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Research Article

COMPARATIVE BIOLOGY OF MEALY BUG *Phenacoccus solenopsis* Tinsley (Hemiptera: *Pseudococcidae*) ON DIFFERENT HOST UNDER LABORATORY CONDITION

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Abstract: Investigations on comparative biology of mealy bug, *Phenacoccus solenopsis* Tinsley on different hosts were carried out under laboratory on cotton, tobacco, pumpkin, congress grass and Kanski (Kangi booti). The result revealed that congress grass gave the best result in term of shorter average duration of various life stages *viz*. incubation period (1.38 days), first instar (4.59 days), Second instar (4.79 days), third instar (5.10 days), total nymphal period (14.58 days), pupal period (3.56 days), fecundity (511.65 eggs/female) on congress grass as compared to cotton, tobacco, pumpkin and Kanski (kangi booti). Total life cycle of male and female was completed earlier when reared on congress grass. Therefore, the congress grass was found better host for faster multiplication with higher fecundity of *P. solenopsis*. On the basis of findings, it was concluded that mealy bug, (*P. solenopsis*) preferred the congress grass and gave higher fecundity and shorter life span over cotton, tobacco, kaski and pumpkin.

Keywords: Developmental time, Mealy bug, Cotton, Tobacco, Pumpkin, Congress grass, Kanski (kangi booti)

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Introduction

Mealy bugs are soft bodied insects belonging to family *Pseudococcidae* of order Hemiptera. Among different species of the mealy bugs, *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhycha: Coccoidea: *Pseudococcidae*) is appear recently and attained the status of serious pest on a wide range of host plants. It was recorded 154 plant species including field crops, vegetables, ornamental, weeds, bushes and trees most of these belong to the families *Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, Amarantheceae* and *Cucurbitaceae* [1]. In middle Gujarat, mealy bug *P. solenopsis* appeared as sporadic pest on isolated cotton fields in Baroda district on *Gossypium hirsutum* L. [2]. During 2003-04 and 2004-05, the pest was noticed on ornamental plants (Croton, Hibiscus, Marigold, Rose) and weed plants *viz*., Cocklebur (*Xanthium straumarium*), Kanski (*Abutilion indicum*), wild bhindi (*Abelmoschus manihot*), Phulni (*Vernoria cinerea*) and Congress grasss (*Parthenium hysterophorus* L.) in severe form [3]. Mealy bug (*P. solenopsis*) was recorded on tobacco in Gujarat during 2008 at Bidi Tobacco Research Station, Anand [4]. Looking to the present scenario, the comparative biology of insect pest is important in predicting its development and emergence and information also play important role in mass-rearing of mealy bug and rearing of natural enemies for augmentative biological control. Little information is available on the comparative biology of *P. solenopsis* on different hosts. Therefore, the present investigation were under taken to study the comparative biology of mealy bug *P. solenopsis* on different host cotton, tobacco, pumpkin, parthenium (congress grass) and kaski (kangi booti) in laboratory. These five plant species were previously recorded as a host plant of *P. solenopsis* and are widely found in many parts of Gujarat.

Materials and methods

The study on comparative biology of mealy bug, *P. solenopsis* on different host *viz*., Cotton (*Gossypium hirsutum* L), Tobacco (*Nicotiana tabacum* L.), Pumpkin (*Cucurbita moschata* L.), Congress grass (*Parthenium hysterophorus* L.), Kanski (kangi booti) (*Abutilion indicum* L.) by using Completely Randomized Design (CRD) with four repetitions was carried out at the entomological laboratory of Bidi Tobacco Research Station, Anand Agricultural University, Anand during 2010 to 2012. All aspects of comparative biology were studied using BOD incubator at constant temperature 26 ± 1ºC. To establish initial culture of mealy bug *P. solenopsis* infested cotton leaves were collected from the field and they were reared in the laboratory. Sprouted Potatoes (*Solanum tuberosum* L.) were used for rearing the mealy bug [5]. Initial culture was maintained on sprouted potato. The potato was kept at room temperature for sprouting. The sprouted potato was kept in transparent plastic jar (23 cm height × 15 cm diameter) covered with plastic lead with tiny holes. Ten gravid females were released on potato. The jar with the mealy bug inoculated sprouted potato were kept at room temperature. Thus, initial culture was maintained on potatoes which subsequently transfer to respective hosts. The mealy bug which reared on different host at least for one generation was used to study the comparative biology. Rearing *P. solenopsis* on different host the newly hatched crawlers were carefully placed on different host leaves with the help of camel hair brush. Such host leaves were placed in glass Petri-dish (9.0 x 1.0 cm). When crawlers settled on leaves, they were marked by drawing red circle around them. The crawlers thus marked were observed daily till adult stage for various aspects of biology. The leaves were used as a food material. The data generated on biology of *P. solenopsis* were compared between each of the above mention host.

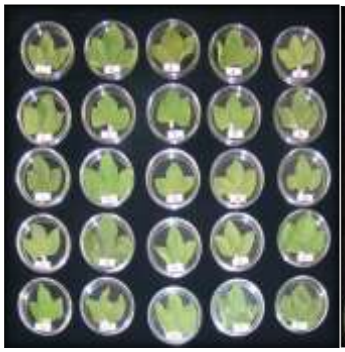
Observations to be recorded

The eggs were observed at every 6 hour under stereo zoom microscope till 100 per cent hatching. Incubation period were calculated from the time of egg laying to the time of hatching. Hatching percentage was calculated from the data on number of eggs hatched out of total number of eggs under observation. Nymphs were observed at every 12 h under stereo zoom microscope till they reach pre-pupal stage. Nymphal period was calculated on the basis of date of egg hatching and the date of formation of pre-pupa (For Male). The moulting was confirmed by the presence of exuivum on the leaf or on the posterior end of the nymphs.

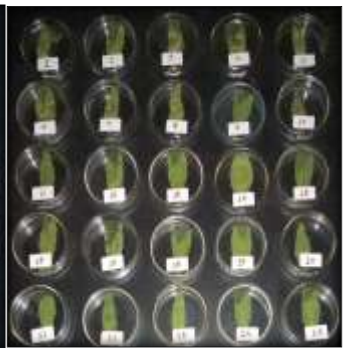
Table-1 Effect of different hosts on *P. Solenopsis* life stages

SN	Particulars	Hosts														
		Cotton			Tobacco			Pumpkin			Congress grass			Kanski (Kangibooti)		
		Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.
1	Incubation Period	0.5	1.5	1.00	1.5	4.0	2.71	1.0	2.0	1.58	1.0	2.0	1.38	1.0	2.0	1.49
2	Nymphal period															
	I- instar	3.00	7.00	4.88	4.00	6.00	5.18	5.00	7.00	5.99	3.00	6.00	4.59	3.00	7.00	4.99
	II – instar	4.00	8.00	5.81	3.00	7.00	5.28	4.00	9.00	5.65	3.00	7.00	4.79	3.00	7.00	5.01
	III – instar	4.00	7.00	5.78	5.00	7.00	6.02	5.00	8.00	6.17	4.00	6.00	5.10	4.00	7.00	5.59
	Total	11.00	21.00	16.48	12.00	20.00	16.47	14.00	24.00	17.81	10.00	19.00	14.58	10.00	21.00	15.59
3	Pre oviposition	6.00	8.00	6.94	6.00	8.00	7.15	6.00	9.00	7.26	5.00	8.00	6.84	5.00	8.00	6.96
4	Oviposition	13.00	20.00	16.10	8.00	16.00	13.09	8.00	16.00	12.27	14.00	18.00	16.58	13.00	20.00	15.38
5	Post oviposition	4.00	11.00	7.39	4.00	9.00	7.58	7.00	10.00	7.59	5.00	8.00	7.28	4.00	8.00	7.47
6	Pre-pupal Period	1.00	2.00	1.50	1.00	2.00	1.62	1.00	2.00	1.65	1.00	2.00	1.43	1.00	2.00	1.50
7	Pupal period	5.00	7.00	5.25	4.00	6.00	5.43	5.00	7.00	5.60	3.00	5.00	3.56	3.00	5.00	3.70
8	Longevity															
	Male	2.00	3.00	2.60	2.00	4.00	2.56	1.00	3.00	2.37	2.00	5.00	3.30	2.00	4.00	2.71
	Female	28.00	36.00	29.97	23.00	31.00	27.34	20.00	28.00	24.08	27.00	34.00	31.28	23.00	34.00	28.90
9	Fecundity	297	634	441	298	467.05	380.25	310	537	374.60	333	655	511.65	285	512	415.97
10	Duration of Entire life span															
	Male	23.00	84.00	24.93	21.00	84.00	25.30	24.00	80.00	27.12	20.00	84.00	22.25	21.00	76.00	24.95
	Female	42.00	55.00	47.08	44.00	56.00	49.35	46.00	59.00	51.32	34.00	44.00	39.59	39.00	53.00	44.40

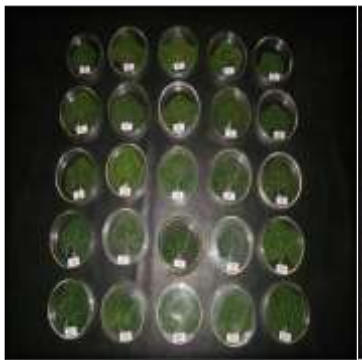
Note: All figures are in Days



Cotton



Tobacco



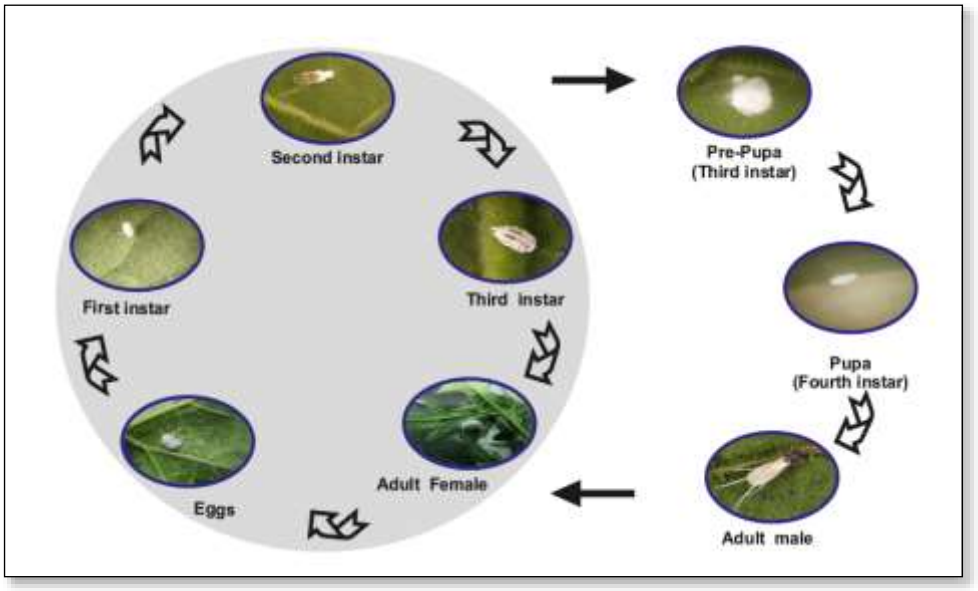
Pumpkin

Congress grass

Kanski

Study carried out for comparative biology of *P. solenopsis* on different hosts

Culture of *P. solenopsis* maintained on sprouted potato in laboratory



Different life stages of *P. solenopsis*

Cotton

Tobacco

Pumpkin

Congress grass

Kanski

Infected leaves/plants of different hosts by *P. solenopsis* in field condition

A period between date of emergence of the female and date of starting of egg laying was considered as pre-oviposition period. Freshly emerged females were reared on leaves of different host plant to study pre-oviposition period. Oviposition period was calculated from the first date of egg laying to the date of ceasing egg laying. Post-oviposition period was calculated from the date of ceasing of egg laying to the date of death of the female adult. To determine the fecundity of female, freshly emerged adult females were transferred individually on different host leaves. Since the female laid eggs in cottony sac located at posterior end of its abdomen, the ovisac was collected during the oviposition period and counted the number of eggs present in each ovisac. Based on this, average fecundity of the female was worked out. Longevity of male and female individuals was calculated separately. The longevity period was calculated from the date of emergence of adult to the death of adult. The adult females emerged out after the last moult in the laboratory was observed under stereo zoom microscope. The adult males emerged out from the silken cocoon were also observed under stereo zoom microscope. Total life cycle of male and female was calculated from the egg stage to the death of adult stage. During the study, newly hatched nymphs were placed individually on a leaf of the different host plant with the help of fine camel hair brush. The leaf was kept in a petri dish and observations were recorded till death of the adult stage.

Results and Discussion

The data presented in [Table-1] indicated significant difference from each other. The mean incubation period was ranged from 1.0 to 2.71 days. The highest mean incubation period (2.71 days) was found in the eggs obtained from tobacco whereas lowest incubation period (1.0 days) was observed in the eggs obtained from cotton. The descending order of the incubation period of eggs in different host was found to be tobacco > pumpkin > kanski (kangi booti) > congress grass > cotton. The difference in the incubation period in eggs may be due to the difference in their nutrition contents of the hosts on which they reared. The observations on nymphal period of *P. solenopsis* showed that the female moulted three times to attain maturity, whereas male moulted four times on five different hosts. The duration of first instar nymph was significantly influenced by different host plants. The highest duration was recorded on pumpkin (5.99 days) whereas lowest duration was recorded for nymph obtained in congress grass (4.59 days) which was remained at par with cotton (4.88 days) and kanski (kangi booti) (4.99 days). The descending order of the first instar duration in different host was found to be pumpkin > tobacco > kanski (kangi booti) ≥ cotton ≥congress grass. The duration of second instar nymph differ significantly on different hosts under study. The highest duration was recorded on pumpkin (5.65 days) which remained at par with cotton (5.81 days) whereas lowest duration was recorded for nymph obtained in congress grass (4.79 days) which was remained at par with kanski (kangi booti)

(5.01 days). The descending order of the second instar duration in different host was found to be pumpkin ≥ cotton > tobacco > kanski (kangi booti) ≥congress grass. The duration of third instar nymph differ significantly on different hosts under study. The highest duration was recorded on pumpkin (6.17 days) which was remained at par with tobacco (6.02 days) whereas lowest duration was recorded for nymph obtained in congress grass (5.10 days) The descending order of the third instar duration in different host was found to be pumpkin ≥ tobacco > cotton > kanski (kangi booti) ≥ congress grass. The data presented in [Table-3] indicated total nymphal duration was significantly influenced by different hosts under study. The highest duration was recorded on pumpkin (17.81 days) whereas lowest duration was recorded for nymph obtained in congress grass (14.58 days). The descending order of the total nymphal period in different hosts was found to be pumpkin > cotton > tobacco > kanski (kangi booti) > congress grass. The pre pupal period was not differed from each other. The mean pre-pupal period was ranged from 1.43 to 1.65 days. The pre pupal period lasted from 1 to 2 days with an average of 1.43, 1.50, 1.50, 1.62 and 1.65 days when *P. solenopsis* reared on congress grass, kaski (kangi booti), cotton, tobacco and pumpkin respectively. The pupal period was significantly differed from each other. The mean pupal period was ranged from 3.56 to 5.60 days. The highest mean pupal period (5.60 days) was found when *P. solenopsis* reared on pumpkin which was at par with tobacco (5.43 days) and cotton (5.25 days). The lowest pupal period (3.56 days) of *P. solenopsis* was observed on congress grass which was at par with kaski (kangi booti) (3.70 days). The descending order of the pupal period in different hosts was found to be pumpkin ≥ tobacco ≥ cotton > kanski (kangi booti) ≥ congress grass. The pre-oviposition period was not differed from each other. The mean pre-oviposition period was ranged from 6.84 to 7.26 days. The pre-oviposition period lasted for 5 to 9 days with an average of 6.84, 6.94, 6.96, 7.15 and 7.26 days when *P. solenopsis* reared on congress grass, cotton, kanski (kangi booti), tobacco and pumpkin respectively. The oviposition period was significantly differed from each other. The mean oviposition period was ranged from 12.27 to 16.58 days. The highest oviposition period (16.58 days) was observed on congress grass whereas lowest mean oviposition period (12.27 days) was found when *P. solenopsis* reared on pumpkin which remained at par with tobacco (13.09 days). The descending order of the oviposition period in different hosts was found to be congress grass > cotton > kanski (kangi booti) > pumpkin ≥ tobacco. The post-oviposition period was not differed from each other. The mean post-oviposition period was ranged from 7.28 to 7.59 days. The post-oviposition period lasted for 4 to 11 days with an average of 7.28, 7.39, 7.47, 7.58 and 7.59 days when *P. solenopsis* reared on congress grass, cotton, kanski (kangi booti), tobacco and pumpkin respectively. The fecundity was significantly differed from each other. The mean number of eggs laid by *P. solenopsis* female ranged from 374.60 to 511.65. The highest fecundity (511.65 eggs) was observed on congress grass whereas the lowest fecundity (374.60 eggs) was observed when reared on pumpkin which was remained at par with tobacco (380.25 eggs). The descending order of the fecundity on different host was found to be congress grass > cotton > kanski (kango booti) > pumpkin ≥ tobacco. The longevity of male was significantly differed from each other. The male longevity was ranged from 2.37 to 3.30 days. The highest male longevity (3.30 days) was observed on congress grass whereas the lowest longevity (2.37 days) of male adults was found when *P. solenopsis* reared on pumpkin which was remained at par with tobacco (2.56 days) and cotton (2.60 days). The descending order of the male longevity in different hosts was found to be congress grass ≥ tobacco ≥ cotton > kanski (kango booti) > pumpkin. The longevity of female *P. solenopsis* was significantly differed from each other. The female longevity was ranged from 24.08 to 31.28 days. The highest female longevity (31.28 days) was observed on congress grass which was remained at par with cotton (29.97 days) whereas the lowest longevity (24.08 days) of female adults was found when *P. solenopsis* reared on pumpkin. The descending order of the female longevity in different hosts was found to be congress grass ≥ cotton > kanski (kango booti) ≥ tobacco > pumpkin. The duration of entire life span of male and female of *P. solenopsis* from egg laying to the death of adult was worked out for different hosts. The data presented in significantly differed from each other. Total life cycle for male was ranged from 22.25 to 27.12 days. Total life cycle of male was longest (27.12 days) when reared on pumpkin whereas the shortest life cycle (22.25 days) of female was observed when reared on congress grass. The descending order for the total life cycle of female was found to be pumpkin > tobacco ≥ kanski (kango booti) ≥ cotton > congress grass. The data presented in significantly differed from each other. Total life cycle for female was ranged from 39.59 to 51.32 days. Total life cycle of female was longest (51.32 days) when reared on pumpkin which was at par with tobacco (49.35 days) whereas the shortest life cycle (39.59 days) of female was observed when reared on congress grass. The descending order for the total life cycle of female was found to be pumpkin ≥ tobacco > cotton ≥ kanski (kango booti) > congress grass.

Conclusion

On the basis of findings, it was concluded that mealy bug, (*P. solenopsis*) preferred the congress grass and gave higher fecundity and shorter life span over cotton, tobacco, kaski and pumpkin.

Application of research: Congress grass is useful for mass rearing of mealy bugs which was gave the faster multiplication with higher fecundity of *P. solenopsis* so, on the basis of these findings we use for mass multiplication of biocontrol agents (Predators and parasitoids) of mealy bugs.

Research Category: Comparative Biology of Mealy Bug

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