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Influence of Different Host Plants and Their Seasonal Variation in the Total Carbohydrate Concentration of Different Tissues of Spodoptera Litura .

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Abstract: Spodoptera litura (F), an economically important polyphagous insect, causes considerable economic damage to multiple agro-crops annually in numerous countries. In the present work, the quantitative analysis of carbohydrate in midgut and fat body of the last instar larvae of Spodoptera litura was carried out by feeding with five different host plants . A comparative study of the carbohydrate concentration in the tissues with respect to the variation in the feeding material in different seasons was carried out. The data obtained were statistically analysed using one-way ANOVA (P<0.01).Analysis of the data demonstrated that there was a significant variation in the carbohydrate concentration in each tissue with respect to the host plants in different seasons. The castor fed larval tissues showed a significantly higher concentration of carbohydrate than the tissues of larvae fed with other host plants which indicate the preference of the nutritionally rich host plants by the insect.A positive correlation was found in the carbohydrate content of the hostplant leaves and that of the insect tissues.
Key words: Spodoptera litura, host plants, mid gut, fat body, carbohydrate concentration.

I. INTRODUCTION

Spodoptera litura, the common cutworm, is an economically important and polyphagous agricultural pest dispersed all over the world. All the larval stages of this pest cause severe damage,about 10-40% yield loss of harvests on which they feed[1].The quality of carbohydrates in the diet of an insect has a significant impact on the insect plant interaction. Generally most of the insects require some amount of carbohydrate in their diet and they can show a better performance at a particular proportion of the dietary carbohydrate relative to other nutrients that varies from species to species[2] .The differences in the utilization of carbohydrates by the insects are based on their ability to hydrolyse the polysaccharides, the capacity to absorb the different compounds and the function of their enzyme system to bring about these compounds in to metabolic processes. To date, nutritional investigations have concentrated fundamentally on biochemical compounds such as carbohydrate which are important to support optimum growth , development, regenerative action and survival of individual species. This biochemical parameter is valuable in assessing and predicting the life cycle of the insect so that this information may be useful for the development of innovative control measures of this economically important insect.The present study was conducted to analyse the effect of diet on carbohydrate content of midgut and fat body of S.litura during different seasons.

II. MATERIALS AND METHODS

A. Host plants

Five host plants used in this study were sweet potato(*Ipomoea batatas*), castor*(Ricinus communis)*, banana(*Musa acuminate colla*) ,colocasia *(Colocasia esculenta*) and papaya (*Carica papaya*).These plants are the primary host plants of *S. litura* and are important as economic crops.

B. Rearing of Spodoptera

Acolony of *S.litura* was established in the laboratory by collecting the pupae from the insect rearing centre ICAR , Bangalore. The pupae were kept in plastic trays in a wooden cage and as the adult emerged, they were transferred into the plastic containers and fed with diluted honey (20%) till the eggs were laid. On hatching the larvae were transferred to separate plastic troughs and were fed with fresh leaves of different host plants. 20-25 larvae were cultured in each trough. Each day the leaves were replaced with fresh one. The utilization of the hostplant leaves and the larval growth and development was noticed. These rearing was performed in three different seasons(summer,monsoon and post monsoon).In each season the last instar larvae from the second generation were used for the experiment.

C. Collection and preparation of tissue sample

Carbohydrate estimation was carried out in the midgut and fat body of last instar larvae of *S.litura* in three different seasons(summer ,monsoon and post monsoon) with five replications for each sample type.The final instar larvae were anaesthetized and midgut and fatbody were dissected out in ringer solution,weighed after removing the adhered ringer by using a blotting paper, and homogenized in ringer (1 ml for each gut).To the tissue homogenate added 80% ethanol to precipitate the protein from the sample and centrifuged at 12,000 rpm for10 min. The supernatant obtained after the precipitation of protein is transferred in to a small dish and allowed to evaporate by keeping it overnight in an oven at 60^0C.The total carbohydrate content in the sample sedimented at the bottom of the dish was scraped using a glass road. This was dissolved in 1 ml of distilled water, centrifuged and the supernatant was used for the estimation. The leaf tissue of five host plants were prepared by boiling 100mg of leaf with 5ml 2.5N HCl and neutralized with solid sodium carbonate .Then it is made up to 100ml and centrifuged and the supernatant was used for estimation.

D. Estimation of Total Carbohydrate

Quantitative estimation of total carbohydrate was done spectrophotometrically by theAnthrone method [3]using glucose as standard.

E. Statistical Analysis

One -way analysis of variance (ANOVA*)* was used to test the significance of differences between mean values of carbohydrate content in the midgut and fat body of fifth instar larvae of *S.litura.* The test was performed to find out the significant difference in the carbohydrate content of different tissues depending on the feeding of different host plants. The difference was significant at $p < 0.01$.

III. RESULTS AND DISCUSSION

Carbohydrate play a significant role in determining the leaf quality which inturn influence the growth and development of the insects. The quality of a herbivore insect diet changes both within and between its host plants, and these fluctuations can be predictable, such as seasonal changes in plant quality or unpredictable, such as the changes caused by environmental stress.

Among the selected host plants it was noticed that the amount of carbohydrate content varies slightly in all the host plant leaves at different seasons(Table.1 and Fig.1).The castor leaves showed highest amount of carbohydrate (0.037±0.00 mg/ml)followed by papaya, colocasia, sweet potato and banana. The least carbohydrate content was noticed in banana leaves(0.028±0.0 mg/ml). The highest amount of carbohydrate content was noticed during the summer season than in monsoon and post monsoon seasons.The higher amount of carbohydrate content in castor leaves was also reported by many workers [4].The present findings corroborate with the previous records of plants that changes in carbohydrates exists at a number of levels, including between the species , within the species [5], and within an individual plant [6] depending on the type of tissue (i.e., leaves, flowers, seeds, and stems),and its age (i.e., young versus old leaves). Besides, a plant's protein and carbohydrate content can vary in response to environmental factors, including the amount of light it receives, the chemical composition of the soil, and inputs of water([7], [8] ,[9], [10]).

Table.1. Seasonal variation in carbohydrate content of the leaves of different host plant leaves.

Seasons	Carbohydrate concentration in	Host plants					F	P
		Sweet potato	Castor	Colocasia	Papaya	Banana		
Summer	Mg/ml	0.033±0.00	0.037±0.00	0.034±0.00	0.036±0.00	0.028±0.0	0.936	0.463
	Mg/gm	0.33±0.01	0.37±0.00	0.34±0.01	0.36±0.03	0.28±0.00	0.657	0.629
Monsoon	Mg/ml	0.027±0.00	0.032±0.00	0.027±0.00	0.030±0.00	0.025±0.0	7.80	0.001

	Mg/gm	0.27±0.01	0.32±0.00	0.27±0.01	0.30±0.00	0.25±0.00	7.77	0.001
Post monsoon	Mg/ml	0.013±0.00	0.029±0.00	0.020±0.00	0.021±0.00	0.007±0.0	3.59	0.023
	Mg/gm	0.13±0.01	0.29±0.08	0.20±0.00	0.21±0.01	0.07±0.03	3.59	0.023

Values are represented as mean ± S.E. n=5

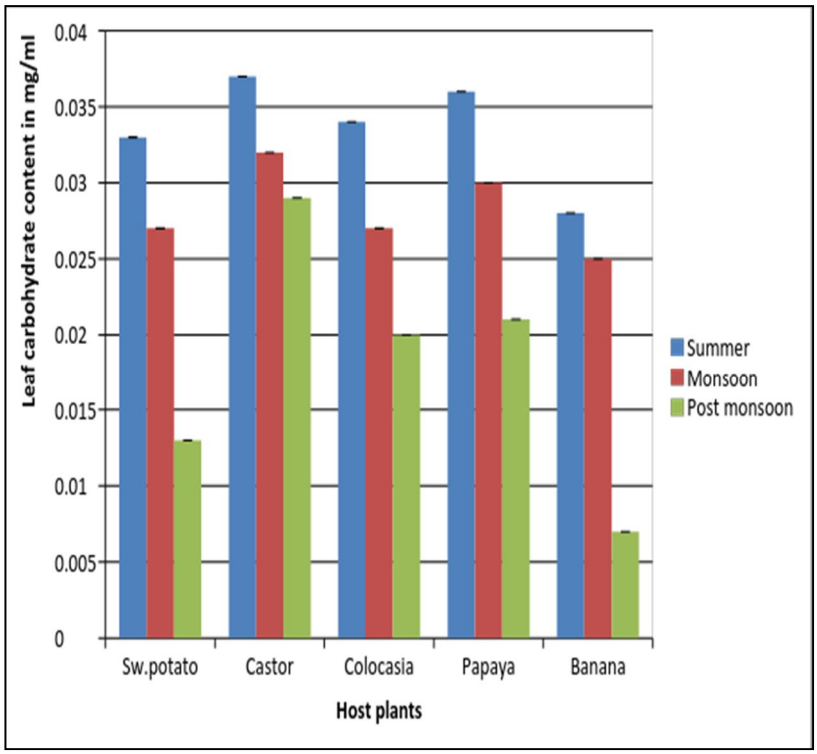


Fig.1 Seasonal variation in carbohydrate content of different host plant leaves.

Carbohydrates play a vital role in insect development like metabolism, reproduction and embryonic development, metamorphosis, development of flight muscles, insect behaviour and as reserve food during diapauses [11]. A carbohydrate rich diet modulates insect metabolic rate by diminishing the energy use on reproduction [12]. The energy obtained from a carbohydrate-rich diet is mainly utilized for the maintenance of the insect life, therefore prolonging the insect life span [13].

The food quality is very important for the growth, development and reproductive potential which depends mainly on nutritional composition, including both the absolute and relative amount of water, proteins, amino acids, carbohydrates ,lipids, minerals, *etc*[14].The variation in carbohydrate content of midgut tissue(Table.2 and Fig. II) and fat body (Table.3 and Fig.III) of *S.litura* by feeding with five different host plant leaves (castor, colocasia, papaya, banana, sweet potato) in three different seasons revealed the variation in carbohydrate content of the tissues during each season correspond with the variation in food materials. The castor fed insect showed the maximum carbohydrate contentof 0.36±0.01 mg/ml in midgut and 2.2±0.17mg/ml in fat body than in the case of other host plants in the summer season. The carbohydrate content in larval tissues were observed in the order of castor>papaya>colocasia> sweet potato> banana.Carbohydrate content in both leaf tissues and larval tissueswas observed to be slightly low in monsoon and still lower in post monsoon compared to the summer season.

During the final instar stage due to the rapid development, the larvae have to face an increasing demand for glucose; this requirement is achieved by the larvae through the rapid and voracious feeding.The carbohydrate content was observed to be higher in the tissues of last instar larvae of *S.litura* fed with castor leaves. This may be due to the increased content of carbohydrate in castor leaves. This indicated the influence of dietary components on the biochemical constituents of the insect tissues. This finding is supported by the previous work[15].

Table.2.Seasonal variation in carbohydrate content of the midgut tissue of last instar larvae of *S. litura* after fed with the leaves of different host plants.

seasons	Concentration of carbohydrate in	Host plants					F	P
		Sweet potato	Castor	Colocasia	Papaya	Banana		
summer	Mg/ml	0.26±0.00	0.36±0.01	0.32±0.00	0.34±0.01	0.21±0.00	37.6	0.000
	Mg/gm	0.51±0.02	1.17±0.13	0.97±0.04	1.06±0.01	0.33±0.00	33.2	0.000
monsoon	Mg/ml	0.25±0.01	0.33±0.00	0.22±0.01	0.31±0.00	0.14±0.01	23.1	0.000
	Mg/gm	0.84±0.07	1.05±0.04	0.33±0.05	0.95±0.03	0.24±0.02	54.9	0.000
Post monsoon	Mg/ml	0.06±0.00	0.09±0.02	0.06±0.00	0.07±0.01	0.04±0.00	2.43	0.081
	Mg/gm	0.24±0.01	0.48±0.08	0.31±0.03	0.44±0.06	0.16±0.02	7.11	0.001

Values are represented as mean ± S.E. n=5

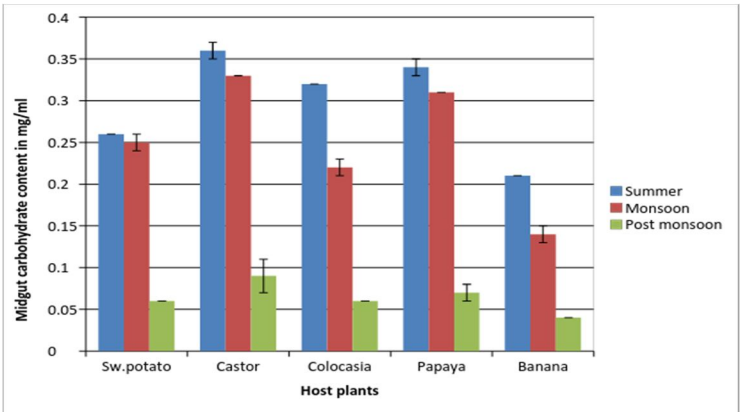


Fig.II. Seasonal variation in carbohydrate content of the midgut tissue of last instar larvae of *S. litura* after fed with the leaves of different host plants

Table.3. Seasonal variation in carbohydrate content of the fat body of last instar larvae *S.litura* after fed with the leaves of different host plants.

seasons	Concentration of carbohydrate in	Host plants					F	P
		Sweet potato	Castor	Colocasia	Papaya	Banana		
summer	Mg/ml	0.16±0.00	0.31±0.02	0.21±0.01	0.23±0.02	0.15±0.00	14.48	0.000
	Mg/gm	0.91±0.02	2.2±0.17	1.1.2±0.05	1.5±0.11	0.79±0.01	33.07	0.000
monsoon	Mg/ml	0.17±0.00	0.29±0.03	0.11±0.00	0.21±0.00	0.09±0.00	34.6	0.000
	Mg/gm	0.71±0.15	1.8±0.14	0.66±0.02	1.17±0.06	0.54±0.02	29.2	0.000
Post monsoon	Mg/ml	0.05±0.00	0.25±0.02	0.09±0.00	0.14±0.00	0.05±0.00	35.2	0.000
	Mg/gm	0.44±0.07	1.6±0.04	0.55±0.05	0.73±0.02	0.38±0.02	98.9	0.000

Values are represented as mean ± S.E. n=5

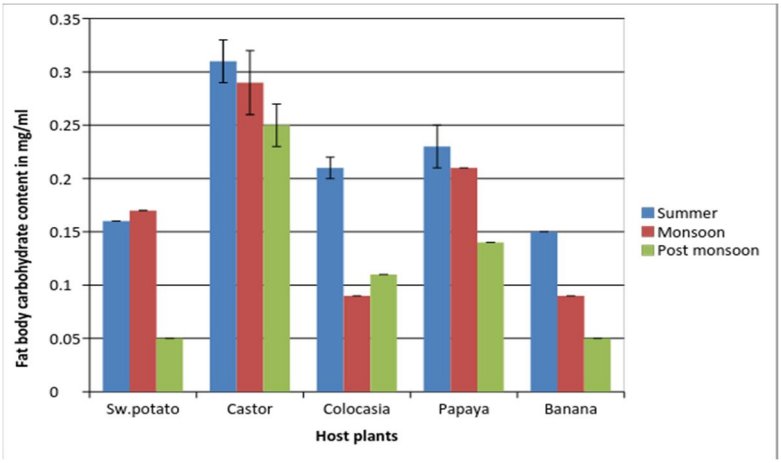


Fig.III. Seasonal variation in carbohydrate content of the fat body of last instar larvae *S.litura* after fed with the leaves of different host plants.

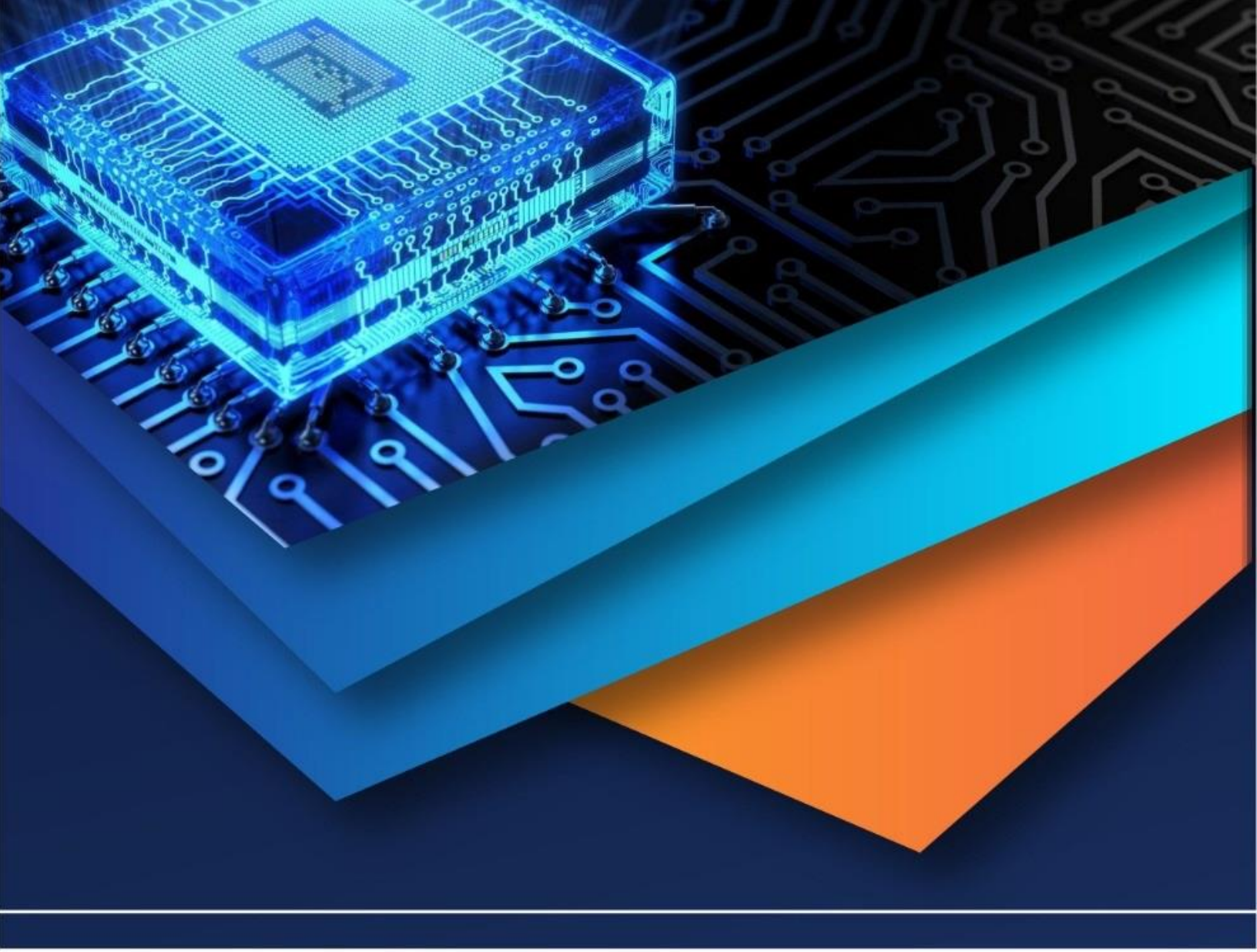
From the above results a positive correlation was observed in the insect tissues with respect to the carbohydrate content in the leaf tissue in relation to different seasons.

IV. CONCLUSION

Considerable discrepancy was noticed in the carbohydrate content of midgut tissue and fat body of the last instar larvae of S. litura based on its feeding on different host plants during different seasons.The host preference of the larvae might be based on the nutritional components of the plant materials they possess. It was revealed that castor fed larvae showed maximum carbohydrate content in their tissue than those fed on other host plants. It is desirable to know the influence of different host plants on the biochemical changes in the tissues of the pest which may help to develop innovative control measures for this pest in future.

REFERENCES

[1] L. H. Reddy and P. Couvreur, “Squalene: A natural triterpine for use in disease management and therapy”, Adv. Drug Delivery Rev., vol. 61, no. 15, pp. 1412-1426, 2009.
[2] J. L.Capinera, “Taro Caterpillar or Rice Cutworm, Spodoptera litura (Fabricius)”, In Encyclopedia of Entomology., Springer Netherlands.,pp. 3699-3700, 2008).
[3] E. A.Bernays, R. F. Chapman, “Host-plant selection by phytophagous insects” , Springer Science & Business Media, Vol. 2, 2007.
[4] Marwari, Richa, and T. I. Khan, "Effect of textile waste water on tomato plant, Lycopersicon esculentum," Journal of Environmental Biologyo.vol. 33. No.5, pp.849, 201
[5] S.Chandrashekhar, B. Sannappa, K. G. Manjunath, and R. Govindan, “ Nutritive value of leaves in different genotypes of castor (Ricinus communis L)”, Indian Journal of Plant Sciences.,vol. 2,no.2,pp. 22-27,2013.
[6] Sattelmacher, Burkhard, Walter J. Horst, and Heiko C. Becker, "Factors that contribute to genetic variation for nutrient efficiency of crop plants," Journal of Plant Nutrition and Soil Science.,vol. 157,no.3 ,pp.215-224, 1994.
[7] J. Mattson. Jr. William, "Herbivory in relation to plant nitrogen content," Annual review of ecology and systematic., vol.11,no.1,pp. 119-161, 1980.
[8] D. A. Holt, and A. R. Hilst, “Daily variation in carbohydrate content of selected forage crops”, Agronomy Journal.,Vol. 61,no.2,pp. 239-242,1969
[9] Hendrix L.Donald and Steven C. Huber, "Diurnal fluctuations in cotton leaf carbon export, carbohydrate content, and sucrose synthesizing enzymes," Plant Physiology .,vol.81,no.2,pp. 584-586, 1986
[10] F. S .Chapin, A. J.Bloom, C. B. Field and R. H. W
[11] aring, “ Plant responses to multiple environmental factors”, Bioscience.,vol. 37,no.1,pp. 49-57, 1987.W. Felton Gary, "Nutritive quality of plant protein: sources of variation and insect herbivore responses," Archives of Insect Biochemistry and Physiology .,vol.32,no.1,pp. 107-130, 1996.
[12] Reginald Frederick. Chapman, “ The insects: structure and function”, Cambridge university press, 1998
[13] Naya, E.Daniel , A. Marco, Lardies, and Francisco Bozinovic, "The effect of diet quality on physiological and life-history traits in the harvestman Pachylus paessleri," Journal of insect physiology .,vol.53,no.2,pp. 132-138, 2007
[14] Lardies, A.Marco, Mauricio J. Carter, and Francisco Bozinovic, "Dietary effects on life history traits in a terrestrial isopod: the importance of evaluating maternal effects and trade-offs," Oecologia ,vol.138,no.3 ,pp.387-395,2004
[15] Slansky and J.M. Scriber, “Nutritional Ecology of Insect Folivores of Woody Plants: Nitrogen, Water, Fiber and Mineral Considerations. In: Nutritional Ecology of Insects, Mites Spiders”, Slansky, Jr.F. and J.G. Rodriguez (Eds.), Wiley, New York, pp: 105-146.
[16] G. P .Waldbauer and S. Friedman, "Self-selection of optimal diets by insects," Annual review of entomology,vol. 36,no.1, pp.43-63,1991.



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