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E: ISSN NO.: 2455-0817 *Remarking An Analisation*

Population Dynamics of Citrus Butterfly *(Papillio Demoleus* L.) Lepidoptera : Papillionidae

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Abstract

Citrus crops namely sweet orange, acid lime, sweet lime, Karna khatta, kinnow etc. are cultivated in commercial scale and give a good dividend to the growers. *Papillio demoleus* or swallowtail butterfly ranges widely and is an extremely successful invader. *Papillio demoleus* has been found ovipositing on under surface of the leaves and tender parts of the plant. The larva are a serious pest of citrus nursery stock where they defoliate entire nursery. Experiments were carried out in Horticulture garden of C.S.A. University of Agriculture & Technology and population dynamics were recorded at weekly interval. Among 40 periods of population of *P. demoleus* was found highest 4.197 and 4.579 per unit in IVth week of August during 2015-2016 respectively. It was followed by 4.058 in first week of September, (4.058) in 3rd week of August. They were statistically significant with the August 2nd week (3.831), August first week (3.689), September 2nd week (3.607) and September 3rd week (3.369) of 2015. In period x crop means maximum number of larva were found (5.248 per unit) in Kagzi lime during 4th week of August 2015 but it was highest 6.499 per unit in 2nd week of September during 2016. In crop mean Kinnow crop was highly infested by butterfly larvae and it was observed 3.121 and 3.282 per unit during 2015 and 2016; respectively.

Keywords: Citrus Crops, Population Dynamics, Incidence, Intensity.

Introduction

Citrus fruits are most important fruit tree crop in the world, with an annual production of over 120 million tons of which oranges constitute about 60% of the total production, followed by tangerines with about 20%. A large number of insect pests have been recorded in citrus orchards and about more than fifty species were found to cause major damage to them. *Papillio demoleus* L. The lime swallow tail is one of the most wide spread members of the family pipilionidae. It is most abundant during the rains when its larvae (Catterpiller) may cause damage to citrus trees. The larval population density of *P. demoleus* was high during October to December (Sarda et al. 2013).

Aim of the Study

Citrus are an important fruit crops and rich source of vitamin C. The aim of this investigation was to study the population dynamics, distribution at weekly and monthly intervals with host plant preferences of insects. So we can make a systematic plan for the management.

Review of Literature

Shahu *et.al.* (2015) conducted research trial on curry leaf insect and found the infestation of *papillio.* Patel *et.al.* (2017) studied the biology of citrus butterfly under laboratory condition lamon. They reported morphometric variation of different life stages. The citrus plant was the most preferred host/food plant of lemon butter fly. Larval development could be completed in minimum period of 16.56.days. Gavr *et.al* (2018) reported seasonal abundance of lemon butter fly *papillio demoleus* on bael crop.

Material and Methods

Population dynamics of *P. demoleus* were recorded on 6 crops at weekly interval in four directions, which were tagged selecting 5 branches in each crop and data were recorded on incidence and intensity as per Atwal (1964) and Atwal and Singh (1999). Number of insects present per 10 leaves/twig, 10 leaves were taken as an unit (10 leaves = 1 unit).

The larval population of citrus butterfly were collected on citrus trees from Kanpur and brought to laboratory of Zoology Department at D.G. College, Kanpur. Larval population were recorded on Kagzi lime (*Citrus aurantifolia* Swingle), Sweet orange (*citrus sinesis* Osback), Sweet lime *(Citrus limettioides* L.), Kinnow orange *(C. Sinensix C. reticulata)*, Karva Khatta *(Citrus Karma* L.*)* in C.S.A. University of Agri. & Tech., Kanpur, D.G. College, Kanpur and farmers field of Kanpur.

Results and Discussion

Catterpillars of lemon butterfly are Pale green with black brown and grey markings usually defoliate the citrus plants. The total life cycle of citrus butterfly ranged from 28.65 - 30.50 days with average period of 29.57 on citrus crop. The female adults survive longer than the male ones. Longevity of female varied from 6.5 - 6.90 days. Present finding revealed close conformity with the findings of Smith and Wright (2008) and Jahnavi *et al.* 2018. It was found that the First instar larvae were black and with two sub dorsal rows with fleshy short spines. However, IInd, IIIrd and IVth instar larvae have dark brown head. Larvae giving bird droplet camouflage. IIIrd, IV and Vth instar was green with black patches. Pupa were green and attach to the stem of the host plant. Population procedure occurrence mostly at night after 10 pm - 3 AM. Smith *et al.* (2008) studied the clarification, nomenclature and identification of 5 species of *P. demoleus* i.e. *P. morondavana*, *P. demoleus, P. crithoniodes, P. grosermithi* and *P. demodeus* based on features of the wings, male and female genifilia.

Data recorded on the population of citrus butterfly larvae in period, period x crops, months, crops and month x crops were summarized in Table 1, and 2, and depicted in Fig. 1 during 2015 and 2016, respectively. Among the 40 periods of population of *P. demoleus* was found highest 4.197 and 4.579 per unit in IVth week of August during 2015 and 2016, respectively. It was followed by 4.058 in 1st week of September (4.058) in 3rd week of August. They were statistically significant with the August, 2nd week (3.831), August 1st week (3.689), September 2nd week (3.607) and September 3rd week (3.369) of 2015 and 4.191 in 2nd week September, 4.071 in 3rd week of September and 4.025 in 1st week of September during 2016.

Table 1: Population dynamics of citrus butterfly larva *Papillio demoleus* L. with period and Period x Crop means (2015)

Period	Weeks	Kagzi lime	Sweet orange	Kinnow	Sweet lime	Karna khatta	Sylhat lime	Period means
Feb.	I	0.911 (0.329)	0.955 (0.413)	0.995 (0.489)	1.189 (0.914)	1.039 (0.580)	1.189 (0.914)	1.046 (0.595)
	II	1.412 (1.495)	1.078 (0.664)	0.55 (0.413)	1.222 (0.993)	0.911 (0.329)	1.222 (0.993)	1.133 (0.785)
	III	1.412 (1.495)	1.258 (1.081)	1.435 (1.560)	1.189 (0.914)	0.911 (0.329)	1.147 (0.815)	1.225 (1.002)
	IV	1.439 (1.572)	1.353 (1.332)	1.554 (1.915)	1.290 (1.165)	1.034 (0.569)	0.995 (0.489)	1.278 (1.133)
March	I	1.321 (1.244)	1.222 (0.933)	1.498 (1.745)	1.554 (1.915)	1.114 (0.742)	0.995 (0.489)	1.284 (1.149)
	II	1.344 (1.307)	1.376 (1.394)	1.527 (1.832)	1.683 (2.332)	1.258 (1.081)	1.079 (0.664)	1.378 (1.398)
	III	1.435 (1560)	1.471 (1.665)	1.681 (2.325)	1.604 (2.074)	1.443 (1.582)	1.321 (1.244)	1.493 (1.728)
	IV	1.527 (1.832)	1.631 (2.162)	1.657 (2.246)	1.728 (2.489)	1.607 (2.082)	1.321 (1.244)	1.579 (1.993)
April	I	1.499 (1.745)	1.222 (0.993)	1.728 (2.486)	1.657 (2.246)	1.471 (1.665)	1.498 (1.745)	1.513 (1.788)
	II	1.554 (1.915)	1.290 (1.165)	2.039 (3.656)	1.755 (2.579)	1.554 (1.915)	1.607 (2.082)	1.633 (2.167)
	III	1.442 (1.582)	1.443 (1.582)	2.254 (4.579)	1.847 (2.909)	1.657 (2.246)	1.683 (2.332)	1.721 (2.462)
	IV	1.707 (2.416)	1.657 (2.246)	2.345 (4.998)	1.705 (2.408)	1.779 (2.665)	1.682 (2.328)	1.813 (2.785)
May	I	2.215 (4.408)	1.499 (1.745)	1.978 (3.410)	1.376 (1.394)	1.413 (1.495)	1.551 (1.906)	1.672 (2.295)
	II	1.775 (2.653)	1.412 (1.495)	2.019 (3.578)	1.443 (1.582)	1.443 (1.582)	1.553 (1.911)	1.608 (2.084)
	III	1.631 (2.162)	1.412 (1.495)	2.217 (4.414)	1.554 (1.915)	1.257 (1.081)	1.581 (2.000)	1.609 (2.088)
	IV	1.979 (3.416)	1.462 (1.638)	2.179 (4.248)	1.658 (2.250)	0.995 (0.489)	1.657 (2.246)	1.655 (2.239)
1	2	3	4	5	6	7	8	9
June	I	1.602 (2.065)	1.379 (1.404)	1.979 (3.416)	1.320 (1.244)	1.705 (2.408)	1.551 (1.906)	1.589 (2.027)

	II	1.802 (2.747)	1.468 (1.655)	2.079 (3.823)	1.527 (1.832)	1.554 (1.915)	1.703 (2.402)	1.689 (2.353)
	III	1.870 (2.997)	1.258 (1.081)	2.159 (4.161)	1.607 (2.082)	1.579 (1.196)	1.796 (2.726)	1.712 (2.429)
	IV	1.681 (2.325)	1.153 (0.831)	2.095 (3.887)	1.471 (1.665)	1.389 (1.404)	1.915 (3.166)	1.616 (2.111)
July	I	1.754 (2.576)	0.911 (0.329)	2.179 (4.329)	1.657 (2.246)	1.756 (2.582)	1.956 (3.3327)	1.785 (2.687)
	II	1.824 (2.826)	1.321 (1.244)	2.197 (4.329)	1.657 (2.246)	1.756 (2.582)	1.956 (3.327)	1.785 (2.687)
	III	1.871 (3.000)	1.631 (2.162)	1.893 (3.083)	1.757 (2.568)	1.893 (3.083)	1.779 (2.66)	1.803 (2.751)
	IV	2.000 (3.55)	1.731) (2.497)	1.825 (2.833)	1.893 (3.082)	1.936 (3.247)	1.893 (3.083)	1.879 (3.033)
August	I	2.216 (4.412)	1.607 (2.082)	2.141 (4.083)	2.141 (4.083)	1.997 (3.489)	2.179 (4.248)	2.047 (3.689)
	II	2.291 (4.748)	1.605 (2.078)	2.217 (4.416)	2.198 (4.33)	1.978 (3.411)	2.197 (4.248)	2.135 (4.058)
	III	2.345 (4.998)	1.756 (2.582)	2.291 (4.748)	2.327 (4.916)	1.913 (3.159)	2.179 (4.248)	2.135 (4.058)
	IV	2.398 (5.248)	1.848 (2.916)	2.363 (5.0983)	2.345 (4.998)	1.796 (2.726)	2.254 (4.578)	2.167 (4.197)
September	I	2.288 (4.736)	1.838 (2.878)	2.252 (4.571)	2.397 (5.245)	1.956 (3.327)	2.079 (3.823)	2.135 (4.058)
	II	2.177 (4.241)	1.681 (2.325)	2.169 (4.205)	2.271 (4.205)	1.779 (2.66)	2.082 (3.833)	2.026 (3.607)
	III	1.956 (3.327)	1.471 (1.665)	1.936 (3.247)	2.363 (5083)	1.956 (3.327)	2.121 (3.998)	1.967 (3.369)
	IV	1.976 (3.405)	1.067 (2.082)	2.179 (4.248)	2.345 (4.998)	1.252 (1.068)	2.018 (3.572)	1.896 (3.096)

1	2	3	4	5	6	7	8	9
October	I	1.633 (2.165)	1.079 (0.664)	1.936 (3.247)	2.179 (4.248)	1.406 (1.479)	1.728 (4.486)	1.660 (2.258)
	II	1.649 (2.221)	0.955 (0.413)	1.913 (3.159)	2.291 (4.748)	1.443 (1.582)	1.498 (1.745)	1.625 (2.193)
	III	1.581 (2.000)	0.911 (0.329)	1.893 (3.083)	1.978 (3.410)	1.408 (1.483)	1.579 (1.996)	1.558 (2.058)
	IV	1.731 (2.496)	1.117 (0.742)	1.657 (0.246)	1.826 (2.832)	1.607 (2.082)	1.657 (2.246)	1.599 (2.057)
November	I	1.631 (2.161)	0.995 (0.489)	1.681 (2.325)	1.442 (1.582)	1.413 (1.495)	1.551 (1.906)	1.452 (1.609)
	II	1.527 (1.831)	1.039 (0.580)	1.754 (2.576)	1.321 (1.244)	1.384 (1.415)	1.504 (1.719)	1.421 (1.520)
	III	1.731 (2.497)	0.950 (0.403)	1.829 (2.826)	1.222 (0.993)	1.258 (1.081)	1.257 (1.081)	1.374 (1.387)
	IV	1.893 (3.083)	0.866 (0.250)	1.443 (1.582)	0.995 (0.489)	1.154 (0.831)	1.186 (0.907)	1.256 (1.077)

The minimum population was recorded 1.046 per unit in the 1st week of February, 2015 similar results were found by Sarda *et al.* (2014)

Note: Figures in parenthesis are transferred back value.

Table 2: Population dynamics of citrus butterfly larva *Papillio demoleus* L. with period and Period x Crop means (2016)

Period	Weeks	Kagzi lime	Sweet orange	Kinnow	Sweet lime	Karna khatta	Sylhat lime	Period means
Feb.	I	1.499 (1.745)	0.955 (0.413)	1.579 (1.996)	1.039 (0.580)	1.499 (1.475)	1.114 (0.742)	1.218 (1.141)
	II	1.288 (1.159)	0.955 (0.413)	1.471 (1.665)	1.258 (1.081)	1.413 (1.495)	1.030 (0.562)	1.236 (1.027)
	III	1.509 (1.777)	1.079 (0.664)	1.577 (1.987)	1.413 (1.495)	1.443 (1.582)	1.183 (0.898)	1.367 (1.369)
	IV	1.596 (2.046)	1.075 (0.655)	1.732 (2.500)	1.498 (1.745)	1.657 (2.246)	1.317 (1.233)	1.479 (1.688)
March	I	1.847 (2.909)	1.257 (1.081)	1.407 (1.479)	1.489 (1.714)	1.308 (1.211)	0.955 (0.413)	1.377 (1.396)
	II	1.893 (3.082)	1.246 (1.052)	1.756 (2.582)	1.731 (2.487)	1.705 (2.408)	1.154 (0.831)	1.581 (1.999)
	III	1.957 (3.332)	1.384 (1.415)	1.936 (3.247)	1.999 (3.497)	1.707 (2.412)	1.407 (1.479)	1.732 (2.499)
	IV	2.061 (3.748)	1.631 (2.162)	1.999 (3.497)	1.630 (2.157)	1.682 (2.328)	1.413 (1.495)	1.736 (2.154)
April	I	1.935 (3.247)	1.657 (2.246)	1.865 (2.980)	1.579 (1.996)	1.802 (2.747)	1.602 (2.066)	1.740 (2.529)
	II	1.936 (3.247)	1.657 (2.246)	1.958 (3.333)	1.754 (2.576)	1.499 (1.745)	1.731 (2.497)	1.756 (2.582)
	III	1.999 (3.497)	1.779 (2.666)	1.891 (3.077)	1.913 (3.161)	1.604 (2.074)	1.705 (2.408)	1.815 (2.796)
	IV	1.802 (2.747)	1.604 (2.074)	2.289 (2.746)	1.931 (3.229)	1.524 (1.823)	1.755 (2.579)	1.817 (2.803)
May	I	1.936 (3.247)	1.351 (1.325)	2.019 (3.577)	1.682 (2.328)	1.473 (1.669)	1.656 (2.239)	1.686 (2.342)
	II	2.121 (3.998)	1.384 (1.415)	2.160 (4.166)	1.617 (2.116)	1.412 (1.494)	1.657 (2.246)	1.725 (2.477)
	III	2.121 (3.998)	1.441 (1.576)	2.217 (4.416)	1.592 (2.033)	1.498 (1.745)	1.681 (2.325)	1.758 (2.592)
	IV	2.121 (3.998)	1.607 (2.082)	2.121 (3.998)	1.524 (1.823)	1.604 (2.074)	1.499 (1.745)	1.746 (2.548)
1	2	3	4	5	6	7	8	9
June	I	1.412 (1.495)	1.079 (0.664)	2.019 (3.578)	1.604 (2.074)	1.206).955)	1.321 (1.244)	1.440 (1.578)
	II	1.376 (1.394)	1.257 (1.081)	2.021 (3.583)	1.499 (1.745)	1.754 (2.576)	1.413 (1.495)	1.553 (1.912)
	III	1.633 (2.165)	1.353 (1.332)	2.159 (4.161)	1.341 (1.297)	1.728 (2.486)	1.579 (1.996)	1.632 (2.164)
	IV	1.435 (1.560)	1.499 (1.745)	2.141 (4.083)	1.512 (1.788)	1.628 (2.150)	1.657 (2.246)	1.645 (2.207)
July	I	1.650 (2.221)	1.288 (1.159)	1.891 (3.083)	1.607 (2.082)	1.842 (2.893)	1.551 (1.906)	1.638 (2.184)
	II	1.731 (2.497)	1.412 (1.495)	1.934 (3.239)	1.710 (2.424)	1.776 (2.653)	1.683 (2.332)	1.708 (2.146)
	III	1.956 (3.327)	1.499 (1.745)	2.141 (4.083)	1.628 (2.150)	1.802 (2.747)	1.893 (3.083)	1.820 (2.811)
	IV	1.870 (2.997)	1.607 (2.082)	2.215 (4.408)	2.095 (3.891)	1.956 (3.327)	1.846 (2.909)	1.932 (2.232)
August	I	1.848 (2.916)	1.580 (1.996)	2.234 (4.492)	2.121 (3.998)	1.774 (2.648)	1.936 (3.247)	1.916 (3.169)
	II	1.792 (2.710)	1.499 (1.745)	2.308 (4.825)	2.139 (4.078)	2.019 (3.578)	1.845 (2.904)	1.934 (3.239)
	III	2.179 (4.248)	1.412 (1.495)	2.376 (5.147)	2.449 (5.498)	2.080 (3.828)	1.978 (3.140)	2.079 (8.823)
	IV	2.040 (3.661)	1.682 (2.328)	2.598 (6.249)	2.414 (5.325)	2.466 (5.579)	2.323 (4.896)	2.254 (4.579)
September	I	2.449 (5.498)	1.847 (2.909)	2.565 (6.080)	2.362 (5.079)	1.604 (2.074)	1.936 (3.247)	2.127 (4.025)

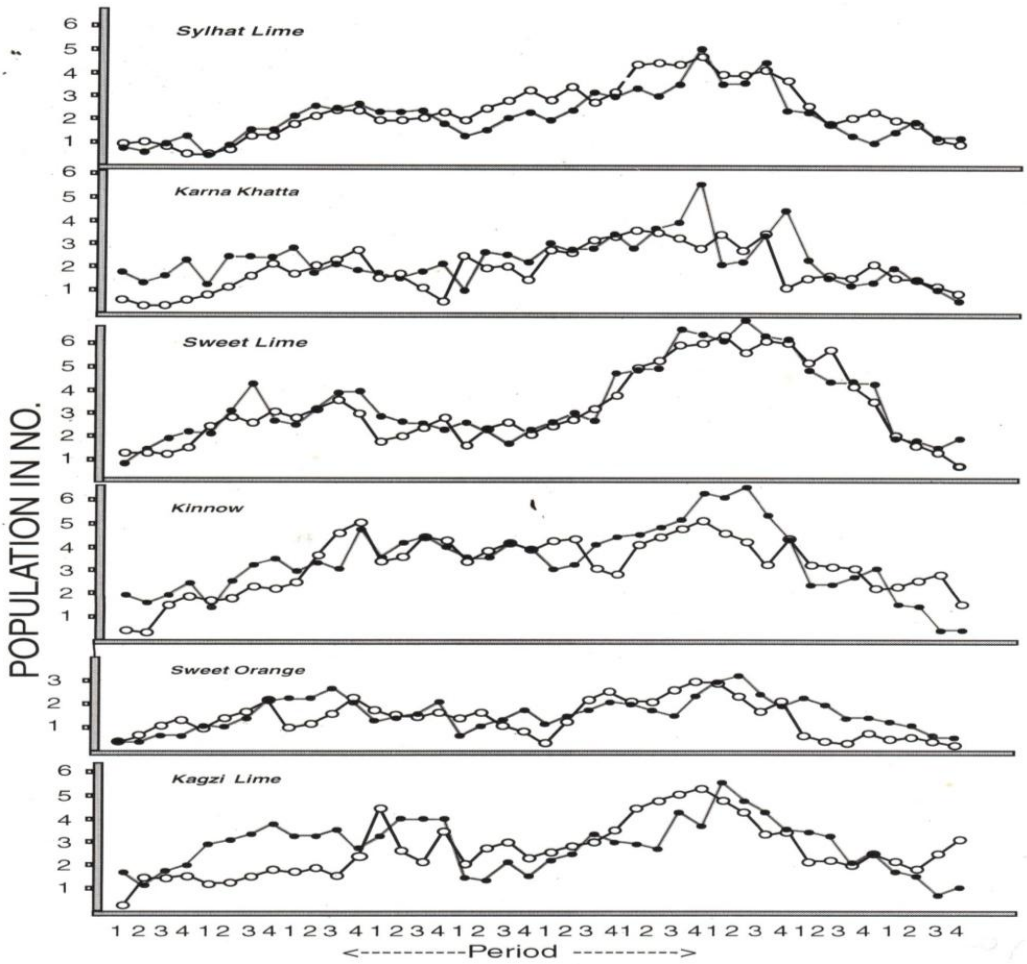
	II	2.288 (4.737)	1.915 (3.166)	2.646 (6.499)	2.515 (5.826)	1.633 (2.165)	1.999 (3.497)	2.166 (4.191)
	III	2.179 (2.248)	1.705 (2.408)	2.414 (5.329)	2.398 (5.248)	1.934 (3.242)	2.197 (4.328)	2.138 (4.071)
	IV	1.998 (3.492)	1.554 (1.915)	2.197 (4.328)	2.376 (5.141)	2.196 (4.322)	1.681 (2.325)	

1	2	3	4	5	6	7	8	9
October	I	1.978 (3.411)	1.657 (2.246)	1.703 (2.402)	2.121 (3.998)	1.657 (2.246)	1.657 (2.246)	1.796 (2.724)
	II	1.934 (3.239)	1.573 (1.972)	1.708 (2.415)	2.018 (3.512)	1.413 (1.495)	1.499 (1.745)	1.691 (2.357)
	III	1.607 (2.082)	1.376 (1.394)	1.802 (2.747)	2.018 (3.572)	1.290 (1.165)	1.321 (1.244)	1.569 (1.962)
	IV	1.731 (2.497)	1.382 (1.409)	1.893 (3.083)	1.999 (3.497)	1.344 (1.307)	1.206 (0.955)	1.593 (2.036)
November	I	1.499 (1.746)	1.321 (1.244)	1.443 (1.582)	1.412 (1.495)	1.554 (1.915)	1.379 (1.403)	1.435 (1.558)
	II	1.288 (1.159)	1.258 (1.081)	1.376 (1.495)	1.376 (1.394)	1.379 (1.404)	1.527 (1.832)	1.373 (1.386)
	III	1.114 (0.742)	1.069 (0.644)	0.995 (0.489)	1.288 (1.159)	1.223 (0.998)	1.285 (1.151)	1.161 (0.851)
	IV	1.252 (1.068)	1.034 (0.569)	0.995 (0.489)	1.408 (1.483)	1.013 (0.527)	1.283 (1.147)	1.164 (0.856)

The minimum population was recorded 1.046 per unit in the 1st week of February, 2015 similar results were found by Sarda *et al.* (2014)

Note: Figures in parenthesis are transferred back value.

Fig. 1: Population Dynamics of Citrus Butterfly *(P. Demoleus)*



Period x Crop means interaction data summarized in Table 1 and 2 and depicted in Fig. 1. Maximum number of larvae were found (5.248 per unit) in Kagzi lime in 4th week of August, 2015 but it was highest 6.499 per unit in 2nd week of September during 2016. The next highest population mean was found 6.249, 6.080 and 5.826 per unit in Kinnow and Sweet lime during 4th week of August and 1st and 2nd week of September 2016, which were found statistically at par. Krishnamurthy and Singh 1986 studied egg and its Parasite on citrus crops.

It was found that Kinnow crop was highly infested by butterfly larvae and it was found 3.121 and 3.282 per unit during 2015 and 2016, respectively. So far as in the month mean highest population was found 3.492 and 3.943 per unit in August, 2015 and September 2016 respectively. Whereas minimum incidence of citrus butterfly was 0.871 and 1.148 per unit in February 2015 and November, 2016, respectively. In December and January, larvae was absent in both years of investigations. Sharma *et al.* (2009) and Suwarna (2012) also studied species life table of Swallow tail butterfly and found similar results.

In the combination of month x crop mean, the population was recorded highest and statistically at par in Sweet lime and Kagzi lime 4.994 and 4.847 per unit in September and August, 2015 respectively. Asokan (1997) done mass rearing of *P. demoleus larvae* and resets showed closeness of present findings.

Different sizes of *Papillio demoleous*

***Papillio* species - Swallowtail butterfly**

Different Larval stages of *Papillio demoleus*

Life cycle of Papillio demoleous

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