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DISTRIBUTION AND POPULATION DYNAMICS OF COTTON MEALY BUG ON DIFFERENT HOST PLANTS

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ABSTRACT

Cotton mealy bug (*Phenacoccus solenopsis*), is the one of the serious pests of cotton and widely distributed throughout Pakistan. In the present studies, the distribution and seasonal dynamics of cotton mealy bug was studied on different hosts. Forty-nine plant species were confirmed as hosts of mealy bug under laboratory conditions as the insect successfully bred, completed its life cycle and produced young ones on these hosts. The maximum intensity or population of mealy bug was recorded on *G. hirsutum* (118.16) followed by *H. rosa-sinensis* (113.42) and *A. indicum* (86.16) whereas the minimum intensity was recorded on *C. arvense*, *M. indicus* and *C. album*. The rest of the hosts harbored intermediate populations of the insect pest. The months of April to October were considered as the seasonal period while those from November to March were regarded as overwintering or carry over months for the pest. It is concluded from the present study that the host plants provide a bridge to cotton mealy bug which became established and thereafter spread to major cash crops like cotton. It is, therefore, recommended that elimination of alternate hosts can be one of the first and most important integrated management strategies for cotton mealy bug.

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INTRODUCTION

Cotton mealy bug (*Phenacoccus solenopsis*), being originated in Central America, is regarded as a wide distributed pest in Pakistan. It has been reported from India and China (Nagrare et al., 2009; Wang et al., 2009) and destroyed the whole cotton industry from the last few years. In Pakistan, it has been recorded as a serious pest of cotton from 2005 to onwards (Abbas et al., 2007; Hodgson et al., 2008; Muhammad, 2007). It was recorded from cotton, vegetables and other ornamental crops,

grown in different areas of the Punjab and Sindh Provinces (Arif et al., 2009). With the passage of time, the pest became more and more voracious on cotton crop (Hodgson et al., 2008). In addition to this, a bale loss of 3.1 million occurred in 2006 and 2007 (Mahmood et al., 2011). This extent of damage and severity might have been achieved due to constant stability as well as drastic increment in the generations (15) of the pest per year (Tanwar et al., 2007). Abiotic factors such as temperature and rainfall favor *P. solenopsis* population growth and

development which has declined the cotton production by 8.7%, 1.2% and 9% in 2005-2006, 2006-2007 and 2007-2008 growing seasons.

Cotton mealy bug sucks cell sap and growth of plants becomes stunted resultantly the infested plants produce fewer bolls of small and deformed sizes (Dhawan et al., 1980). The leaves turn curly, yellow, crinkle and drop off completely. In case of severe infestation, plant death occurs. Infested flowers often drop and sometimes produce little or no fruit. The pest also produces honeydew resulting in sooty mold on leaves that hinders photosynthesis (Culik and Gullan, 2005; Saeed et al., 2007). It has a wide range of variations in morphological characters, biological adaptations and ecological adjustability (Hodgson et al., 2008). Winged males and wingless females of *P. solenopsis* have two and three nymphal instars respectively (Hodgson et al., 2008). Eggs are normally laid in ovi-sacs (about 300-500) with first instar/crawlers lack feeding due to high motility and later instars occupy heavy feeding sites (Hodgson et al., 2008; Kumar et al., 2009). However, the feeding is age/size dependent. The pest is also suspected as a vector of plant diseases (Culik and Gullan, 2005).

It has been recorded from 154 plant species including field crops, fruits, vegetables, ornamentals, grasses, weeds, bushes and trees belonging to families such as: Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, Amaranthaceae and Cucurbitaceae. However, economical damage has been observed on cotton, brinjal, okra, tomato, sesame, sunflower and China rose (Arif et al., 2009). In addition to this, 52 plant families are consistently damaged by cotton mealy bug. These plant families serve as carry-over places to spread on economic crops such as cotton.

Tropical and subtropical climate with summer rains and mild winters enhanced mealy bug breeding to remain present throughout the year. All stages are evident with many overlapping generations found damaging plant parts such as leaves, shoots, twigs, branches flowers and roots. Infestation occurs in patches that make huge loss to cotton yield. Severely damaged plants suffer premature dehydration and give the appearance of defoliator spray on cotton plant (Mahmood et al., 2011).

As the pest has very wide host range, therefore, the present studies were conducted to determine seasonal distribution and population intensity of cotton mealy bug

in different host plants.

MATERIALS AND METHODS

As cotton mealy bug has been found to survive on different hosts for the last ten years, therefore, surveys were conducted to record alternate hosts in district Multan to determine seasonal distribution and host preference of the insect pest. The response of mealy bug was also evaluated to different hosts present in the said area.

During the survey to record alternate host plants in Multan district, five locations with high agricultural intensification were selected randomly. The data were taken at fortnightly intervals from each location. *P. solenopsis* affected plant samples i.e. 15 cm twigs were collected in air tight pouches and placed into chest boxes. The samples were then brought to laboratory to study the biology of *P. solenopsis* on these plants. Unidentified hosts were taken to botanist for accurate identification of hosts. The host-biology relationship was confirmed by rearing crawlers or young ones of female mealy bug on small cut pieces (1 square inch of leaf, stem, fruit) of each host plant, at $26\pm 1^{\circ}\text{C}$ and RH $65\pm 5\%$ laboratory conditions, using a glass Petri dish of 6.5 cm diameter having a lid. The preferred portion of host plant was placed in Petri dish on daily basis and three replicates were made. The mortality or survival, growth and development were observed daily. The plant was regarded as a host if the pest completed its life cycle in addition to producing crawlers or young ones. On the other hand, if the pest failed to complete its life cycle or did not produce crawlers, it was regarded a non-host plant. The identified hosts were listed with their vernacular names (Abbas et al., 2010). The data regarding population of cotton mealy bug on 20 g fresh biomass in case of small plant or on upper six inch or per twig of different host plants were also recorded (Abbas et al., 2010; Shahid et al., 2013).

RESULTS

Forty-nine plant species listed in Table 1 were confirmed as mealy bug hosts under laboratory conditions as the insect successfully bred, completed its life cycle and produced young ones on these hosts.

The seasonal distribution of different host plants of cotton mealy bug is given in Table 2. The months of April to October were considered as the seasonal period while those from November to March were regarded as overwintering or carry over months.

Table 1. Confirmed alternate host plants of cotton mealy bug.

Sr. No.	Vernacular Name	English Name	Technical Name	Family
1	Aaloo	Potato	<i>Solanum tuberosum</i> L.	Solanaceae
2	Aksun	Winter cherry	<i>Withania somnifera</i> L.	Solanaceae
3	Anthurium	Anthurium	<i>Anthurium andraeanum</i>	Araceae
4	Bathu	Lambs quarters	<i>Chenopodium album</i> L.	Chenopodiaceae
5	Baingun	Brinjal	<i>Solanum melongena</i> L.	Solanaceae
6	Bhakra	Puncture clover	<i>Tribulus terrestris</i> L.	Zygophyllaceae
7	Bhindi	Lady finger	<i>Abelmoschus esculentus</i> L.	Malvaceae
8	Billi booti	Scarlet	<i>Amaranthus paniculatus</i> L.	Amaranthaceae
9	Boganvilla	Bougainvillea	<i>Bougainvillea spectabilis</i>	Nyctagenaceae
10	Chulai	Spiny amaranth	<i>Amaranthus spinosus</i> L.	Amaranthaceae
11	Daryai booti	False daisy	<i>Eclipta prostrata</i> (L.) L.	Asteraceae
12	Dhatura	Thorn apple	<i>Datura alba</i>	Solanaceae
13	Duranta	Sky flower	<i>Duranta repens</i> L.	Verbenaceae
14	Gajar booti	Parthenium	<i>Parthenium hysterophorus</i> L.	Asteraceae
15	Gardenia	Gardenia	<i>Clerodendron inerme</i> Gaertn.	Verbenaceae
16	Gudhal	Shoe flower	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae
17	Gule dupehri	Moss rose	<i>Portulaca grandiflora</i> Hook.	Portulacaceae
18	Haloon	Garden cress	<i>Lepidium sativum</i> L.	Brassicaceae
19	Hazardani	Blue weed	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae
20	Hazardani dodhak	Trailing spurge	<i>Euphorbia granulata</i> Forssk.	Euphorbiaceae
21	Itsit	Horse purslane	<i>Trianthema patulacastrum</i> L.	Aizoaceae
22	Jangli chulai	Pigweed	<i>Amaranthus viridis</i> L.	Amaranthaceae
23	Jangli itsit	Hogweed	<i>Boerhavia diffusa</i> L.	Nyctaginaceae
24	Kaddu	Pumpkin	<i>Cucurbita moschata</i> Duchesne	Cucurbitaceae
25	Kangi booti	Mallow	<i>Abutilon indicum</i> L.	Malvaceae
26	Kapah	Cotton	<i>Gossypium hirsutum</i> L.	Malvaceae
27	Kharbuza	Musk melon	<i>Cucumis melo</i> L.	Cucurbitaceae
28	Kheera	Cucurbits	<i>Cucumis sativus</i> L.	Cucurbitaceae
29	Krund	Fathen	<i>Chenopodium morale</i> L.	Chenopodiaceae
30	Kulfa	Common purslane	<i>Portulaca oleracea</i> L.	Portulacaceae
31	Lal dodhak	Red garden spurge	<i>Euphorbia hirta</i> L.	Euphorbiaceae
32	Lani	Atriplex crassifolia	<i>Atriplex crassifolia</i>	Chenopodiaceae
33	Lantana	Tickberry, Lantana	<i>Lantana camara</i> L.	Verbenaceae
34	Leh	Canadian thistle	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae
35	Lehli	Field bindweed	<i>Convolvulus arvensis</i> L.	Convolvulaceae
36	Lusan booti	Fleabane	<i>Conyza ambigua</i> DC.	Asteraceae
37	Maina	Black clover	<i>Medicago polymorpha</i> L.	Fabaceae
38	Mako	Black nightshade	<i>Solanum nigrum</i> L.	Solanaceae
39	Mirch	Chillies	<i>Capsicum annum</i> L.	Solanaceae
40	Mohabbat booti	Cocklebur	<i>Xanthium stumarium</i> L.	Asteraceae
41	Oont chara	Wild heliotrope	<i>Heliotropium indicum</i> L.	Boraginaceae
42	Peeli dodhak	Yellow spurge	<i>Launaea nidicaulis</i> Hook. F.	Asteraceae
43	Pohli	Wild safflower	<i>Carthamus oxyacantha</i> M. Bieb.	Asteraceae
44	Puth kanda	Devil's horse whip	<i>Achyranthes aspera</i> L.	Amaranthaceae
45	Senji	Indian clover	<i>Melilotus indicus</i> (L.) All.	Fabaceae

46	Shahtra	Fumitory	<i>Fumaria indica</i> Pugsley	Fumariaceae
47	Suraj mukhi	Sunflower	<i>Helianthus annus</i> L.	Asteraceae
48	Tamater	Tomato	<i>Lycopersicon esculentum</i> Mill.	Solanaceae
49	Tandla	Digera	<i>Digera muricata</i> Mart.	Amaranthaceae

Table 2: Seasonal distribution of host plants of cotton mealy bug during the study years 2012 and 2013.

Sr. No	Host	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Potato	+	+	+	+	-	-	-	-	+	+	-	-
2	Winter cherry	+	+	+	+	+	+	+	+	+	+	+	+
3	Anthurium	+	+	+	+	+	+	+	+	+	+	+	+
4	Lambs quarters	+	+	+	+	+	+	-	-	+	+	+	+
5	Brinjal	-	-	+	+	+	+	-	-	-	-	-	-
6	Puncture clover	-	+	-	+	+	+	+	+	-	-	-	-
7	Lady finger	-	-	+	+	+	-	-	-	+	+	-	-
8	Scarlet	-	+	+	+	+	+	-	-	-	-	-	-
9	Bougain villea	-	-	-	-	-	+	+	+	+	+	-	-
10	Spiny amaranth	-	+	+	+	+	+	+	+	+	-	-	-
11	False daisy	+	-	-	-	-	-	-	-	-	-	+	+
12	Thorn apple	-	-	+	+	+	-	-	+	+	+	+	+
13	Sky flower	-	-	+	+	+	+	+	-	-	-	-	-
14	Parthenium	-	-	-	-	-	+	+	+	+	+	-	-
15	Gardenia	-	+	+	+	-	-	+	+	+	+	-	-
16	Shoe flower	+	+	+	+	+	+	-	-	+	+	+	+
17	Moss rose	-	-	-	+	+	+	+	-	-	-	-	-
18	Garden cress	-	+	+	+	+	-	-	-	-	-	-	-
19	Blue weed	-	-	+	+	+	+	+	+	+	+	+	+
20	Trailing spurge	-	-	+	+	+	+	+	+	+	+	+	+
21	Horse purslane	-	+	+	+	+	+	+	+	+	+	-	-
22	Pigweed	-	+	+	+	+	+	-	-	-	-	-	-
23	Hogweed	-	-	+	+	+	-	-	-	+	+	+	+
24	Pumpkin	-	+	+	+	+	-	-	-	-	-	-	-
25	Mallow	+	+	+	+	+	+	-	-	+	+	+	+
26	Cotton	-	-	+	+	+	+	+	+	+	+	+	-
27	Musk melon	-	-	+	+	+	-	-	-	-	-	-	-
28	Cucurbits	-	-	+	+	+	-	-	-	-	-	-	-
29	Fathen	-	-	+	+	+	+	+	+	+	+	+	+
30	Common purslane	-	+	+	+	+	+	-	-	+	+	-	-
31	Red garden spurge	-	-	+	+	-	-	-	-	+	+	+	+
32	Atriplex crassifolia	+	-	-	-	-	-	-	-	+	+	+	+
33	Tickberry, Lantana	-	+	+	+	+	-	-	-	+	+	+	-
34	Canadian thistle	-	-	+	+	+	+	-	-	-	-	-	-
35	Field bindweed	-	+	+	+	+	+	-	-	-	+	-	-
36	Fleabane	-	+	+	+	+	+	+	+	-	-	-	-
37	Black clover	-	-	-	+	+	+	+	+	-	-	-	-
38	Black nightshade	-	-	+	+	+	+	+	+	+	+	-	-
39	Chillies	-	-	+	+	+	+	+	-	-	-	-	-
40	Cocklebur	-	-	+	+	-	-	+	+	+	-	-	-
41	Wild heliotrope	-	-	-	-	-	-	-	-	+	+	+	+
42	Yellow spurge	-	+	+	+	-	-	+	+	+	+	+	-
43	Wild safflower	-	-	+	+	+	+	-	-	+	+	+	-

44	Devil's horse whip	-	-	+	+	+	+	+	-	-	-	-	-
45	Indian clover	-	-	+	-	-	+	-	-	-	+	-	-
46	Fumitory	-	+	+	-	-	-	-	-	-	-	-	-
47	Sunflower	-	-	+	+	+	-	-	-	-	-	-	-
48	Tomato	-	-	-	-	-	-	-	-	+	+	+	-
49	Digera	-	+	+	+	+	+	+	-	-	-	-	-

Where + means present and - means absent

The maximum intensity or population of mealy bug was recorded on *G. hirsutum* (118.16) followed by *H. rosasinensis* (113.42) and *A. indicum* (86.16) whereas the

minimum intensity was recorded on *C. arvense*, *M. indicus* and *C. album*. The rest of the hosts harbored intermediate populations of the insect pest (Table 3).

Table 3. Population density of cotton mealy bug on different host plants.

S. No.	Vernacular Name	Intensity Level	S. No.	Vernacular Name	Intensity Level
1	Kapah	118.16 ± 5.71	26	Lal dodhak	9.76 ± 1.01
2	Gudhal	113.42 ± 8.28	27	Hazardani	8.88 ± 1.63
3	Kangi booti	86.16 ± 3.95	28	Pohli	8.66 ± 1.27
4	Aksun	79.34 ± 4.3	29	Kheera	8.56 ± 1.09
5	Anthurium	51.43 ± 5.06	30	Billi booti	8.24 ± 1.62
6	Bhindi	44.86 ± 2.8	31	Maina	7.88 ± 0.95
7	Puth kanda	40.04 ± 3.5	32	Jangli itsit	7.02 ± 1.84
8	Mohabbat booti	36.48 ± 2.4	33	Mirch	6.86 ± 1.15
9	Baingun	35.34 ± 3.79	34	Suraj mukhi	6.7 ± 1.25
10	Gajar booti	30.42 ± 3.19	35	Lusan booti	6.68 ± 1.06
11	Lantana	27.08 ± 3.17	36	Daryai booti	6.46 ± 1.34
12	Dhatura	23.38 ± 4.45	37	Kulfa	6.38 ± 1.1
13	Duranta	20.3 ± 3.16	38	Jangli chulai	6.3 ± 1.67
14	Gule dupehri	19.7 ± 3.36	39	Chulai	5.68 ± 1.18
15	Tamater	17.88 ± 2.7	40	Kaddu	5.36 ± 0.97
16	Itsit	16.14 ± 2.32	41	Lani	5.32 ± 2.7
17	Gardenia	15.1 ± 2.3	42	Lehli	5.22 ± 1.39
18	Tandla	14.28 ± 1.45	43	Hazardani dodhak	4.88 ± 1.03
19	Mako	13.46 ± 3.28	44	Shahtra	4.8 ± 1.13
20	Aaloo	12.56 ± 1.75	45	Krund	4.78 ± 1.08
21	Haloon	12.04 ± 1.83	46	Oont chara	4.26 ± 0.79
22	Bhakra	11.1 ± 1.94	47	Leh	3.86 ± 1.3
23	Kharbuza	11.1 ± 2.09	48	Senji	3.62 ± 1.09
24	Boganvilla	10.46 ± 1.81	49	Bathu	2.56 ± 0.66
25	Peeli dodhak	10.06 ± 1.77			

DISCUSSION

The present findings confirmed that cotton mealy bug is a polyphagous pest and these findings are in agreement with those of (Abbas et al., 2006). The pest becomes more and more devastating and threatening and capable of surviving on each and every kind, size, stature, pattern and more importantly plant species which is in easy access and approach of the former. Vennila et al. (2011)

recorded 194 host plants (field, forage, fruits, vegetables, ornamentals and weeds) of cotton mealy bug. Similarly, more than 50% weeds are responsible for sustainability of mealy bug. Vennila et al. (2013) also recorded 108 weeds that are mostly present within fields, borders of fields, roadsides, irrigation channels and water channels. In the present study, 49 plant species were confirmed as hosts of mealy bug belonging to eighteen (18) families.

The maximum population was recorded on *G. hirsutum* (118.16) followed by *H. rosa-sinensis* (113.42) and *A. indicum* (86.16) whereas minimum intensity was recorded from *C. arvensis*, *M. indicus* and *C. album*. These results are in accordance with those of (Abbas et al., 2010) who while working in Pakistan recorded 173 host plants which belong to 54 families. They also reported that host plants are continuously available for cotton mealy bug throughout the year. In India, Suresh et al. (2010) recorded mealy bug on cotton, Dhawan et al. (2010) on 22 hosts, Prishanthini and Vinobaba (2011) on 28 host plant species that comprised of 10 families, Kedar and Saini (2015) on 51 plant species belonging to 19 different families and Sahito and Abro (2012) recorded fitness of mealy bug on okra and China rose. In Pakistan, Aheer et al. (2009) recorded 22 and Shahid et al. (2013) 18 different host plant species of cotton mealy bug. The pest has also been reported from other parts of the world such as Qaha, Egypt (Ibrahim et al., 2015), Iraq (Abdul-Rassoul et al., 2015), Victoria City (Culik and Gullan, 2005) and Southwest and Middle São Francisco (Silva, 2012) on tomato, weeds, ornamentals and especially cotton.

The seasonal prevalence of the pest was found during the months from April to October whereas the months from November to March were found as overwintering or carry over months. Some plants were recorded from January to December on which mealy bug was found. There are reports that monoculture cropping pattern favored the pest (Arif et al., 2009). Similarly, the pest seriously infested cotton crop no necessary measures were adopted. Abbas et al. (2010) reported that the pest remain sustained in the field, on different host plants round the year. The host plants are present in the form of trees, shrubs, herbs, creepers, climbers and grasses (Fallahzadeh et al., 2014). It is concluded from the present study that the host plants provide a bridge to cotton mealy bug which became established and thereafter spread to major cash crops like cotton. It is, therefore, recommended that elimination of alternate hosts can be one of the first and most important integrated management strategy for cotton mealy bug.

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