



Ornamental hosts of cotton mealybug (*Phenacoccus solenopsis*)

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Cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae), a polyphagous sap feeder of USA origin (Ben-Dov *et al.* 2009) invaded India in 2006 with its initial infestation reported on cultivated cotton *Gossypium hirsutum* (L.) including Bt hybrids at Central Gujarat (Jhala *et al.* 2008), and its pest status was reported from all the nine cotton growing states of India during 2008 (Nagrare *et al.* 2009). Alternate host plants of *P. solenopsis* numbering 183 plant species from 52 families (Ben-Dov *et al.* 2009), 154 host plants from 53 families (Arif *et al.* 2009) and 194 plant species from 50 families (Vennila *et al.* 2011) reported across the globe, Pakistan and India, respectively provide an evidence of its pervasive occurrence and successful exploitation of habitats. Species of ornamental plants grown in urban and rural settings, at home backyards and their commercial cultivation in the fields of farmers constitute potential alternate hosts for the sustenance of *P. solenopsis* in the cropping systems. Study of host range and spatial and temporal preference for ornamentals by *P. solenopsis* constitute foundation for understanding the source and time of spread of the pest and to devise cultural management strategies towards managing the pest.

Study was conducted over two years between July 2008 and June 2010 through fortnightly surveys in three representative States of Indian cotton growing zones, viz. Haryana of North zone, Maharashtra of Central zone and Tamil Nadu of South zone. Ornamental hosts of the cotton ecosystem comprising cultivated fields, fallow lands, waste land and home backyards harbouring *P. solenopsis* were located and severity of infestation was measured using zero to four scale, viz. 0 – no mealybug; Grade 1 (G1) – scattered appearance of few mealybugs on the plant; Grade 2 (G2) –

severe incidence of mealybug on any one branch of the plant; Grade 3 (G3) – severe incidence of mealybug on more than one branch or half portion of the plant and Grade 4 (G4) – severe incidence of mealy bug on the whole plant. The number of plants for anyone ornamental host of *P. solenopsis* during each survey period was ten. The ornamental plants were also collected and preserved as herbarium to confirm their botanical identity. The location of the ornamental hosts with *P. solenopsis* infestation in the fields of cotton ecosystem, viz. within fields or field boundary or road side including backyards or near water channels was also noted during surveys. Since the North, Central and South cotton zones belonged to different agroclimatic regions, ornamental species exclusive to each zone, common between any two zones and ubiquitous among all three zones for their diversity, seasonality, severity and locations were studied for evolving general and specific strategies for *P. solenopsis* management.

A total of 24 ornamental plant species from 12 different families served as hosts of *P. Solenopsis* (Vennila *et al.* 2011). Host records of ornamentals exclusive to South zone (6) was higher followed by North (4) and Central (3) zones belonging to 4, 3 and 2 families, respectively. While common hosts between Central+South (5) and North+Central+South (6) zones were noted, commonality was absent at North+South and North+Central zones (Table 1). Arif *et al.* (2009) reported 45 ornamentals out of 154 host plants of *P. solenopsis* from Pakistan. Although total number of host plants documented was higher in India (194) (Vennila *et al.* 2010), the ornamental hosts were lesser by 21 over Pakistan attributable to the vastness and larger geographical diversity of India allowing *P. solenopsis* to be preferential in host selection although the possibility of differing floral fauna between the countries cannot be ruled out. Highest number of ornamental hosts of *P. solenopsis* belonged to Asteraceae and Euphorbiaceae (5) > Malvaceae (4) > Amaranthaceae (2). Eight families had single ornamental species as hosts for *P. solenopsis*. Acanthaceae, Apocyanaceae and Euphorbiaceae families were common between C+S zones. Ornamental hosts of *P. solenopsis* common across all cotton growing zones belonged to Asteraceae with two hosts (*Tagetes erecta* L. and

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Chrysanthemum indicum L.) and single host from Malvaceae (*Hibiscus rosa-sinensis* L.), Nyctaginaceae (*Bougainvillea glabra* L.), Rosaceae (*Rosa indica* L.) and Verbenaceae (*Lantana camara* L.). *Helianthus bebilis* L., *Gaillardia pulchella* Fougier and *Hibiscus micranthus* L.f. were the exclusive hosts in respect of North, Central and South zones during cotton season. *Withania somnifera* (L.) Dunal at North zone and *Gomphrena globosa* L., *Celosia cristata* L., *Codiaeum variegatum* (L.) A.Juss and *Croton petra* at South zone served as hosts during cotton + off seasons. Higher number of ornamentals exclusive to South zone (4) occurring throughout the year enhances the possibility of effective spread on cotton. *H. rosa-sinensis* (Malvaceae) and *R. indica* (Rosaceae) were the common ornamental hosts across all three zones, throughout the year and off season, respectively. *Nerium oleander* L. (Apocynaceae) occurred throughout the year at C+S zones.

All scales of *P. solenopsis* severity (G1 to G4) were noticed for the ornamental hosts exclusive to all three zones (Table 1). Number of ornamental hosts with G1 severity (11) was considerable among exclusive and common hosts indicating their role towards carryover of the insect rather than being suitable for perpetuation. The North zone exclusive ornamentals, viz. *H. debilis* (Asteraceae) and *W. somnifera* (Solanaceae), and *Vicoa indica* (L.) DC. (Asteraceae) of Central zone had the highest severity (G4). No South zone exclusive ornamental host had G4 severity. *H. rosa-sinensis* (Malvaceae) had shown G4 severity of *P. solenopsis* across all the cotton zones (N+C+S). Scenario of severity of *P. solenopsis* implies the transient and carry-over role of ornamentals as alternate hosts and the exception being *H. rosa-sinensis*, a favourable host at all zones. It is on *H. rosa-sinensis* in Nigeria the first record of *P. solenopsis* was made (Akintola and Ande 2008). Aheer *et al.* (2009) and Abbas *et*

al. (2010) also have reported shoe flower (*H. rosa-sinensis*) as the most preferred ornamental plant species by *P. solenopsis* in Pakistan. Since *H. rosa-sinensis* is one of the common and all season ornamental species across rural and urban settings of the globe, and that the infestation by *P. solenopsis* is severe and continuous year round, periodical monitoring is needed from the perspective of preserving the plant species, and prevention of rapid spread of mealybug in the region.

Roadside located ornamentals dominated as hosts of *P. solenopsis* at all zones individually and among common hosts. *H. debilis* (Asteraceae) and *G. pulchella* (Asteraceae) were the exclusive hosts found within fields of cotton in respect of North and Central zones, respectively. Six exclusive hosts of South zone were located along roadside confirming their significant role of roadside ornamentals in determining spatial spread. Present study revealed the diverse group of ornamental species found located at roadside and field border of the cotton ecosystems are capable of supporting perpetuation of *P. solenopsis* population throughout the year. Based on the seasonality and spatial distribution of the diverse ornamental hosts of *P. solenopsis* and the pest severity on them across all, common between any two and specific to a cotton growing zone, “what, when, and where of its management strategies” have been formulated for adoption (Table 2).

Cultural management of *P. solenopsis* implies need for monitoring of ornamentals that are its alternate hosts. Disposal of *P. solenopsis* infested ornamentals should be through burying or burning that would result in complete destruction of pest stages. While burial practice can be practiced for host plants of herb categories with severity one and two, for hosts with extreme severity burning is advocated. Continued practice of cultural recommendations on ornamentals has the potential to eradicate the pest from India, if practised

Table 1 Profile of ornamental hosts of *P. solenopsis* in cotton growing zones

Particulars	Number of ornamentals					
	Exclusive hosts			Common hosts		Total
	North (N)	Central (C)	South (S)	Central and South (C+S)	North, Central and South (N+C+S)	
Total records	4	3	6	5	6	24
Number of families	3	2	4	3	5	12
Seasonality						
Cotton season	1	1	1			3
Off season	2	2	1	3	1	9
Throughout the year	1		4	1	1	7
Severity						
Grade 1		2	4	3	2	11
Grade 2			2	1		3
Grade 3	2			1		3
Grade 4	2	1			1	4

Table 2 What, when, and where of *P. solenopsis* management on ornamentals

Cotton growing zone	Host plants	Season	Location
All	Shoe flower <i>Hibiscus rosa-sinensis</i>	Throughout the year	Backyard and roadside
North	Ashwagandha <i>Withania somnifera</i>	Throughout the year	Roadside and water channel
	Beach sunflower <i>Helianthus debilis</i>	Cotton season	Within field
Central	Ran shevanti <i>Vicoa indica</i>	Off season	Within field and field border
Central and South	Oleander <i>Nerium oleander</i>	Throughout the year	Roadside
	Lantana <i>Lantana camara</i>	Off season	Field border , roadside and water channel

simultaneously over all cotton growing regions.

SUMMARY

Ornamental hosts and their significance in the management of cotton mealybug *P. solenopsis* were studied over two years. Twelve of the 24 documented ornamental hosts belonged to three families, viz. Asteraceae, Malvaceae and Euphorbiaceae. Higher number of ornamentals as off season hosts (9) outnumbering cotton season (3) at Central over North and South zones indicated the strong carryover of the pest at Central India. *Helianthus debilis* during cotton season, *Vicoa indica* during off season and *Hibiscus rosa-sinensis* and *Withannia somnifera* throughout the year are the preferential ornamental hosts with extreme severity. Role of roadside and backyard ornamentals in the spread of *P. solenopsis* was higher at South followed by North > Central zones. Removal and careful destruction of plants or plant parts of *P. solenopsis* infested ornamentals should be adopted for prevention of pest spread and to mitigate the loss to the crop of cotton.

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