonymph started moulting, the male was found helping her to cast off the skin. Copulation started immediately after the emergence of female. During the act of copulation the male was found under the posterior ventral surface of the female and arched its opisthosomal part in such a way that the aedeagus could entre the genital aperture of the female. A single male mated with several females.

Pre-oviposition period : Female laid eggs only after the laps of the certain period and this period was minimum (0.21 ± 0.41 days) on maize at 30° C and maximum (1.91 ± 1.04 days) on the same food at 27.5° C. Irrespective of food this period was of shorter duration at high temperature (32.5° and 35° C where it varied from 0.22 ± 0.42 to 0.71 ± 0.59 days) and of longer duration at lower temperature (25° and 27.5° C where it varied from 0.86 ± 1.02 to 1.91 ± 1.04 days).

Egg and oviposition period : Freshly laid eggs were shining, spherical, 110-120 μ in diameter and laid on the leaf surface. The colour of the egg changed to brownish with age and the red eye spots were visible before hatching. Maximum fecundity per female per day was 18 eggs on maize at 30° C and minimum was 0 egg. Maximum number of eggs laid in an entire life cycle was 193 on sorghum at 32.5° C and minimum was 4 on maize at 35° and 27.5° C.

Oviposition continued for a shorter duration at higher temperatures and vice-versa. In general this period was of shorter duration on maize at all the temperatures and the minimum (4.78 ± 1.45 days) was seen on maize at 35° C. Whereas on sugarcane, in general, the oviposition continued for a longer period at all the temperatures and the maximum (14.50 ± 6.72 days) was seen on sugarcane at 27.5° C.

Post-oviposition period : Irrespective of temperature post-oviposition period was maximum on sugarcane and minimum (3.94 ± 2.04 days) on sugarcane at 25° C. It was also found that higher the temperature shorter was the duration of the postoviposition period.

Incubation period : Incubation period was shortest (2.12 ± 0.10 days) on maize at 35° C and maximum (4.87 ± 0.83 days) on sorghum at 25° C. Usually this period took more time at lower temperatures and vice-versa no matter what the food was provided with. Only exception was sugarcane at 25° C where this period also took very little time.

TABLE 1. — Biology of *Oligonychus indicus* Hirst.

	Incubation period	Larval period	Proto nymphal period	Deuto nymphal period	Egg-adult period	Adult period	Preovi position period	Ovi position period	Post-ovi position period	Fecundity	
										Fertilized	Unfertilized
1	2	3	4	5	6	7	8	9	10	11	12
25° C Sugarcane	2.67±	1.86±	2.58±	1.53±	6.28±	16.12±	1.24±	11.53±	3.94±	20.1±	18.29±
	0.47	0.81	0.56	0.54	0.57	4.46	1.03	1.97	2.04	10.33	8.30
Sorghum	4.87±	2.71±	2.31±	1.20±	11.73±	15.14±	1.00±	12.57±	1.57±	39.14±	74.00±
	0.83	0.59	0.79	0.65	0.63	8.05	0.39	7.80	0.76	35.27	25.68
Maize	4.74±	2.10±	3.05±	3.26±	11.30±	12.50±	1.14±	10.21±	1.14±	57.80±	54.00±
	0.48	0.39	1.24	0.81	0.66	4.58	0.66	5.07	1.02	38.90	22.08
27.5° C Sugarcane	3.34±	1.80±	2.52±	1.67±	8.00±	19.00±	0.86±	14.50±	3.64±	10.44±	19.10±
	0.48	0.56	0.81	0.59	0.57	6.60	1.02	6.72	3.05	4.34	9.42
Sorghum	4.41±	2.41±	1.98±	2.52±	10.54±	16.45±	1.32±	14.50±	1.36±	55.00±	37.40±
	0.50	0.49	0.36	0.95	0.50	8.81	0.89	8.02	1.19	37.69	22.56
Maize	4.06±	2.47±	2.44±	2.05±	10.44±	11.36±	1.91±	8.36±	1.18±	32.25±	20.89±
	0.63	0.66	0.80	0.89	0.85	1.63	1.04	5.06	0.98	52.73	15.88
30° C Sugarcane	2.69±	1.25±	2.22±	2.08±	8.00±	15.52±	1.48±	11.95±	2.10±	35.71±	25.93±
	0.46	0.44	0.94	0.93	0.83	3.66	1.40	4.12	1.45	14.64	9.85
Sorghum	2.43±	1.60±	2.15±	1.27±	8.09±	14.00±	0.64±	11.91±	1.36±	73.20±	41.67±
	0.50	0.50	0.81	0.47	0.99	7.56	0.68	7.39	1.38	32.87	34.90
Maize	3.13±	1.76±	1.14±	1.18±	6.86±	8.46±	0.21±	7.29±	1.00±	69.27±	75.92±
	0.36	0.48	0.35	0.39	1.76	3.62	0.41	3.76	1.61	35.05	35.75
32.5° C Sugarcane	2.96±	2.21±	2.54±	1.67±	8.87±	14.31±	0.50±	12.81±	1.00±	13.78±	20.67±
	0.67	0.59	1.07	0.59	0.75	4.53	0.81	4.01	1.37	4.96	11.55
Sorghum	2.27±	1.67±	1.51±	1.46±	6.00±	12.42±	0.58±	11.17±	0.63±	50.50±	66.43±
	0.48	0.47	0.50	0.76	1.02	8.93	0.67	7.14	1.52	26.82	62.52
Maize	3.00	2.06±	1.79±	1.42±	5.15±	6.82±	0.55±	6.00±	0.27±	17.44±	11.00±
		0.34	0.49	0.50	0.31	2.82	0.60	2.79	0.28	7.39	4.32
35° C Sugarcane	2.27±	1.31±	1.54±	1.59±	8.59±	12.35±	0.71±	10.24±	1.41±	27.25±	19.33±
	0.44	0.47	0.25	0.25	0.25	4.33	0.59	4.05	0.94	13.18	5.34
Sorghum	2.37±	1.85±	1.63±	1.25±	6.75±	13.25±	0.36±	9.55±	2.45±	52.33±	39.50±
	0.49	0.29	0.76	0.45	1.06	6.30	0.50	5.30	2.94	9.29	19.90
Maize	2.12±	1.00	1.36±	1.00	4.05±	5.60±	0.22±	4.78±	0.65±	23.60±	28.78±
	0.10		0.46		0.73	1.30	0.42	1.45	0.49	11.90	8.72

Larval Period : Minimum larval period (1 day) was seen on maize at 35° C and maximum (2.71 ± 0.59 days) on sugarcane at 25° C. There was not much variation in the duration of this period with either temperature or food.

Larvae were almost spherical in shape, amber coloured and measured 150-170 μ in length and 130-150 μ in width. The larvae developed greenish tinge and dark specks on the dorsum at the later stage.

Protonymphal period : Irrespective of food the duration of protonymphal period was shorter at 32.5 and 35° C (except sugarcane at 32.5° C) and longer at 25°, 27.5° and 30° C (exception on maize at 30° C). The maximum time was 3.05 ± 1.24 days on maize at 25° C. Amongst the food, this period, in general, was longer on sugarcane and shorter on sorghum and maize except at 35° C where the time taken on sorghum was more than that on sugarcane.

Protonymphs were deep amber coloured and measured 220-230 μ in length and 160-180 μ in width. All the protonymphs passed through an active stage in the beginning and a resting stage called quiescent stage before moulting into the next stage. Female protonymphs moulted into deutonymphal stage whereas the male protonymphs moulted directly into adult males.

Deutonymphal stage : The shortest deutonymphal period (1 day) was seen on maize at 35° C and longest (3.26 ± 0.81 days) was on the same food at 25° C. In other cases it varied from 1.18 ± 0.39 to 2.52 ± 0.95 days. On maize the deutonymphal period passed through rapidly in comparison to other two food excepting at 27.5° and 25° C where the development on this food was slow, and therefore, took more time.

Deutonymphs were greyish green in colour and measured 290-310 μ in length and 220-230 μ in width. The colour darkened and blotches appeared at the later stage.

Life Cycle : Like the previous cases, the time taken to complete all the stages from egg-adult varied with temperature. At lower temperatures (25° and 27.5° C) it took more time to complete all the stages but it took shorter time at higher temperatures. At 30°, 32.5° and 35° C the life cycle was completed rapidly on maize in comparison to other two food and the time taken on sugarcane was longest. But at 25° and 27.5° C life cycle on sugarcane took shortest time in comparison to other two food. The minimum time to complete the life cycle was 4.05 ± 0.73 days on maize at 35° C and maximum was 11.73 ± 0.63 days on sorghum at 25° C. In this comparison maize was better food as the life cycle was completed within 4-6 days at 30-35° C. Therefore, maize was best food at least at higher temperatures (30-35° C) because life cycle was completed within 4-6 days whereas sugarcane was better at lower temperatures.

Adult period : Adult period was minimum (5.60 ± 1.30 days) on maize at 35°C and maximum (19.00 ± 6.60 days) on sugarcane at 27.5° C. Irrespective of temperatures, the adult lived for a longer period on sugarcane and sorghum and for shorter period on maize. Adult period was more influenced by food provided than the temperature prevailed.

Adult was 380-430 μ in length and 280-330 μ in width. Colour was greyish green with black blotches on the dorsum.

Fecundity : Adults laid eggs irrespective of being fertilized or unfertilized. As a rule, the progeny of the fertilized females produced individuals of both the sexes whereas the progeny of unfertilized females produced males only. There was not much difference in fecundity of fertilized and unfertilized females. At all the temperatures the fecundity on sorghum was high and next to that was on maize. Fecundity was poorest on sugarcane. In case of fertilized females the minimum fecundity was (10.44 ± 4.34 eggs) on sugarcane at 27.5° C. and maximum was (73.20 ± 32.87 eggs) on sorghum at 30° C. Trend of fecundity was almost similar in case of unfertilized females too. Fecundity in case of unfertilized female was poorest (11.00 ± 4.32 eggs) on maize at 32.5° C and highest (75.92 ± 35.75 eggs) on the same food at 30° C. Overall

fecundity on sorghum was far better than that on sugarcane and slightly better than that on maize. Among the temperatures 30° C was found to be the best as the fecundity was maximum at this temperature.

So, by summarising the overall results this can be concluded that maize was the best food and 30° C was the most favoured temperature as because of the minimum time taken to complete the life cycle (egg — adult) with high fecundity of both fertilized and unfertilized females at this combination of bood and temperature. Sorghum was the second best food as the rate of development was rapid and fecundity was also high on this food.

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