



## SOYBEAN BASED ARTIFICIAL DIET FOR TOBACCO CATERPILLAR *SPODOPTERA LITURA* (F.)

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### ABSTRACT

The present study compares a soybean based oligidic diet for tobacco caterpillar *Spodoptera litura* (F.) with other artificial diets. The results revealed that populations reared on soybean-based diet showed a significant reduction in total larval (16.3 days) and life cycle periods (35.65 days) with high development indices and survival (81.23%).

**Key words:** *Spodoptera litura*, artificial diet, mass rearing, tobacco caterpillar, oligidic, development indices, survival, larval period, total life cycle

Soybean [*Glycine max* (L.) Merrill.] is an important leguminous crop, and emerged as a domesticated crop around the eleventh century in China (Hymowitz, 1970). It harbours more than 300 insects, of which a few attain major pest status, causing nearly 25% reduction of yield (Gaur and Mogallapu 2018). These include Bihar hairy caterpillar, green semilooper, girdle beetle, stem fly, whitefly and aphids (Suyal et al., 2018). Among these, tobacco caterpillar *Spodoptera litura* (F.) attacks 112 cultivated food plants (Chari and Patel, 1983; Lefroy, 1908, Moussa et al., 1960; Thobbi 1961). The larvae initially scrape the leaf tissue (Patil 2012; and late instars defoliate the plants. For IPM programs, it is essential to mass rear the insect, and evaluate the life parameters on different artificial diets. Previous study revealed total larval duration as 17.8 days, pre-pupal duration as 2.8 days, pupal duration as 8.5 days and total immature duration as 31.2 days with gram based artificial diet (Ahmad et al., 1998). Diet based on groundnut, red gram and winged bean- based flour led to 17.2 days total larval duration, pre-pupal duration of 2.7 days, pupal duration of 8.3 days and 30.8 days of total immature duration (Ahmad et al., 2007). The present study evaluates the effect of castor, soybean, black gram, leaf powders in the artificial diet on the lifecycle of *S. litura*.

### MATERIALS AND METHODS

Study was carried out during 2016-17 in the Department of Entomology, College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The egg mass and larva of *S. litura* collected from the infested vegetable fields were used for mass rearing on artificial diet. Initially, the diet recipe given by Saljoqi et al. (2015) was followed

with few modifications (Diet 1). An upgradation was made by adding dried soybean, castor, black gram leaf powders and agar (diets- 2, 3, 4, 5). Ingredients include chickpea flour, yeast powder, ascorbic acid, sorbic acid, formaldehyde solution, agar and other chemicals- baking yeast powder 10g, methyl paraben 2.5g, sorbic acid 1.5g, ascorbic acid 3.0g, casein 3.0g, choline chloride 0.5g, agar 14g, niacin, 6.0g, calcium pantothenate 6.0g, thiamine 3.0g, riboflavin 3.0g, pyridoxin monohydrochloride 1.5g, folic acid 1.5g, biotin 120g, and inositol 10g, and 1000ml distilled water. All the dry and wet ingredients of the diet were weighed/ measured, and kept in separate containers. Half of the total water was taken in a steel vessel, brought to boil and agar was added. The total quantity of gram flour was added to the boiling agar. Remaining water was poured and stirred continuously to reduce the clump formation. Then, all the dry and wet ingredients were added to the mixture and thoroughly homogenized using blender. The prepared diets were then poured into the sterilized plastic boxes and allowed for solidification. Diet was left over for whole night and used next day for feeding. The diet was cut into small pieces of size 2x2 cm and introduced to the plastic rearing troughs. The larvae were introduced to the diet piece in the trough. The same procedure was used to rear the larvae using diets 2, 3, 4 and 5, of which the constituents are given in Table A.

A colony of *S. litura* raised from two pairs of adults collected from field at Norman Borlaugh Crop Research Center, Pantnagar was transferred to the laboratory. Each pair was kept in a separate glass jar with a nappy-liners pasted at the walls of jars for egg laying. The

Table A

Chickpea flour based (Diet 1)	Soybean leaves based (Diet 2)	Castor leaves based (Diet 3)	Black gram leaves based (Diet 4)	Agar based (Diet 5)
Chickpea flour-150g	Soybean leaves-150g	Castor leaves-150g	Black gram leaves-150g	Agar-150g
Fraction A	Fraction A	Fraction A	Fraction A	Fraction A
1 litre distilled water	1 litre distilled water	1 litre distilled water	1 litre distilled water	1 litre distilled water

mouth of jar was kept closed with a muslin cloth. The adults were fed on a piece of cotton soaked in honey solution. The eggs laid were collected and kept in petri dishes for hatching. As the larvae emerged, these were reared on the five diets.

To maintain the culture the larvae of *S. litura* were regularly fed on the prepared diets and the adult stages were fed with honey solution. The data on time taken to complete different life stages reared on artificial and natural diet were compared. Larval growth index and total developmental index were calculated based on pupation and survival, respectively (Gupta et al., 2005)- Larval growth index = % Pupation / Larval Period (days). Total developmental index = % Survival / Total Developmental Period (days). Design followed was completely randomized design (factorial). Pooled data obtained from three generations was subjected to analysis by using OP Stats software.

#### RESULTS AND DISCUSSION

The data on the lifecycle parameters of the *S. litura* fed on the five diets is given in Table 1. The results on the

duration of life stages reveal that number of days taken by the first instar larva was 2.16 days on soybean-based diet 2, and it was significantly on par with those on diet 1 with duration of 2.4 days; with other diets it varied between 3.2 and 3.43 days. The larva raised on diet 2 showed a duration of 2.16 days, significantly varying from other diets except artificial diet 1. Second instar larvae showed duration of 2.39, 2.16 and 3.2 days on chickpea, soybean and castor leaves- based diets, respectively and are significantly different. Whereas, larvae reared on agar-based diet 5 showed duration of 3.8 days and it was on par with castor (3.28). However, soybean-based diet 2 showed a reduced duration of 2.16 days.

Third instar larvae reared on soybean leaf registered duration of 2.2 days which was significantly different. Larval duration of 3.93, 3.23 and 4.06 were documented with black gram, chickpea and diet 5, which were statistically on par with each other. Larval duration of 4th instar *S.* was significantly more on agar-based diet (diet 5) and with black gram leaves it was 4.7 and 3.73 days, respectively. Chickpea, soybean, and castor- based diets showed duration of 3.43, 3.33 and

Table 1. Growth and survival parameters of *S. litura* on artificial diets (Mean  $\pm$  SD\*)

Biological Parameters	Diet I	Diet II	Diet III	Diet IV	Diet V	CD	CV	Significance
Egg period	2.13 $\pm$ 0.55	2.8 $\pm$ 0.61	3.23 $\pm$ 0.25	2.8 $\pm$ 0.15	2.5 $\pm$ 0.26	NS	15.165	0.07361
1st instar	2.4 $\pm$ 0.49	2.16 $\pm$ 0.08	3.28 $\pm$ 0.11	3.2 $\pm$ 0.05	3.43 $\pm$ 0.12	0.759	14.213	0.01119
2nd instar	2.39 $\pm$ 0.14	3.2 $\pm$ 0.15	3.63 $\pm$ 0.32	2.4 $\pm$ 0.08	3.83 $\pm$ 0.14	0.607	10.615	0.00078
3rd instar	3.23 $\pm$ 0.14	2.2 $\pm$ 0.15	2.33 $\pm$ 0.16	3.9 $\pm$ 0.14	4.07 $\pm$ 0.21	0.536	9.228	0.00003
4th instar	3.43 $\pm$ 0.12	3.33 $\pm$ 0.08	3.03 $\pm$ 0.20	3.7 $\pm$ 0.12	4.7 $\pm$ 0.15	0.454	6.754	0.00009
5th instar	3.3 $\pm$ 0.25	3.03 $\pm$ 0.03	3.53 $\pm$ 0.26	3.53 $\pm$ 0.08	4.96 $\pm$ 0.08	0.549	8.106	0.00011
6th instar	2.83 $\pm$ 0.16	2.37 $\pm$ 0.13	3.43 $\pm$ 0.29	3.96 $\pm$ 0.27	4.63 $\pm$ 0.08	0.658	10.353	0.00012
Pre-Pupal period	3.21 $\pm$ 0.15	3.1 $\pm$ 0.05	2.53 $\pm$ 0.31	3.7 $\pm$ 0.12	3.26 $\pm$ 0.39	NS	13.343	0.06689
Pupal period	10.7 $\pm$ 0.30	8.95 $\pm$ 0.53	10.74 $\pm$ 0.40	12.5 $\pm$ 0.57	14.13 $\pm$ 0.68	1.635	7.88	0.00036
Adult life span	3.5 $\pm$ 0.28	4.5 $\pm$ 0.28	3.25 $\pm$ 0.14	4.1 $\pm$ 0.20	5.6 $\pm$ 0.46	0.956	12.363	0.00167
% Pupation	83.35 $\pm$	89.15 $\pm$	82.34 $\pm$	75.23 $\pm$	89.36 $\pm$	4.32		
% Survival	74.32 $\pm$	81.23 $\pm$	85.32 $\pm$	64.31 $\pm$	55.21 $\pm$	6.55		
Larval growth index	4.74	5.47	4.28	3.61	3.49	-		
Total Development Index	2.00	2.28	2.19	1.46	1.08	-		
Total life cycle	37.13	35.65	39.00	43.93	51.16			

3.03 days, respectively and were statistically on par. For 5<sup>th</sup> instar, number of days taken was 3.00 and 3.3 days, respectively on soybean and chickpea-based diets, which were on par with each other. The least duration was observed in soybean-based diet (2.36) which significantly differed from other diets. Total mean larval duration was found to be maximum when raised on agar-based diet (25.63) followed by black gram (20.83), which were significantly different. The least mean larval duration of 16.3 days was observed with soybean-based diet (Table 1).

Highest pre-pupal duration was observed with black gram based diet (3.73 days) followed by agar-based diet (3.26 days) which were on par with chickpea and soybean based diets. Pupal duration was maximum with agar-based diet (14.13 days) followed by blackgram one (12.5 days) and soybean- based diet (8.95 days). Maximum adult period of 7.44 days was observed with soybean-based diet. Incubation period was found to be maximum with castor- based diet (3.23) followed by soybean one (2.8 days). Incubation period with soybean and castor-based diets was 3.25 days and 3.16 days, respectively which were statistically at par. Total lifecycle period was maximum with agar-based diet (51.1 days), while it was 37.13 and 35.65 days with bengal gram and soybean- based diets. The larval growth index was 5.46 for soybean based diet followed by 3.48 to 4.73 in others; the developmental index was also maximum (2.27).

The development of artificial diets pioneered by Vanderzant et al. (1962) facilitated the continuous production of insects. Total larval period documented for *S. litura* reared on modified diet was 16.3 days and is comparatively lower with 17.2 days and 15.08 days reported by Saljoqi et al. (2015) on bean based and gram based artificial diets. Present results are in corroboration with those of Sorour et al. (2011) on *S. littoralis*. Total developmental index reported by Gupta et al. (2005) and Diwakara and Manjulakumari (2015) were 2.84 and 1.95 which were in accordance with the present soybean-based diet. Thus, the present study shows the effect of modified soybean based diet in mass rearing of *S. litura*.

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