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Research Article

Effect of four host plants on nutritional performance of cotton leafworm, *Spodoptera littoralis* (Lepidoptera: Noctuidae)

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Abstract: Effects of four vegetable host plants, artichoke, cabbage, potato and tomato on nutritional indices of the cotton leafworm *Spodoptera littoralis* (Boisduval) (Lep.: Noctuidae), were studied under laboratory conditions (25 ± 1 °C, 65 ± 5% RH, with a 16: 8 L: D photoperiod). Fourth instar reared on tomato showed the highest approximate digestibility (AD) (90.406 ± 1.125%) and efficiency of conversion of ingested food (ECI) (30.249 ± 4.128%). The highest values of efficiency of conversion of digested food (ECD) and ECI of fifth instars (38.663 ± 4.34 and 20.083 ± 1.581%, respectively) were on artichoke and the lowest of both values on cabbage (ECD: 6.314 ± 1.128 and ECI: 5.448 ± 1.052%).The 3rd to 6th instars as a whole showed the highest ECD and ECI values on tomato (23.412 ± 2.252 and 19.845 ± 1.798%, respectively). However, the highest and lowest values of consumption index (CI) were on cabbage (33.943 ± 2.669) and tomato (6.145 ± 0.578). The highest values of relative consumption rate (RCR) and (AD) were obtained on cabbage (1.49 ± 0.109 mg/mg/day and 86.431 ± 1.141%, respectively). The results of nutritional indices and the cluster analysis indicate that tomato was nutritionally the most suitable food for *S. littoralis*.

Keywords: Host plants, Lepidoptera, Noctuidae, Nutritional indices, *Spodoptera littoralis*

Introduction

The cotton leaf worm *Spodoptera littoralis* (Boisduval) (Lep.: Noctuidae) is a highly polyphagous defoliator of many cultivated plants (Brown and Dewhurst, 1975; Holloway, 1989). A wide range of at least 87 plant species in 40 plant families including many vegetable, fruit and ornamental crops are hosts for *S. littoralis* (Salama *et al.*, 1970). *Spodoptera littoralis* attacks most vegetable crops, including tomato, pepper, eggplant, lettuce, artichoke, strawberry and asparagus, but it also damages ornamental plants and herbs (Lanzoni *et al.*, 2012).

Spodoptera littoralis is present in Algeria and many other African and Mediterranean countries, the Mediterranean region and the Middle East, particularly in Cyprus, Israel, Malta, Morocco, Italy, Greece and Spain (Salama *et al.*, 1970; Ahmad, 1988; Blackford *et al.*, 1997; Champion *et al.*, 1997; Azab *et al.*, 2001; Hatem *et al.*, 2009). The cotton leafworm causes a variety of damages as a leaf feeder, sometimes as a cutworm

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on seedlings, and occasionally destroying the bolls (Darvishzadeh *et al.*, 2014).

Different host plants could play an important role in population increase and outbreaks of polyphagous insect pests (Singh and Parihar, 1988; Lu and Xu, 1998). From a nutritional point of view, utilization efficiency reflects the quality and the quantity of food consumed (Naseri *et al.*, 2010; Baghery *et al.*, 2013) which may increasingly affect insect development, survivorship, reproduction, and life table parameters (Scriber and Slansky, 1981; Tsai and Wang, 2001; Kim and Lee, 2002). In fact, low quality plants may reduce insect survival, size or weight, their longevity and reproduction viabilities or indirectly increase their exposure to the natural enemies as a result of prolonged developmental time (Ali and Gaylor, 1992; Greenberg *et al.*, 2001; Awmack and Leather 2002; Chen *et al.*, 2008). Therefore, the aims of the present study focus on the *S. littoralis* larvae's quantified consumption rate of some vegetable crops grown in Algeria and determining food utilization of *S. littoralis* on the four host plants, artichoke, cabbage, potato and tomato. The results could improve pest management programs on vegetable crops.

Materials and Methods

The present study was carried out at the National Institute of Agronomic Research of Algeria, Experimental Station of Hmadna, Algeria (35° 54' N. and 0° 47' E. with an altitude of 48m) to evaluate the effect of different host plants on the feeding indices of different stages of *S. littoralis*. The experiment was performed at constant temperature 25 ± 1°C, 65 ± 5% RH, with a 16: 8 L: D photoperiod.

Host plants

Four host plants were used in this study, including cabbage *Brassica oleracea* L., globe artichoke *Cynara scolymus* L., potato *Solanum tuberosum* L. and tomato *Solanum lycopersicum* L. Selection of these plants was based on their importance as vegetable crops in Algeria. Furthermore, *S. littoralis* causes considerable damage to these host plants in Algeria. All plant materials used in this experiment were collected from plants grown under field conditions without using any pesticides.

Insects

Spodoptera littoralis were originally collected from artichoke fields during October 2016 brought to the laboratory and were subsequently reared on artichoke until pupation. Newly emerged adults were transferred into plastic jars for mating and egg laying. Adults were fed on 10% honey solution impregnated onto cotton wool.

Experiments

Newly hatched larvae were collected from stock culture and reared on mentioned host plants. Fifty larvae were used in each of the four host plant treatments. Nutritional indices were determined using third to sixth instars of *S. littoralis* on each host plant, as they were easier to measure than the primary instars. For this purpose, leaves and larvae were weighed and placed inside plastic containers (Diameter 8cm, Depth 7cm) with a hole covered by a mesh net for ventilation. The weights of the larvae were recorded daily before and after feeding until they finished feeding and reached the pre-pupal stage. The initial fresh food and the food and faeces remaining at the end of each experiment were weighed daily. Plastic containers were cleaned and new weighed leaves were supplied. Sixth instars were kept in plastic tubes (2cm diameter, 5cm deep) for pupation.

The quantity of food ingested was determined by subtracting the diet remaining at the end of each experiment from the total weight of diet provided. To find the dry weights of leaves, faeces, and different stages, extra specimens (20 specimens for each) were weighed, oven-dried (48 hours at 60 °C), and then re-weighed to establish a percentage of their dry weight. The pre-pupae, pupae, and adults from the larvae reared on each host plant were weighed as well. Food utilization rates were then calculated according to Waldbauer (1968): CI (Consumption index), AD (Approximate digestibility), ECI (Efficiency of conversion of ingested food), ECD (Efficiency of conversion of digested food), RCR

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(Relative consumption rate), and RGR (Relative growth rate):

$$CI = \frac{E}{A}$$

$$RCR = \frac{E}{A \times T}$$

$$RGR = \frac{P}{A \times T}$$

$$AD(\%) = \left(\frac{E-F}{E}\right) \times 100$$

$$ECI(\%) = \left(\frac{P}{E}\right) \times 100$$

$$ECD(\%) = \left(\frac{P}{E-F}\right) \times 100$$

P-dry weight gain (mg), A-initial and final mean dry weights of the larvae during feeding period (mg), E-dry weight of food ingested (mg), T-duration of feeding period (day), F-the dry weight of faeces produced (mg).

Statistical analyses

Nutritional indices of *S. littoralis* reared on different host plants were analysed with one-way ANOVA using the statistical software XLSTAT to find significant differences. Statistical differences among the means were assessed using the LSD test (α = 0.05). A dendrogram of different host plants based on nutritional indices of whole instars of *S. littoralis* was created after cluster analysis by Ward's method using XLSTAT statistical software.

Results

The results of the nutritional indices of third, fourth, fifth, and whole instars of *S. littoralis* are presented in Tables 1, 2, 3, and 4, respectively. Different host plants had significant effects on nutritional indices of *S. littoralis* ($P < 0.05$).

Table 1 Nutritional indices of third instars of *Spodoptera littoralis* on different host plants.

Parameters	Artichoke	Cabbage	Potato	Tomato	F (df = 3)
RCR (mg/mg/day)	1.105 ± 0.051b	2.136 ± 0.196a	1.178 ± 0.104b	0.638 ± 0.075c	27.5706
ECD (%)	12.157 ± 1.043a	4.736 ± 0.698b	11.298 ± 1.212a	14.099 ± 1.740a	10.8792
CI	11.117 ± 1.006b	23.499 ± 2.151a	9.093 ± 1.394b	4.372 ± 0.471c	34.1163
ECI (%)	10.857 ± 0.884a	4.418 ± 0.629b	10.449 ± 1.118a	13.076 ± 1.554a	11.3492
RGR (mg/mg/day)	0.116 ± 0.005a	0.084 ± 0.002b	0.114 ± 0.007a	0.077 ± 0.007b	12.0806
AD (%)	89.633 ± 0.767b	93.812 ± 0.731a	92.865 ± 0.993a	93.301 ± 0.771a	5.2627
E (mg)	2.425 ± 0.181b	5.089 ± 0.388a	2.310 ± 0.330b	1.276 ± 0.118c	34.4583
F (mg)	0.242 ± 0.014a	0.296 ± 0.030a	0.159 ± 0.028b	0.083 ± 0.011c	17.5642
P (mg)	0.254 ± 0.015a	0.204 ± 0.008b	0.221 ± 0.021ab	0.156 ± 0.013c	7.5394

P = dry weight gain, E = dry weight of food ingested, F = the dry weight of feces produced. Means in a row followed by the same letter are not significantly different (LSD test, α = 0.05).

Table 2 Nutritional indices of fourth instars of *Spodoptera littoralis* on different host plants.

Parameters	Artichoke	Cabbage	Potato	Tomato	F (df = 3)
RCR (mg/mg/day)	0.487 ± 0.026b	0.840 ± 0.074a	0.784 ± 0.064a	0.527 ± 0.045b	10.35
ECD (%)	28.983 ± 2.79a	10.606 ± 1.06b	34.406 ± 5.34a	33.548 ± 4.59a	8.41
CI	1.228 ± 0.093b	6.031 ± 0.518a	1.801 ± 0.18b	1.509 ± 0.225b	57.34
ECI (%)	22.093 ± 1.735b	8.610 ± 0.889c	25.996 ± 3.26ab	30.249 ± 4.128a	11.13
RGR (mg/mg/day)	0.108 ± 0.012b	0.069 ± 0.005b	0.189 ± 0.01a	0.149 ± 0.018a	13.84
AD (%)	77.807 ± 2.420b	81.216 ± 1.42b	79.604 ± 4.004b	90.406 ± 1.125a	4.99
E (mg)	1.207 ± 0.128b	6.440 ± 0.541a	1.795 ± 0.152b	1.137 ± 0.161b	72.57
F (mg)	0.261 ± 0.036b	1.241 ± 0.183a	0.342 ± 0.066b	0.115 ± 0.023b	26.15
P (mg)	0.255 ± 0.023b	0.526 ± 0.036a	0.431 ± 0.030a	0.313 ± 0.044b	12.64

P = dry weight gain, E = dry weight of food ingested, F = the dry weight of feces produced. Means in a row followed by the same letter are not significantly different (LSD test, α = 0.05).

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Table 3 Nutritional indices of fifth instars of *Spodoptera littoralis* on different host plants.

Parameters	Artichoke	Cabbage	Potato	Tomato	F (df = 3)
RCR (mg/mg/day)	0.346 ± 0.025c	0.905 ± 0.095a	0.638 ± 0.075b	0.381 ± 0.041c	15.8928
ECD (%)	38.663 ± 4.340a	6.314 ± 1.128c	25.403 ± 5.429b	24.505 ± 3.413b	11.5360
CI	0.865 ± 0.096b	4.116 ± 0.493a	1.559 ± 0.236b	1.204 ± 0.117b	27.3186
ECI (%)	20.083 ± 1.581a	5.448 ± 1.052b	16.389 ± 1.798a	18.612 ± 2.639a	12.7460
RGR (mg/mg/day)	0.069 ± 0.007b	0.044 ± 0.006b	0.101 ± 0.014a	0.070 ± 0.013b	4.7528
AD (%)	55.504 ± 4.702b	85.947 ± 1.863a	74.139 ± 6.275a	77.670 ± 3.435a	8.6243
E (mg)	1.342 ± 0.156b	7.291 ± 0.919a	2.551 ± 0.364b	1.847 ± 0.185b	31.2578
F (mg)	0.584 ± 0.079b	1.035 ± 0.200a	0.515 ± 0.080b	0.394 ± 0.065b	3.8713
P (mg)	0.265 ± 0.032a	0.362 ± 0.056a	0.421 ± 0.083a	0.364 ± 0.082a	1.9603

P = dry weight gain, E = dry weight of food ingested, F = the dry weight of feces produced. Means in a row followed by the same letter are not significantly different (LSD test, α = 0.05).

Table 4 Nutritional indices of whole (3rd, to 6th) instars of *Spodoptera littoralis* on different host plants.

Parameters	Artichoke	Cabbage	Potato	Tomato	F (df = 3)
RCR (mg/mg/day)	0.680 ± 0.032b	1.490 ± 0.109a	0.818 ± 0.049b	0.469 ± 0.035c	46.881
ECD (%)	21.226 ± 1.570ab	6.086 ± 0.617c	17.684 ± 1.606b	23.412 ± 2.252a	22.675
CI	10.181 ± 0.594a	33.943 ± 2.669b	10.114 ± 0.747b	6.145 ± 0.578b	77.189
ECI (%)	16.227 ± 0.832b	5.250 ± 0.528c	14.398 ± 0.923b	19.845 ± 1.798a	30.558
RGR (mg/mg/day)	0.108 ± 0.003a	0.073 ± 0.002c	0.115 ± 0.005a	0.088 ± 0.005b	22.062
AD (%)	77.755 ± 2.191b	86.431 ± 1.141a	82.963 ± 2.811ab	85.567 ± 1.824a	3.519
E (mg)	4.975 ± 0.219bc	18.821 ± 1.116a	6.656 ± 0.620b	4.260 ± 0.340c	104.229
F (mg)	1.088 ± 0.100b	2.572 ± 0.315a	1.017 ± 0.120b	0.592 ± 0.066b	23.325
P (mg)	0.799 ± 0.041a	0.952 ± 0.066a	0.924 ± 0.065a	0.823 ± 0.087a	1.257

P = dry weight gain, E= dry weight of food ingested, F= the dry weight of feces produced. Means in a row followed by the same letter are not significantly different (LSD test, α =0.05).

The third instars reared on tomato showed the highest values of ECD and ECI compared with that reared on other host plants. The lowest values of ECD were on cabbage. The highest values of AD and CI were observed on cabbage. However, the lowest values of AD and CI were on artichoke and tomato, respectively. The highest values of RCR and RGR were observed on cabbage and artichoke, respectively. The highest value of food consumption and feces produced was observed on cabbage and the highest value of larval dry weight gain was in artichoke (Table 1).

The data presented in Table 2 showed that there were significant differences among nutritional indices of the fourth instars of *S. littoralis* on four host plants. The highest values of ECD and ECI were on potato and tomato, respectively. The approximate digestibility (AD) of *S. littoralis* larvae on the four host plants differed significantly and was higher on tomato than the other host plants. RGR on potato and RCR on cabbage had the highest values compared to other host plants. The larvae reared on cabbage showed the highest values of food consumption, feces produced and weight gain.

[DOR: 20.1001.1.22519041.2019.8.3.4.8]

In the fifth instar (Table 3), the highest ECD and ECI were on artichoke. The larvae reared on potato showed the highest value of RGR.

However, the highest RCR and AD values were recorded in larvae fed on cabbage. The highest and lowest CI values of fifth instar *S. littoralis* were on cabbage and artichoke, respectively. The lowest value of consumed food and produced feces were on artichoke and tomato. Different host plants showed no significant effect on dry weight gain of fifth instars.

The results of Table 4 for the three cumulative (third, fourth, and fifth) instars shows that the ECD and ECI values were the highest on tomato and lowest on cabbage. However, the highest and lowest values of CI were on cabbage and tomato, respectively. The approximate digestibility of larvae (AD) on four host plants differed significantly and was higher on cabbage and tomato. The lowest RCR and RGR were obtained on tomato and cabbage, respectively. The consumed food and produced feces values were the highest on cabbage. The least amount of feces was produced on tomato. No significant differences were observed on dry weight gain among the four host plants.

Different host plants showed no significant effect on pre-pupal weight of *S. littoralis* (F = 1.563; df = 3, 39). However, the effect of host plants on pupal weight (F = 2.913; df = 3, 39) was significant; pupae of *S. littoralis* reared on artichoke were the heaviest (0.44 ± 0.012g). While, larvae reared on tomato and potato showed the lightest pupal weight with (0.27 ± 0.007) among the four host plants (Fig. 1).

Cluster analysis

A dendrogram based on nutritional indices of the whole instars of *S. littoralis* reared on four host plants is shown in Figure 2. The dendrogram shows two separate clusters labeled A (including A_1 and A_2) and B. The cluster A consists of subclusters A_1 (potato and artichoke) and A_2 (tomato), the cluster B includes cabbage.

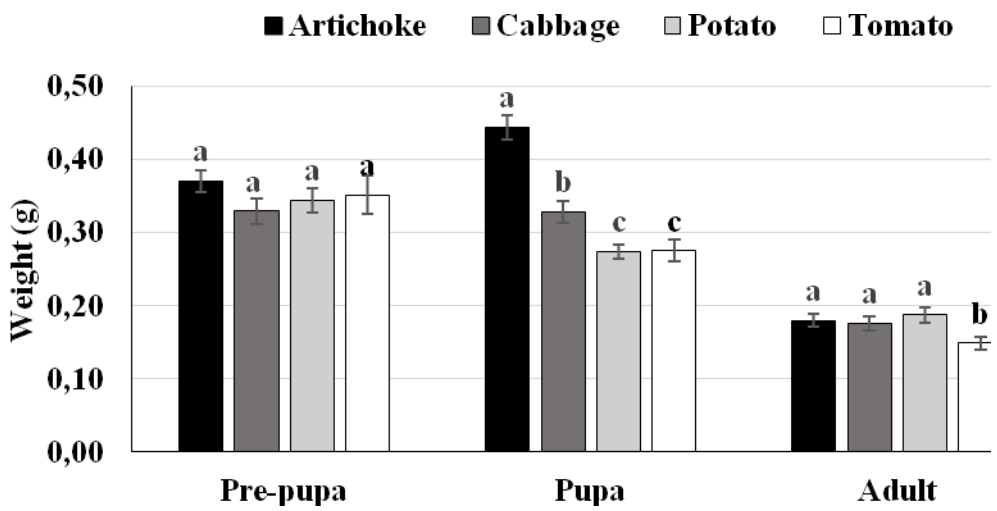

Figure 1 Pre-pupae, pupae and adult weights of *Spodoptera littoralis* on different host plants. Means in a row followed by the same letter are not significantly different (LSD test, α = 0.05).

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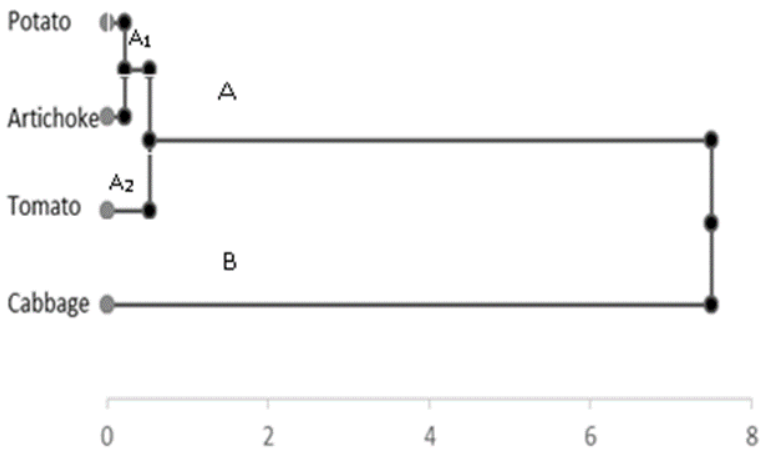

Figure 2 Dendrogram of four host plants based on nutritional indices of *Spodoptera littoralis*.

Discussion

In this study, our data show that larval and pupal weight as well as nutritional indices were significantly affected when *S. littoralis* fed on the four different host plants. The efficiency of conversion of ingested food on different host plants varied considerably by *S. littoralis* (Duodo and Biney, 1981) and in general it varies for other insects (Slansky and Scriber, 1985; Scriber and Slansky, 1981). Among nutritional indices, ECI is an indicative index of insect's ability to use the ingested food for growth and ECD is an index of the efficiency of conversion of consumed food into growth (Nathan *et al.*, 2005). RGR is the rate of increase in body weight per unit time period, whereas RCR is the quantity of ingested food per unit on insect body per unit of time (Talaee *et al.*, 2017). The duration of developmental period can be influenced by suitability of host plant (Hwang *et al.*, 2008). ECI and ECD values of *S. littoralis* fed on four host plants were significantly different, suggesting different nutritional quality of these plants.

The data of nutritional indices for 3rd, 4th and 5th instars of *S. littoralis* are not consistent with each other because the nutritional requirements of the insect change through development, and such differences typically result in changes of food consumption and utilization (Barton Brown, 1995; Hemati *et al.*, 2012). Generally, when the quantity of food ingested is decreased, the duration of development is extended and insect becomes smaller and lighter. Another reason may be related to increased instar duration, when increased amount of consumed food must be used to maintain metabolism.

Higher CI value of the whole *S. littoralis* instars was on cabbage indicating that the rate of intake relative to the mean larval weight during the feeding period was the highest on this host plant. These results are similar to those reported by Duodo and Biney (1981) who mentioned that *S. littoralis* had the greatest value of CI on cabbage. Otherwise, a large difference was recorded in the CI value of *S. littoralis* reared on artificial diet (Khafagi *et al.*, 2016). The results for AD value of the whole instars of *S. littoralis* fed on cabbage, potato and tomato were similar to those reported by Khedr *et al.* (2015) on some cotton cultivars and castor bean (85.72% and 90.30% respectively). Ladhari *et al.* (2013), Khedr *et al.* (2015), and Khafagi *et al.* (2016) indicate that AD value of *S. littoralis* was 40.4% on artificial diet. The lowest AD for whole instars was on artichoke, no previous studies have been carried out on the nutritional indices of *S. littoralis* on artichoke, but AD value of *S. littoralis* was higher than its value on artificial diet (Khafagi *et al.*, 2016). Kianpour *et al.* (2014), Mehrkhou

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et al. (2015), Talaee *et al.* (2017) and Fathipour *et al.* (2018) studied nutritional indices of different lepidopteron pests *Plutella xylostella* L. (Lep.: Plutellidae), *Spodoptera exigua* (Hübner) (Lep.: Noctuidae) and *Helicoverpa armigera* (Hübner) (Lep.: Noctuidae) on various host plants and mentioned that nutritional indices can play an important role in evaluation of the host plants resistance and their combination with other techniques in integrated pest management programs.

Third instar fed on cabbage had the highest AD value and the lowest ECD and according to Grabstein and Scriber (1982), Sheppard and Friedman (1990) and Lazarevic and Peric-Mataruga (2003), the growth reduction is a general response of phytophagous insects due to changing to a new host plant which explains the reduced growth rate obtained in cabbage according to the increase in AD value and the decrease in ECD. This finding is similar to previous studies on other pests reared on other host plants by Hemati *et al.* (2012), Mehrkhou *et al.* (2015) and Fathipour *et al.* (2018). They reported that larvae of *H. armigera* fed on chickpea and canola and larvae of *S. exigua* fed on eggplant had the highest AD while their ECD values were the lowest.

Nutritional indices of fourth instars show that the larvae fed on potato had the highest ECD value and on tomato had the highest ECI value. In addition, those reared on cabbage had the lowest ECD and ECI. In contrast, the lowest AD in fourth instar was recorded on potato and artichoke, suggesting more intakes do not necessarily mean more digestion. Different factors such as secondary biochemicals can cause lower digestibility, which leads to slow growth rate despite consumption of a large quantity of food (Price *et al.*, 2011; Panizzi and Parra, 2012).

Stockhoff (1993) suggests that changes of preferred host plant in different instars may be related on the effect of ontogenetic shifts on the diet choice. The highest ECI value of whole instars of *S. littoralis* was on tomato and potato; these results indicate that they were more efficient in converting ingested food to biomass. The larvae fed on cabbage had the lowest value of ECD in the instars of *S. littoralis*, as a whole, compared with other host plants, which suggest that these larvae have less efficiency for the conversion of digested food to biomass. It is well known that the degree of food utilization depends on the digestibility of food and the efficiency with which digested food is converted to biomass (Baptista Pereira *et al.*, 2002).

The duration of feeding period is effective factor in RGR and RCR values that shows if a host is suitable or unsuitable for feeding of larvae, e.g. Lepidopteron larvae fed on highly nutritious food increased growth rates and completed development period faster than larvae that fed on low nutrition food (Hwang *et al.*, 2008). Our results of whole instars show that the RCR and RGR values were highest on cabbage and artichoke respectively, and lowest on tomato. In our study, potato and tomato were a high nutrient food for larvae; a shorter period of development was needed to complete larval stages. However, cabbage was a low nutrient food for the larvae and a longer period of development was necessary to complete larval development.

Among the different host plants, artichoke produced the heaviest pre-pupae, pupae and adults compared to other host plants. Tomato recorded the lightest pupae and adults weights. These results are similar to those of Khedr *et al.* (2015) that found pupal weights around (0.302 ± 0.01 g) on castor leaves and on a cotton genotype (H10) (0.281 ± 0.02 g). The shortest larval period of *S. littoralis* was in larvae reared on potato and tomato and longest period obtained in larvae fed on cabbage. This finding is almost close to that reported by El-Aw and Hashem (2004).

The results of cluster analysis revealed that grouping different host plants within each cluster might be due to high level of physiological similarity of host plants. The host plants grouped in subcluster A_2 were the most suitable and those in subcluster A_1 were fairly suitable for *S. littoralis*, while host plant in cluster B had the least suitability.

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The study of nutritional indices leads to a good understanding of the physiological behaviour of insects with respect to their host plants (Lazarevic and Peric-Mataruga, 2003). Based on nutritional values of instars of *S. littoralis*, development period, pupal and adults weights on the four host plants; the suitability of selected host plants for development and survival of *S. littoralis* was ranked as tomato > artichoke > potato > cabbage. These findings will help in understanding response of this pest to different host plants with varying nutritional values as well as its host plant preference to manage and control this pest on vegetable crops, especially with the insect adaptability to different host plants, despite the difference in nutritional values. Future studies should focus on testing a wider range of host plants and cultivars for nutritional indices and assessment of the chemical components of the host plants, which can lead to a better understanding in selection of partially resistant host plants and cultivars to *S. littoralis*, which will help us in IPM of this pest.

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تأثیر چهار گیاه میزبان بر عملکرد تغذیه‌ای کرم برگ‌خوار *Spodoptera littoralis* (Lepidoptera: Noctuidae)

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چکیده: تأثیر چهار گیاه میزبان گیاهی شامل کنگر فرنگی، کلم، سیب‌زمینی و گوجه‌فرنگی بر شاخص‌های تغذیه‌ای کرم برگ‌خوار پنبه *Spodoptera littoralis* (Boisduval) (Lep: Noctuidae) تحت شرایط آزمایشگاهی در دمای۱ ± ۲۵ درجه سلسیوس، رطوبت نسبی ۵ ± ۶۵ درصد و دوره نوری ۱۶ ساعت روشنایی و ۸ ساعت تاریکی مورد بررسی قرار گرفت. لارو سن چهارم پرورش داده شده روی گوجه‌فرنگی بالاترین قابلیت هضم نسبی (AD) ۱/۱۲۵ ± ۹۰/۴۰۶ درصد و بازدهی تبدیل غذای خورده شده (ECI) ۴/۱۲۸ ± ۳۰/۲۴۹ درصد را نشان داد. بالاترین مقادیر بازدهی تبدیل غذای هضم شده (ECD) و ECI در لارو سن پنجم به‌ترتیب ۴/۳۴ ± ۳۸/۶۶۳ و ۱/۵۸۱ ± ۲۰/۰۸۳ درصد مربوط به کنگر فرنگی و کم‌ترین میزان هر دو مقدار روی کلم به‌ترتیب ۱/۱۲۸ ± ۶/۳۱۴ و ۱/۰۵۲ ± ۵/۴۴۸ درصد بود. در لارو سن سوم تا ششم، بالاترین مقادیر ECD و ECI در گوجه‌فرنگی به‌ترتیب ۲/۲۵۲ ± ۲۳/۴۱۲ و ۱/۷۹۸ ± ۱۹/۸۴۵ درصد بود. با این حال، بیش‌ترین و کم‌ترین مقدار شاخص مصرف (CI) مربوط به کلم ۲/۶۶۹ ± ۳۳/۹۴۳ و گوجه‌فرنگی ۰/۵۷۸ ± ۶/۱۴۵ درصد بود. بالاترین مقادیر نرخ مصرف نسبی (RCR) و (AD) روی کلم به‌ترتیب ۰/۱۰۹ ± ۱/۴۹ میلی‌گرم بر میلی‌گرم بر روز و ۱/۱۴۱ ± ۸۶/۴۳۱ درصد به‌دست آمد. نتایج شاخص‌های تغذیه‌ای و تجزیه‌وتحلیل خوشه‌ای نشان می‌دهد که گوجه‌فرنگی از نظر تغذیه‌ای مناسب‌ترین ماده غذایی برای *S. littoralis* بود.

واژگان کلیدی: گیاهان میزبان، پروانگان، Noctuidae، شاخص‌های تغذیه‌ای، *Spodoptera littoralis*

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