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Research Note

Natural parasitization of *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) on cotton by *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae)

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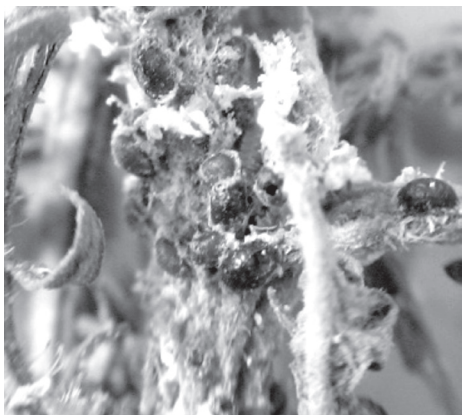
ABSTRACT: Studies were conducted during 2007 and 2008 over a considerable geographical area under cotton cultivation for finding potential natural enemies of *Phenacoccus solenopsis* Tinsley. In July 2008, large numbers of mummified *P. solenopsis* along with healthy mealybugs were observed on heavily infested cotton crop at Central Institute for Cotton Research, Regional Station, Sirsa (Haryana) due to parasitization by *Aenasius bambawalei* Hayat, a potential bioagent of *P. solenopsis*. The parasitoid completed its life cycle on the mealybug leaving the mummified body along with the exit hole behind. The parasitization efficiency of the parasitoid from field collected mealybugs was 57.2 per cent (range 46-64%) whereas under laboratory condition, it was 60.6 per cent (45-74%). As biological control is a supplement to chemical control, the adverse effect of commonly used insecticides on cotton on the efficiency of this parasitoid was studied and monocrotophos was recorded as the most deleterious (57.52% reduction in parasitization). Spinosad and spirotetramet were found to cause the least reduction in parasitization.

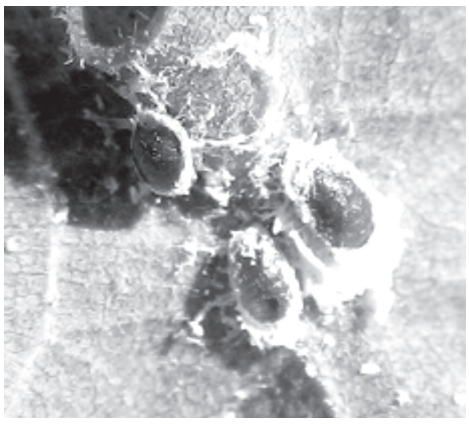
KEY WORDS: *Aenasius bambawalei*, insecticidal intervention, parasitoid, parasitization, *Phenacoccus solenopsis*

In 2005, an invasive species of mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) was found causing serious damage to cotton in Punjab and Sindh provinces of Pakistan (Hodgson *et al.*, 2008). The first report of this species in India was from Gujarat where it was thought to be undescribed. The species then spread to the cotton growing areas of North India (Punjab, Haryana and Rajasthan) and was later identified as *P. solenopsis*, an exotic species. Similar to the dramatic impact this pest had on cotton cultivation in north India, its damage has been observed on other alternate hosts including field crops (cluster bean, mung bean), vegetables (okra, brinjal, tomato, cucurbits, etc.), fruits (guava, ber, papaya), weeds (congress grass, wild sunflower, *Abutilon indicum*, *Sida* sp., *Withania somnifera*, *Achyranthes aspera*, *Xanthium* sp., etc.), ornamentals and plantation trees. *P. solenopsis* was surveyed from 2006 onwards to determine its spread in cotton growing areas of north India, monitor plant damage and record plant species affected and identify the natural enemies.

The pest has spread quickly to cotton growing areas posing a serious problem. The pest is hard to kill as it inhabits concealed locations and even in exposed conditions, the congregation of individuals, protection of late age nymphs and adults by loose, cottony waxy substance secreted by the mealybugs and oviposition in waxy ovisacs act as barriers to proper penetration and action of insecticides. The mealybug was found associated with 46 hosts including fruit, vegetable, ornamental and plantation crops and weeds (Monga *et al*., 2009). Many already reported mealybug species (*Maconellicoccus hirsutus* (Green) and *Ferrisia virgata* (Cockerell)) on cotton have been associated with 16 parasitoids, belonging to 6 families of Hymenoptera. Minor feeding by coccinellids (*Coccinella septempunctata* and *Cryptolaemus montrouzieri*) and Neuroptera (*Chrysoperla* sp.) was recorded on cotton and other infested plants during the survey. The predators remain exposed to all chemical intervention and are more prone to mortality and less effective than parasitoids as in the case of classical biological control of cassava mealybug in 1970s in Africa. During the first year (2007), no potential parasitoid was recorded on the mealybug. In July 2008, mummified mealybugs with wax removed from thorax were recorded from the experimental area of Central Institute for Cotton Research, Regional Station, Sirsa. The samples (10 mealybug infested hosts having mummified and healthy mealybugs) were collected



Mummified Body



Exit hole in mealybug body

Adult Parasitoid

Adult Parasitoid

and the emergence of adult parasitoids was recorded in IRM laboratory of CICR, RS, Sirsa. The emerged adults were preserved in 75% alcohol and later identified as *Aenasius bambawalei* Hayat. *Aenasius* sp. has earlier been recorded in India on *Planococcus citri* (Narasimham *et al.,* 1997).

The culture of the parasitoid was maintained in the laboratory on healthy mealybug colonies for further studies. The population of the parasitoid was density-dependent and the parasitoid population decreased with decline in mealybug infestation. Random samples collected from various highly mealybug infested cotton fields were found to be parasitized to an extent of 46-64 per cent in August, 2008. The mean per cent parasitization of the mealybug was 57.2 (SEM±1.94). Its potential as a natural bioagent was confirmed by releasing 10 parasitized (mummified) mealybugs with 50 crawlers in plastic jars and the extent of mummified mealybugs in the jar at the end was 45-70 per cent with a mean of 60.8 per cent (SEM±3.08) (Table 1). Statistical analysis of the paired differences under laboratory and field parasitization of *A. bambawalei* indicates that the difference is non-significant (Table 2).

Impact of insecticidal intervention on the parasitization efficiency of *Aenasius bambawalei*

Cotton, being the largest consumer of insecticides, is receiving application of insecticides for the management of sucking pests including mealybugs though insecticide use has significantly reduced after the introduction of Bt-cotton. Seven most prominently followed insecticidal interventions on cotton from synthetic pyrethroid group (cypermethrin), organophosphate group (monocrotophos, acephate, ethion and profenophos), spinosad (microorganism based) and

Table 1. Parasitization efficiency of *A. bambawalei* against *P. solenopsis*

No. of mealybugs released	Laboratory conditions		Field conditions	
	No. of mealybugs parasitized	Per cent parasitization	No. of mealybugs parasitized	Per cent parasitization
50	30	60	26	52
50	30	60	31	62
50	35	70	30	60
50	35	70	32	64
50	25	50	28	56
50	22	45	25	50
50	32	64	30	60
50	32	65	23	46
50	37	74	32	64
50	25	50	29	58
50	30.3	60.8	28.6	57.2
SD		9.75		6.12
SEM		3.08		1.94

Table 2. Statistical analysis of the paired differences in laboratory and field parasitization of *P. solenopsis* by *A. bambawalei*

Treated-Untreated	Paired differences				t- cal	df	2-tailed P-value
	Mean	Std. Error of Mean	95% Confidence Interval of the Difference				
			Lower	Upper			
	3.60	2.741	-2.60	9.80	1.31	9	0.2216

spirotetramet (IGRs) alone and in combination were found to adversely affect the efficiency of this parasitoid in cotton fields (after 10 sprays at 10 days interval). Monocrotophos @ 600 ml/acre was most harmful and the data recorded after first, third and seventh days of application of the insecticide showed maximum reduction (57.52%) in parasitization within 24 hours after application and was followed by a combination of cypermethrin+monocrotophos (55.18% reduction 24h after application). The organophosphates (monocrotophos and acephate) were also found to be harmful to the parasitization activity of *Anagyrus* sp. against *Planococcus citri*. In contrast, spinosad (18.08% reduction) and spirotetramet (19.63% reduction) were found to be safer to the parasitoid (Table 3). Buprofezin (IGR) (Cloy and Amy, 2006) was reported to be safe to the parasitoid, *Leptomastix dactylopii* against *P. citri*.

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Table 3. Effect of different insecticides used on cotton on parasitization of *P. solenopsis* by *A. bambawalei* under field conditions

Treatments	Per cent reduction in parasitization on day		
	I	II	III
Cypermethrin	44.19** (48.62)*	43.80 (47.95)	39.88 (41.23)
Monocrotophos	57.52 (70.92)	56.61 (69.55)	52.65 (63.17)
Acephate	41.36 (43.73)	40.28 (41.89)	38.06 (38.06)
Ethion	44.95 (49.94)	44.02 (48.32)	42.40 (45.50)
Profenophos	34.56 (32.35)	33.12 (30.09)	30.44 (26.12)
Spinosad	18.08 (9.94)	16.63 (8.43)	14.60 (6.47)
Cyp+Mono	55.18 (67.31)	54.39 (66.08)	51.43 (61.13)
Cyp+Acephate	39.36 (40.27)	37.91 (37.81)	36.82 (35.95)
Cyp+Ethion	38.93 (39.62)	37.09 (36.51)	34.92 (32.85)
Cyp+Profeno	37.81 (37.66)	36.14 (34.90)	34.07 (31.44)
Spirotetramet	19.63 (11.37)	18.03 (9.77)	16.72 (8.37)
No spray	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
C.D. at 5%	5.614	4.658	4.576
C.V.	9.160	7.800	8.220

* Per cent reduction value; ** angular transformed values

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