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Survey on host plants and host plant preference by lemon butterfly *Papilio demoleus* Linnaeus (Lepidoptera: Papilionidae)

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Abstract
Studies on host preference indicated significant differences in egg laying among different hosts by lemon butterfly *Papilio demoleus* (Linnaeus) was observed. Maximum number of eggs was laid on Lemon: *Citrus limon* (L.) Osbeck (11.03 eggs), followed by Mandarin: *Citrus grandis* (L.) Osbeck (10.18), Lime: *Citrus aurantifolia* (Christm.) Swingle (9.34), Curry leaf: *Murraya koenigii* (L.) Sprengel (8.49), Beal: *Aegle marmelos* (L.) Corrêa (7.64), while minimum number of eggs was recorded on Ber: *Zizyphus mauritiana* Lam. (6.49). This showed that there were significant differences among the citrus species for egg laying. Lemon: *Citrus limon* (11.03) was the most preferred host plant for egg laying by adult of lemon butterfly. The results of survey on host plants revealed that all the plants such as lemon, lime, mandarin, beal, *curry leaf*, *ber* and *babchi* supported the larvae of lemon butterfly from 46th to 7th Standard Meteorological Week while maximum larvae were recorded at 49th and 50th SMW. Hence, these plants can be considered as the host plants of lemon butterfly.

Keywords: survey, host plants, host plant preference, lemon butterfly, *Papilio demoleus*, Lepidoptera, Papilionidae

Introduction
Citrus is native to a large area, which extends from Himalayan foot hills of northeast India to north central China, the Philippines in east and Burma, Thailand, Indonesia and New Caledonia in Southeast. In India, in terms of area under cultivation, citrus is the third rank after Banana and Mango. Over the last 30 years, the area and production under citrus cultivation has increased at the rate of 11 and 9%, respectively, which shows that the expansion of citrus industry was quite sustainable. The average yield of citrus fruits in India is alarmingly low (10.1 t/ha) compared to other developed countries like Brazil, USA, China, Mexico and Spain (30-40 t/ha). Among mandarins, Nagpur mandarin (Central India), Kinnow mandarin (North–West India), Coorg mandarin (South India) and Khasi mandarin (North-East India) are the commercial cultivars of India. Whereas, Mosambi (Maharashtra), Sathgudi (Andhra Pradesh) and Malta and Jaffa (Punjab) are the sweet orange cultivars traditionally grown.
A number of insect pests attack citrus plants both in the nurseries as well as in the orchards inflicting heavy economic losses. Some of the most serious pests of citrus includes *Papalio demoleus* Linnaeus and *Papalio polytes* Linnaeus (citrus caterpillar), *Diaphorina citri* Kuwayama (citrus psylla), *Phyllocnistis citrella* Stainton (citrus leaf miner), *Aonidiella aurantii* Maskell and (citrus red scale) and *Dialeurodes citri* Ashmnead (citrus whitefly) (Saljoqi *et al*., 2006) [12].
The citrus swallowtail butterfly also known as orange dog, chequered swallowtail, lemon butterfly (*P. demoleus*) belongs to the family Papilionidae. The citrus butterfly is one of the economically important pests whose larval forms cause serious damage by devouring large quantity of foliage of rutaceae, rhamnaceae, anacordiaceae, apiaceae, sapidaceae and fabaceae family with special preference towards both wild and cultivated species of citrus during the later stages of their development. The genus *Papilio* is widely distributed all over the world. Different species of citrus butterfly occurs in different parts of the world. However, *P. demoleus* is the most prevalent species and was found in greater parts of Asia, Formosa and Japan etc.
Host-plant selection by the herbivore insect involves not only choosing the right species of plant, but also selecting an individual plant within that species that is, or will be,

suitable for feeding, survival and development of immature stages. The importance of selection within the species is clearly indicated by a field study on butterfly oviposition (Bernays and Chapman, 1994). The factors determining differences in the establishment of different species of *Papilio* on different plants, according to Saxena and Goyal (1978) can be arranged under the following six categories; (1) Orientation, determining arrival of the insect on a plant (2) Oviposition (3) Feeding (4) Utilization of ingested food (5) Growth and (6) Egg-production. Dethier (1982) stated that most herbivorous insect species accept only a limited number of plant species as hosts. Their behavioral decisions to accept or reject a particular plant species as oviposition substrate or food source are based largely on the perception of the chemical profile of the plant under evaluation.

Peak activity period of *P. demoleus* is synchronized with the emergence of new foliage (Narayanamma and Savithri, 2002). According to Yunus and Munir (1972), the caterpillar preferred young nursery plants 1-2 feet high and were capable of completely defoliating nursery groves. Larvae of *P. demoleus* feed on citrus plants pieces of which lime and pomelo are the preferred host of *P. demoleus.* It causes heavy loss in citrus orchard and significant reduction in yield (Pratap and Singh, 2000).

Considering importance of this pest, to generate information regarding host plant preference and host plant survey. The present investigation was undertaken.

Material and Methods

The investigation on host preference of lemon butterfly (*Papilio demoleus* Linnaeus*)* under south Gujarat condition was conducted at the P.G. Laboratory, Department of Entomology, ASPEE College of Horticulture and Forestry, NAU, Navsari during 2015 and 2016. Navsari is situated at 72° 54' East longitude and 20° 57' North latitude and it is situated at an average elevation of 9 m above sea level. Growing season was normal and favourable for growth. The materials used and techniques employed for conducting various experiments are presented here under.

Completely randomized design was laid out with six treatments and four repetitions.

T_1–Lime (*Citrus aurantifolia*), T_2-Lemon (*Citrus limon*), T_3-Mandarin (*Citrus grandis*), T_4-Beal (*Aegle marmelos*) T_5-Curry leaf (*Murraya koenigii*) T_6-Ber (*Zizyphus mauritiana*).

Preference of *P. demoleus* to six various hosts were carried out in mosquito net, wherein ten pairs of newly emerged adults of lemon butterfly were released in mosquito net structure (10×10×10ft) having five potted plants of each host arranged randomly and number of eggs laid on each plant were recorded separately. Host plants survey was carried out at weekly interval at Navsari Agricultural University Farm. Twenty-five twigs of five trees/plants were observed critically and number of larvae were recorded.

Results and Discussion

The results indicated significant differences in egg laying among different hosts by lemon butterfly. Maximum number of eggs were laid on Lemon: *Citrus limon* (11.03 eggs), followed by Mandarin: *Citrus grandis* (10.18), Lime: *Citrus aurantifolia* (9.34), Curry leaf: *Murraya koenigii* (8.49), Beal: *Aegle marmelos* (7.64), while minimum number of eggs were recorded on Ber: *Zizyphus mauritiana* (6.49). This showed that there were significant differences among the citrus species for egg laying. Lemon: *Citrus limon* (11.03) was the most preferred host plant for egg laying by adult of lemon butterfly (Table -1 and Fig. -1).

Survey on host plants of lemon butterfly revealed that larvae of lemon butterfly were observed from 46th to 7th standard meteorological weeks at Navsari Agricultural University farm on all the plants such as lemon, lime, mandarin, beal, curry leaf, *ber* and *babchi* supported the larvae of lemon butterfly, while maximum larvae were recorded at 49th and 50th Standard Meteorological Week (SMW).

The number of larvae on the host plant lemon ranged from 1.2 to 3.2 /twenty-five twigs of five trees. Maximum number of larvae was recorded at 50th SMW while minimum larvae were observed at 7th SMW. Maximum number of larvae on the host plant, lime was recorded at 49th SMW (2.8 larvae/ twenty-five twigs of five trees) while minimum number of larvae (1.1 larvae) were recorded at 7th SMW.

The number of larvae on the host plant mandarin ranged from 1.6 to 3.1 /twenty-five twigs of five trees. Maximum number of larvae (3.1 larvae) was recorded at 49th SMW while minimum larvae (1.6 larvae) were recorded at 7th SMW. The host plant beal recorded 1.2 to 1.8 larvae/twenty-five twigs of five trees. Maximum number of larvae was recorded at 50th SMW while minimum larvae were observed at 7th SMW.

The number of larvae on the host plant curry leaf ranged from 1.1 to 2.5 /twenty-five twigs of five trees. Maximum number of larvae was recorded at 50th SMW while minimum larvae were observed at 7th SMW. Similar trends were also observed on the host plants *viz., ber* and *babchi* also. The host plants lemon, lime and mandarin recorded maximum number of larvae at 49th to 50th SMW and there after declining trend in the larval population were observed. All the plants supported the larvae and can be considered as the host plants of lemon butterfly (Table 2. Fig. 1).

Table 1: Host preference of *P. demoleus*

Sr. No.	Treatments	Egg laying
1	*Citrus aurantifolia* (Lime)	9.34
2	*Citrus limon* (Lemon)	11.03
3	*Citrus grandis* (Mandarin)	10.18
4	*Aegle marmelos* (Beal)	7.64
5	*Murraya koenigii* (Curry leaf)	8.49
6	*Zizyphus mauritiana* (Ber)	6.79
S.Em ±		0.25
C.D. at 5%		0.74
C.V. %		5.56

Table 2: Host plant survey of *P. demoleus* at NAU farm

SMW	Lemon	Lime	Mandarin	Beal	Carry leaf	*Ber*	*Babchi*
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	1.8	2.4	2.2	1.2	1.8	1.1	1.2
47	2	2.7	2.8	1.3	1.9	1.3	1.5
48	2.2	2.3	3	1.6	2	1.3	1.9
49	2.5	2.8	3.1	1.7	2.2	1.4	1.6
50	3.2	2.6	2.9	1.8	2.5	1.5	2
51	2.8	2.7	2.7	1.6	2.1	1.3	1.8

52	2.3	2.2	2.4	1.5	1.9	1.2	1.7
1	2.2	2.3	2.6	1.6	1.7	1.2	1.6
2	1.8	2	2.2	1.7	1.8	1.4	1.3
3	2.6	1.9	2.8	1.5	1.6	1.1	1.5
4	2.1	1.5	2.4	1.3	1.5	1.3	1.8
5	1.6	1.4	1.9	1.4	1.7	1.3	1.4
6	1.4	1.2	1.9	1.2	1.4	1.1	1.4
7	1.2	1.1	1.6	1.2	1.1	1.1	1.1
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0

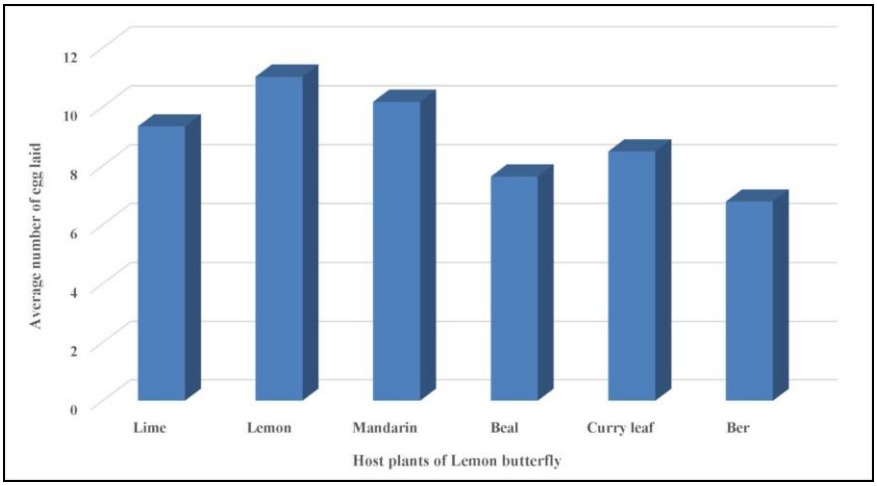

Fig 1.

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