A Survey for Pink Hibiscus Mealybug, *Maconellicoccus hirsutus* (Green) and its Parasitoids in Egypt, Spain and Morocco

D. Gonzalez*, A. H. El-Heneidy, S. M. Mousa**, S.V. Triapitsyn*, Dalia Adly**, V.A. Trjapitzin*** and D.E. Meyerdirk******

*Deptartment of Entomology, University of California, USA.

**Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza,, Egypt

*** Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

**** U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Riverdale, MD, USA

(Received, February 15, 2003; Accepted, February26, 2003)

ABSTRACT

A search for the pink hibiscus mealybug (PHMB), *Maconellicoccus hirsutus* (Green) and its parasitoids were conducted in Egypt, Spain, and Morocco in 2000-2001. Ornamental hibiscus host plants were found abundantly in all 3 countries but PHMB was found only in Egypt. Among several parasitoids recovered from PHMB, a gregarious parasitoid, *Allotropa* sp. near *mecrida* (Walker) (Hymenoptera: Platygastridae) was by far the most abundant parasitoid attacking PHMB in Egypt. Primary parasitoids made up 94.9% of total parasitoids emerging and 5.1% were secondary. A potential for a successful introduction biological control program against this pest in California is enhanced by the collaborative efforts of personnel from several agencies: the Plant Protection Institute of Egypt, the University of California at Riverside, CDFA- Biological Control Program, and USDA-APHIS.

Key Words: Survey, Pink hibiscus mealybug, Parasitoids, Egypt, Spain, Morocco.

Problem

The pink hibiscus mealybug (PHMB), *Maconellicoccus hirsutus* (Green) is an exotic, newly introduced pest to California. It was first found on mulberry in the Imperial Valley, California, in August 1999 and originally was believed to be an ornamental pest. However, it has a host range of over 200 plant species including many plants important to agriculture as well as ornamental hosts in California such as grapes, cotton, corn, chrysanthemums, roses, and mulberries (USDA-APHIS 1997).

In this paper, we summarize a collaborative effort among the 4 agencies: the Plant Protection Institute of Egypt, the University of California at Riverside, CDFA-Biological Control Program, and USDA-APHIS, our findings on a survey for natural enemies in Egypt during April-November 2000 and a survey for PHMB in Spain and Morocco in July 2001. We initiated this search for natural enemies of PHMB because of the threat that this pest poses to California agriculture and to the ornamental industry. In the Caribbean Islands where the pest was recently introduced, damage losses have been reported to exceed $3.5 million per year in Grenada and $125 million a year in Trinidad and Tobago (USDA-APHIS 1997).

A biological control program is essential also because historically, insecticides and oils have not been effective in controlling this pest (USDA-APHIS 1997). The parasitoids' widespread association with PHMB under a wide range of climates and habitats similar to those in California provides evidence of their potential to reduce PHMB numbers in California. Our survey was conducted initially in Egypt, because PHMB was also introduced there in the 1940's where it initially became the most injurious mealybug species, recorded attacking 60 host plants (Assam 1982). In recent years PHMB has not been a pest in Egypt, being under effective biological control mostly by parasitoids (Hamed *et al.* 1991; Kamal *et al.* 1999; Meyerdirk 2000; Hendawy unpublished data, personal communication, following up on the earlier studies of Moursi 1948 a, b, c, d).

The survey was extended to Spain and Morocco in 2001 to search for additional PHMB parasitoid species or biotypes (Gonzalez *et al.* 1979; Gonzalez 1988). A search in several geographic areas was based on our findings in previously searching for parasitoids of other introduced exotic pests. We found different parasitoid species attacking pests in different geographical areas and also found genetic, behavioral, and bio-systematic differences among populations of parasitoids described under one species name (Gonzalez *et al.* 1978; Gonzalez *et al.* 1980; Gonzalez *et al.* 1990; Unruh *et al.* 1989).

Survey for Parasitoids

Samples of 20-25 plants infested with PHMB were collected biweekly from representative governorates of the three agro-ecosystems in Egypt: Upper-, Middle and Lower Egypt (Delta area of the Nile Valley), during the period from April through November 2000. Samples were kept under laboratory conditions (25±2°C and 60±5% R.H.) until emergence of parasitoid adults. Parasitoid species were counted, classified, preserved in 70% alcohol and sent to S. Triapitsyn and V. Triapitzin for identification. Voucher specimens are deposited in the Entomology Research Museum, Department of Entomology, University of California, Riverside, USA and in the Plant Protection Research Institute, Department of Biological Control, Giza, Egypt.

The survey in Egypt included 11 governorates (latitudes 24.02 to 31.2 N and 29.53 to 32.53 E) having a climate very similar to that of southern California desert and inland areas. Because many of the economic host plants were treated with insecticides, most of the sampling was taken from ornamental hibiscus plants, which normally are not treated with insecticides. Ninety one percent of plants sampled were hibiscus, 2% were okra and 7% included; oleander, mulberry and guava. Among plants sampled, hibiscus consistently had more

Table (1): Total numbers of most abundant parasitoids recovered from the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) in Egypt, 2000)

Governorate	Total No. of samples	No. of parasitized	Primary			Hyper Parasitoids				Total
			A	B	Total	C	D	E	Total	
1- Upper Egypt										
Sohag	19	9	278	18	296			10	10	306
Assuit	24	7	32	19	51					51
Menia	2	2	93	72	165					165
Total	45	18	403	109	512			10	10	522
2- Middle Egypt										
Beni-Suef	25	19	336	160	496	15	113		128	624
Giza	54	40	406	84	490	16			16	506
Fayoum	39	27	455	208	663	35	7		42	705
Total	118	86	1197	452	1649	66	120		186	1835
3- Lower Egypt (Delta)										
Qaluobia	8	6	192	8	200	15		1	16	216
Menoufia	16	14	484	357	841	3	1	2	6	847
Gharbia	6	4	610	32	642	2		2	4	646
Dakahlia	2	1	5	78	83					83
Sharkia	1	1	62	41	103					103
Total	33	26	1353	516	1869	20	1	5	26	1895
Grand total	196	130	2953	1077	4030	86	121	15	222	4252

Primary Parasitoids:
A:*Allotropa nr. mecrida*
B:*Gyranusoidea indica*

Hyper Parasitoids:
C:*Chartecerus sp.*
D:*Marietta sp.*
E:*Pachyneuron sp.*

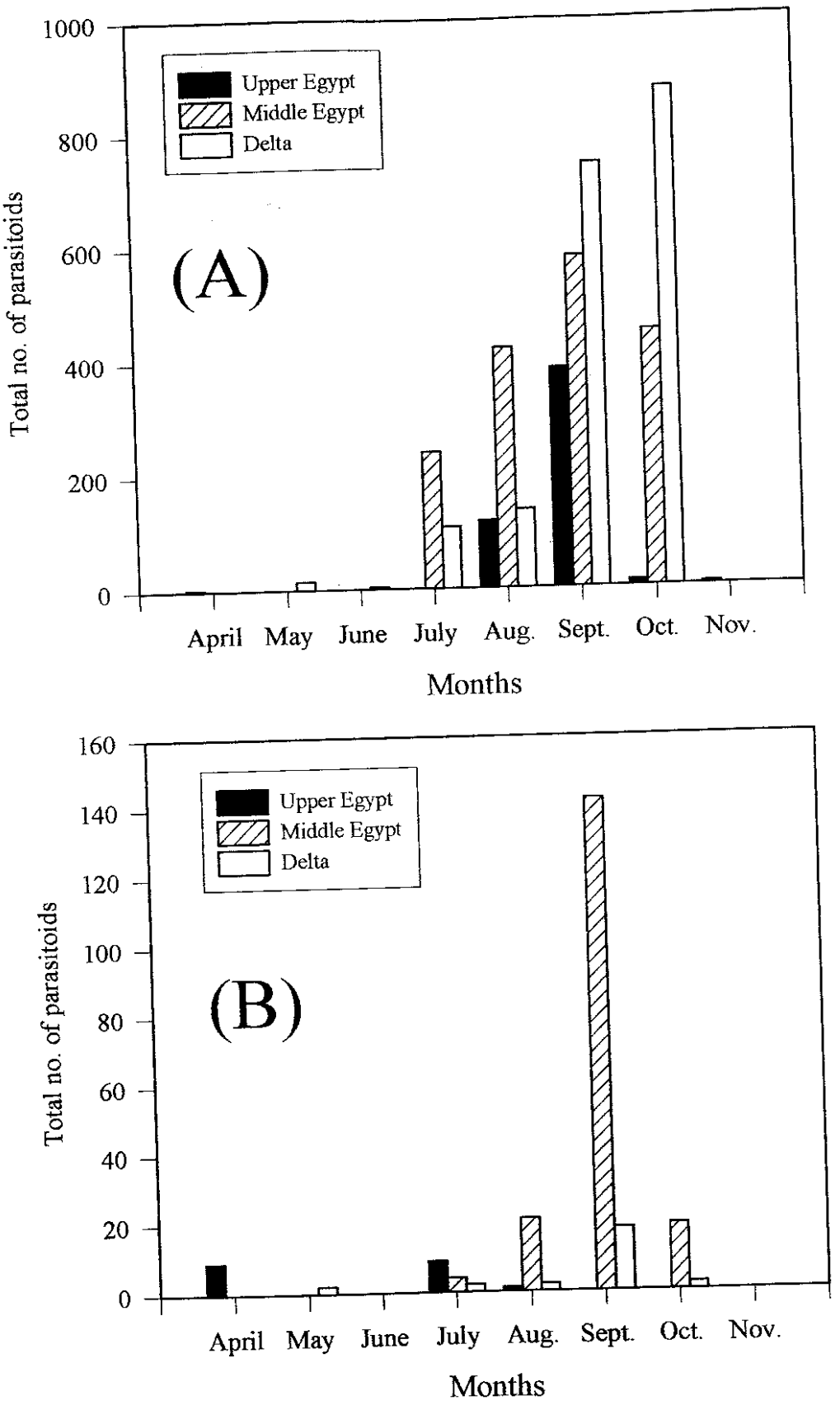

Fig. (1): Monthly abundance of primary (A) and secondary (B) parasitoid species recovered from pink hibiscus mealybug in different regions in Egypt, 2000

PHMB, and more plants infested. There were a total of 196 samples collected throughout the period from 6 host plants. Out of the total samples, 66.3% of the PHMB were parasitized.

In Egypt, we found 8 primary and 4 secondary parasitoid species. The primary parasitoid species are: *Allotropa* sp. near *mecrida* (Walker) (Platygastridae), *Gyranusoidea indica* Shafee, Alam and Agarwal, *Leptomastidea abnormis* (Girault), *Leptomastix algirica* Trjapitzin, *Leptomastix* sp., *Anagyrus kamali* Moursi, *Anagyrus* sp., and *Clausenia* sp. (all Encyrtidae). The secondary parasitoids are *Chartocerus* sp. (Signiphoridae), *Marietta* sp. (Aphelinidae), *Pachyneuron* sp. (Pteromalidae), and *Prochiloneurus bolivari* Mercet (Encyrtidae). Several encyrtid species noted above were present from the male sex only; therefore their positive identification to the species will be possible only after the females are obtained. Dr. Lubomir Masher, Canadian National Collection of Insects, Ottawa, and Ontario, Canada, confirmed identification of *Allotropa* sp. near *mecrida*. To verify a positive identification as *mecrida*, a comparison with these specimens of the type *mecrida* at the British Museum of London is required.

The survey for PHMB in 2001 in Spain and Morocco was in July-August, and concentrated largely in the hot and dry areas of southern Spain (18 locations in 10 provinces from Valencia to Algeciras), and in inland and southern areas in Morocco (9 locations from Marrakech to Tangier) on ornamental hibiscus host plants. The survey was focused on hibiscus because it was by far the favorite host plant for PHMB found in Egypt in 2000. Although hibiscus is found throughout southern Spain and in inland and southern Morocco, we did not find PHMB or any other mealybugs on many plants from several places in each location. There were also, no symptoms of damage. These findings are difficult to believe because of the relatively close proximity of these 2 countries to Egypt where we found PHMB almost everywhere hibiscus were present. Nevertheless, the consistency in our findings from many samples in many areas may provide convincing evidence of the absence of PHMB on hibiscus from these 2 countries.

Promising New Parasitoid

Distribution and abundance of the most common parasitoid species of PHMB in the governorates sampled in Egypt are numerically summarized in table 1. Relative numbers of parasitoids recovered in the 3 main growing areas are shown graphically in Fig. (1). Primary parasitoids made up 94.9% of total parasitoids emerging, and 5.1% were secondary. PHMB and its parasitoids were found from April to November on hibiscus in different areas. Highest populations of the pest and parasitoids occurred during September. Among primary parasitoids, *Allotropa* sp. near *mecrida* was by far the most abundant (highest numbers) in all 3 major survey areas, comprising 69.5% of total parasitoids recovered. *Gyranusoidea indica* was the only other parasitoid recovered in significant numbers, comprising 25% of the total parasitoids recovered.

We believe that this species of *Allotropa* collected in Egypt has significant potential for reducing PHMB in California for several reasons. First, this is a gregarious parasitoid; thus many parasitoids are produced from each host whereas solitary parasitoids only produce one parasitoid from each host. A second important characteristic is that we found it under a wide range of temperature and relative humidity conditions from all areas where PHMB was present (Table 1). This included areas where habitats differed appreciably, especially in crops grown and in farming practices.

From our results it is evident that this *Allotropa* sp. near *mecrida* is closely associated with PHMB under a wide range of environmental conditions that are similar to those in inland valleys and deserts of southern and central California.

Information in this paper has additional importance with approval from USDA and the California Department of Food and Agriculture for mass rearing and releasing *Allotropa* sp. nr. *mecrida* in California. Releases against PHMB are anticipated to begin in April 2003.

Collaborative Efforts

The potential for a successful biological control program against PHMB using this species of *Allotropa* is enhanced by the collaborative efforts of agencies, institutions and personnel involved. Personnel from the Plant Protection Institute in Egypt in collaboration with personnel from the University of California are conducting the survey for parasitoids in Egypt and other countries. Personnel from USDA-APHIS are receiving parasitoids from Egypt under quarantine conditions, to assure pure parasitoid cultures providing a basis for release from quarantine. Parasitoids released from quarantine are sent to personnel from the California Department of Food and Agriculture - Biological Control Program where they will be mass reared, released and evaluated in California.

REFERENCES

Assem, S.M. 1982. Studies on certain coccid pests of ornamental plants in Egypt. M. Sc. Thesis, Faculty of Agric., Ain Shams University, Egypt, 160 pp.

Awadallah, K.T.; A. Ibrahim; M.A., Atia; R. Angel and S.M. Nada. 1999. Survey of mealybug parasitoids and their associated hyperparasitoids on certain ornamental host plants at Giza region. Bull. Ent. Soc. Egypt, 77: 97-101.

Gonzalez, D.; W. White; J. Hall, and R.C. Dickson. 1978. Geographical distribution of Aphidiidae (Hymenoptera) imported to California for biological control of *Acyrthosphon kondoi* and *Acyrthosiphon pisum* [Homoptera: Aphididae]. Entomophaga 23 (3): 239-248.

Gonzalez, D.; G. Gordh; S.N. Thompson and J. Adler. 1979. Biotype discrimination and its importance to biological control. Pp.129-137 In: Genetics in Relation to Insect Management. Hoy and J. McKelvey, Jr., (eds). Working Papers. The Rockefeller Foundation. New York. 179 pp.

Gonzalez, D.; L. Etzel; M. Esmaili; A.H. El Heneidy and I. Kaddou. 1980. Distribution of *Bathyplectes curculionis* and *Bathyplectes anurus* (Hymenoptera: Ichneumonidae) from *Hypera brunneipennis* Boh. (Col.:

Curculionidae) on alfalfa in Egypt, Iraq, and Iran. Entomophaga 25 (2): 111-121.

Gonzalez, D. 1988. Biotypes in biological control-examples with populations of *Aphidius ervi, Trichogramma pretiosum* and *Anagyrus epos*. Pp. 475-482 In: Adv. Par. Hymenop. (V. Gupta, ed.). E. J. Brill, Leiden. 546 pp.

Gonzalez, D., F. Gilstrap; G. Zhang; J. Zhang; N. Zareh; R. Wang; E. Dykstra; L. McKinnon; P. Stary and J. Woolley. 1990. Foreign exploration for natural enemies of Russian wheat aphid in China, Iran, Turkey, and the Netherlands. Proc. Russian Wheat Aphid Conf., Bozeman, Montana. Pp. 154-165.

Hamed, A. R. and Fawzia A. Hassnein 1991. Survey of parasitoids of important scale insects, mealybugs and whiteflies in Egypt. Egypt. J. Biol. Pest Cont. 1 (2): 147-152.

Meyerdirk, D.E. 2000. Biological Control of the Pink Hibiscus Mealybug, *Maconellicoccus hirsutus* (Green) in the Caribbean. XXI International Congress of Entomology, Iguasso Falls, Brazil, Aug. 20-26, 2000.

Moursi, A.A. 1948a. Description of two new species of *Anagyrus* (Hymenoptera: Encyrtidae). Bull. Soc. Fouad 1er Entomol., 32: 1-7.

Moursi, A.A. 1948b. *Anagyrus kamali* Moursi, a parasite of the hibiscus mealybug, *Phenococcus hirsutus* Green. Bull. Soc. Fouad 1er Entomol., 32: 9-16.

Moursi, A.A. 1948c. *Anagyrus aegyptiacus* Moursi, a parasite of the Lebbek mealybug, *Pseudococcus filamentosus* Ckll. Bull. Soc. Fouad 1er Entomol., 32: 33-40.

Moursi, A.A. 1948d. *Leptomastix phenacoccus* Compere, a parasite of the Lebbek mealybug, *Pseudococcus filamentosus* Ckll. Bull. Soc. Fouad 1er Entomol., 32: 41-48.

Unruh, T.; W. White; D. Gonzalez and J. Woolley. 1989. Genetic relationship among 17 *Aphidius* populations includes six species. Ann. Entomol. Soc. Amer. 82: 754-768.

USDA-APHIS. 1997. Look Out for the Pink *Hibiscus* Mealybug. USDA-APHIS Prog.