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Host preference of Bihar hairy caterpillar *Spilosoma obliqua* in laboratory condition

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Abstract
Bihar hairy caterpillar (*Spilosoma obliqua*) is a serious polyphagous insect pest. An experiment was conducted to determine the host preference of Bihar hairy caterpillar in Entomology laboratory, Lamjung Campus at room temperature from March to April, 2019. The experiment was conducted in CRD with seven treatments namely; Cotton (*Gossypium hirsutum*), Cauliflower (*Brassicae oleracae var. botrytis*), Cabbage (*Brassicae oleracae var. capitata*), Broccoli (*Brassicae oleracae var. italica*), Mulberry (*Morus alba*), Castor (*Ricinus communis*), Broad bean (*Vicia faba*). Five pure cultured larvae were set in each plastic jar containing respective plant sample. All the host plants showed highly significant difference at 1% level of significance. The first instar larvae fed highly in cabbage (13.2g) and least on castor (6.07g) where as in the later stages the larvae preferred broad bean more followed by the cabbage and other crucifers where as the least consumption was seen in mulberry and castor throughout the entire larval period. The time taken to reach the pupal stage was shortest in broad bean and cabbage i.e. within 14 days conversely the pupal stage was reached a lot later in castor and mulberry i.e. after 18 days.

Keywords: Bihar hairy caterpillar, crucifer, feeding, host preference, lepidoptera & pupation

Introduction

Bihar hairy caterpillar, *Spilosoma obliqua* (Walker) is a polyphagous pest that comes under lepidoptera order of class insect consisting of chewing type of mouthpart which is confined to the oriental region known to cause severe damage to several crops of agricultural and horticultural importance. Besides Nepal, this pest has also been reported in various other countries too such as India, Myanmar, Pakistan, China (Kabir & Khan, 1968: Singh & Seghal, 1992) [19, 30]. *S. obliqua* is a sporadic in nature. The adult female lays eggs in clusters on lower surface of the epidermis of the leaves in the crowded condition. The young caterpillars are gregarious and they feed on green, soft tissues and leave behind the veins, thus skeletonizing the leaves whereas in later stages the larvae eat the leaves from the margin thereby giving the leaves of plant an appearance of net or web. *S. obliqua* larvae pass through six instars (Adsule & Kadam, 1979) [2]. (Gyawali, 1988) [15] found that the sixth instars larvae are the most damaging ones. They are capable of attacking 126 plant species belonging to more than 24 plant families which includes a number of economically important plant as such cereals, grams, oilseeds and pulses (Singh & Varatharajan, 1999) [44]. Jute has been one of its major hosts causing severe economic damage (Gupta & Bhattacharya 2008) [14]. The pest causes yield loss up to 30% in jute (Bandyopadhyay *et al*. 2014) [43].This pest are profoundly found to infest bean, cotton, groundnut, brinjal, cabbage, cauliflower, linseed, pea, soybean and other leguminous crops (Kabir, 1966) [18]. Of late it has also become the major pest of mulberry (Geetha & Marimadaiah, 2006) [42]. This pest has become the second most serious pest of cole crops mostly cabbage being preferred as reported by Bhatia *et al.*, (1995) [41]. Kadam *et al.*, (1995) [2] observation recorded that the damage by *Spilosoma obliqua* and concluded that the fourth to sixth in stars are highly destructive in nature and shall require chemical control.
Host plant species are those which slow or increase the development of the insect which have considerable relevance to the management method Tange *et al*., (2013) [34]. These are plants upon which an organism lodges and subsists (Marriam-Webster). By this definition host plants are those biologically active plants that provide food and shelter to caterpillar to complete their lifecycle and reproduce. During the process of evolution, plants and insects have developed different strategies to dodge SSSeach other harmful effects. Plants respond to those harmful effects of insect through various morphological, biochemical, and molecular mechanisms.

Direct defense mechanism includes plants affecting host plant preference or survival and reproductive success of the insects, and indirectly by natural enemies. These defenses are wide-ranging, highly dynamic, and mediated by biochemical mechanisms. Secondary metabolites as such terpenoids, alkaloids, anthocyanins, phenols, and quinones are produced in response to the damage of the crops which ultimately affect the survival and feeding habbit of the pest (Howe &Jander 2008; Arimura *et al*. 2009; War *et al*. 2012) [12, 1, 37]. Different insects have their own type of host preferences.

Agriculture is the backbone of the Nepal economy because 65.6% of Nepalese's population depends on agriculture for the livelihood. However, it is disheartening to know that Nepalese's economic growth is not keeping up to the expectations because its agricultural growth is lagging. The state is worsened by the fact that 35% of the produce goes to the waste in pre and post harvest operation due to the insect pest attacks in the field and storage (Palikhe, 2002) [40]. The 3rd instars onward larvae of this pest is the most damaging one and cause heavy reduction in the yield (Hussain & Begum, 1995; Gupta& Bhattacharya, 2008) [37, 14]

Being a sporadic and polyphagous pest it has wide range of the host, the rate of larval survival and development vary greatly on different host plants. Nevertheless, polyphagy offers *S. obliqua* an avenue for the population survival and persistence. However in Nepal the polyphagous nature of *S. obliqua* larvae has been scarcely studied. The knowledge on host plant preference and vulnerable stages will ultimately help to combat the pest in terms of effective measures of controlling its population and reducing the pest damage.

Materials and Methods

The experiment was conducted in entomology lab of lamjung campus during March-April 2019. The study site is located at 28 7' to 28 10' North and longitude from 84 24' to 84 28' east at an altitude of 675m above sea level.

This place has humid sub-tropical climate. The total annual rainfall in this area is reported as 2800 mm maximum and minimum temperature is 28-30 °C and 20-22 °C respectively.

The experiment was conducted in CRD with seven treatments namely; Cotton (*Gossypium hirsutum*), Cauliflower (*Brassicae oleracae var. botrytis*), Cabbage (*Brassicae oleracae var. capitata*), Broccoli (*Brassicae oleracae var. italica*), Mulberry (*Morus alba*), Castor (*Ricinus communis*), Broad bean (*Vicia faba*).

Collection and Rearing of insect

A pure culture is a population of cells or multicellular organisms growing in the absence of other species or types which originate from a single cell or single organism, in which the cells are genetic clones of one another (Morello). The eggs of Bihar hairy caterpillar was collected from research field of Gunjanagar, Chitwan. The eggs, was then allowed to hatch in the laboratory of department of Entomology, IAAS lamjung campus and the larvae was given a 10% sugar solution as a food for their growth and development. The male and female adults of *Spilosoma obliqua* were separated and allowed to mate in a breeding cage. On the completion of mating female adults started laying eggs in clusters. Thus, the eggs obtained were left undisturbed for hatching. In this way, pure culture larvae were used in the experiments.

Inoculation of stock culture

Larvae were starved for 12 hrs before its inoculation. Five pure cultured larvae were inoculated in a plastic jar containing the respective sample leaves. Fresh sample leaves was collected from the periphery of lamjung campus and each of 5g was put in a plastic jar and the leaves was changed in each 2 days. The jar was then covered with fine muslin cloths for the aeration. The moisture loss of the leaves was checked as a control by placing the respective sample leaves in a jar without larvae on each 2 days.

Data collection

The data was taken on every 2 days i.e. when the fresh leaves was placed. The leaves was weighed on every 2 days till the larvae reached to the pupation. The other plastic jar containing only the leaves was also weighed to determine the moisture lost. The food consumption by the larvae was calculated as;

Food consumption: 5g-(weighed of leaves after feeding by larvae + weighed of leaves due to moisture loss)

Statistical analysis

All the data were recorded and tabulated based on replications and treatments with the help of MS Excel. Recorded data were managed and then subjected to analyze by using R-studio. Microsoft word 2010 was used for word processing, Excel for tabulating the data and finding the correlation between different parameters, R studio for running statistical analysis. Calculation of the significant critical difference at 1% level of significance was made by mean comparisons.

Results and Discussion

The present study dealt with the host suitability and food consumption of *Spilosoma obliqua* (Walker). The results of different experiments are discussed below:

Food consumption

Table 1: Influence of different host on consumption index of *Spilosoma obliqua*

Treatment	Mean consumption index of larvae									
	Day2	Day4	Day6	Day8	Day10	Day12	Day14	Day16	Day18	Day20
Cotton	9.05^{c}	2.52^{e}	12.81^{bc}	15.09^{bcd}	26.24^{b}	24.57^{b}	6.28^{e}	24.95^{d}	37.9^{c}	45.71^{b}
Cauliflower	11.13^{abc}	7.87^{d}	13.87^{bc}	17.13^{bc}	40.6^{a}	22.6^{b}	41.27^{a}	60^{a}	60.6^{a}	26.27^{d}
Cabbage	13.2^{a}	8.8^{d}	15.33^{b}	17.6^{b}	37.6^{a}	26.93^{b}	26.93^{c}	60^{a}	61.6^{a}	41.27^{c}
Broccoli	11.67^{ab}	18.8^{a}	11.73^{c}	14.2^{cde}	38.87^{a}	36.05^{a}	33.53^{b}	37.53^{c}	60.2^{a}	11.87^{e}
Mulberry	10.81^{bc}	16.05^{b}	11.19^{cd}	13.19^{de}	24.33^{b}	21.48^{b}	12.67^{d}	13.86^{f}	9.62^{d}	28.86^{d}
Castor	6.07^{d}	10^{d}	8.2^{d}	11.47^{e}	21.47^{b}	21.47^{b}	7.13^{e}	18.8^{e}	34.13^{c}	1.8^{f}
Broad bean	9.76^{bc}	13.29^{c}	21.76^{a}	24^{a}	45.23^{a}	39.05^{a}	34.28^{b}	51.43^{b}	51.43^{b}	51.43^{a}
F value	***	***	***	***	***	***	***	***	***	***
LSD	2.37	2.37	2.99	3.06	9.86	6.65	4.45	3.62	6.49	3.88
CV%	13.24	12.27	12.58	10.84	16.81	13.83	10.98	5.4	8.22	7.49

The feed consumption of *S. obliqua* on seven different host plants are presented in the above table. All the host plants showed highly significant difference at 1% level of significance. The first instar larvae fed highly in cabbage and least on castor where as in the later stages the larvae preferred broad bean more followed by the cabbage and other crucifers where as the least consumption was seen in mulberry and castor throughout the entire larval period. The higher consumption rate in broad bean and cabbage was due to the higher nutrient contents such as crude protein and fat (Taleb, 2008) [33].

Lower consumption in the castor was due to the fact that castor has toxic and anti feedant property which changes the internal metabolic processing of the larvae that donot inhibits the food uptake rather slow down (Ali M. Ali & Ahmed Ibrahim, 2018) [38].

As the concentrations and proportion of nutrients differ greatly among different host plants, this variation determines the regulation of the pest population (Slansky & Rodriquez 1987; Schoonhoven *et al.*, 2005) [32, 27].

Roy & Barik (2012, 2013) [25] found that when 4 host plants were tested with respect to food quality, various parameters as such the growth duration, consumption rate, utilization efficiency, development time, longevity, fecundity and survival of *Diacrisia casignetum* Kollar were found to be significant.

Days to pupation

The result on influence of host plants on its days to reach the pupation has been discussed below:

Table 2: Influence of different host on the pupation of *Spilosoma obliqua*

Treatment	Pupation index of larvae				
	Day 14	Day 16	Day 18	Day 20	Day 22
Cotton	6.67^{a}	20^{bc}	33.33^{bc}	60^{cde}	100^{a}
Cauliflower	26.67^{a}	40^{a}	60^{a}	86.67^{ab}	100^{a}
Cabbage	20^{ab}	40^{a}	60^{a}	93.33^{a}	100^{a}
Broccoli	20^{ab}	26.67^{abc}	53.33^{a}	73.33^{bc}	100^{a}
Mulberry	13.33^{abc}	26.67^{abc}	26.67^{c}	53.33^{de}	73.33^{b}
Caster	0^{c}	13.33^{c}	26.67^{c}	46.67^{e}	73.33^{b}
Broad bean	26.67^{a}	33.33^{ab}	46.67^{ab}	66.67^{cd}	100^{a}

The above table shows that the pest took shortest days to pupate in the broad bean and cabbage followed by other crucifers (started within 14 day) such that all the 5 larvae reached pupation within 22 days in these respective host plants whereas in the castor and mulberry days to reach the pupation was found to be longest such that all the larvae reached pupation in 24 days or more.

Correlation between the food consumption by larvae and the pupation is given below: After 14 days

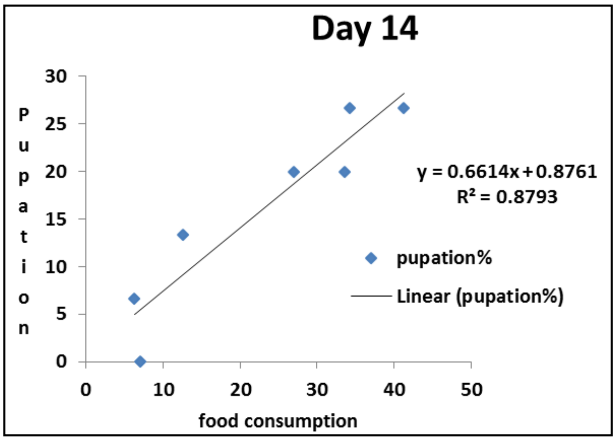

Fig 1: Correlation between food consumption and pupation% after 14 days

The correlation between them was found to be 0.93755 which is close to the 1 such that they are nearly perfectly correlated.

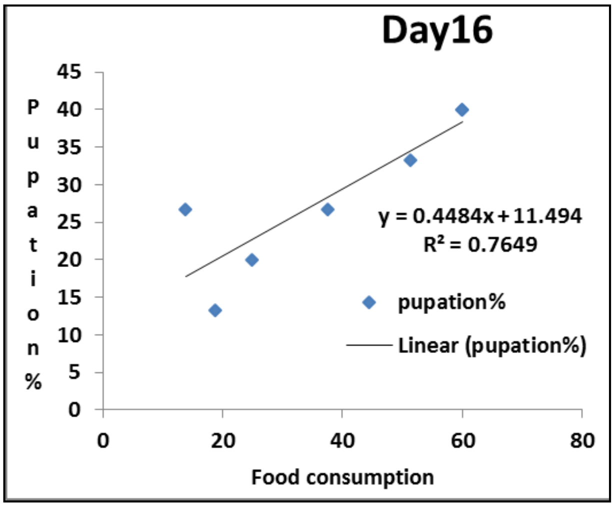

Fig 2: Correlation between food consumption and pupation % after 16 days

The correlation between them was found to be 0.8741 thus has a positive correlation.

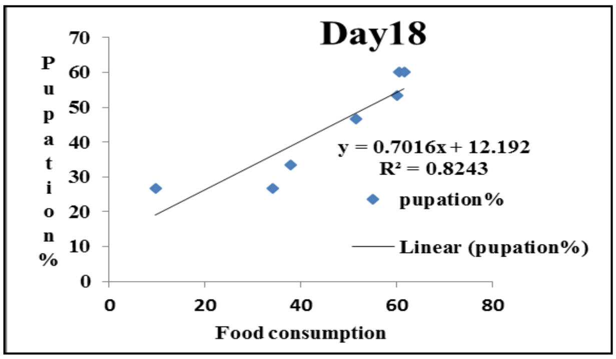

Fig 3: Correlation between food consumption and pupation% after 18 days

The correlation was found to be 0.91 thus are nearly perfectly correlated.

Therefore, the above correlation graph shows that the food consumption of the pest in the larval developmental period has a positive effect on the transformation of these larvae to the pupation phase as well as the pupal weight of the pest (Goel & Kumar, 1983) [10].

This finding is also supported by the fact that the food types helps in the increment of developmental rate which allows this species to reach the pupal period faster and finally to the adulthood and increase their population size (Miller *et al.*, 2014) [39].

As the larval period increases, the consumption index and approximate digestibility is also increased and inversely related is the efficiency of conversion of digested food(ECD) and efficiency of conversion of ingested food(ECI) with the ageing of the larval (Kumar *et al.*, 2011) [22].

During the later stage, the increase in ECD is attributed to the fact that the more food is utilized in the assimilation of various tissues resulting in the faster pupation as reported by the findings of Reynolds *et al*., (1985) [24] and Sharma *et al*., (1999) [29].

The presence of various compounds as such phenol and peroxidase in the host plants adversely affect the larval growth of the insects thereby delaying the pupation period of the insects Gotyal *et al.,* (2015) [11].

Different growth parameter as such the larval period, pupal period is in direct relation with the presence of nutrients in the host plants as reported by Hockensmith *et al.,* 1986 [17].

Summary and Conclusion

The statistical result showed that the different host plants showed highly significance results at 1% level of significance. The pest, polyphagous and causing more damage have high level of preferences on cabbage and other crucifers in initial instars followed by the broad bean and cabbage in the later instar of larvae till formation of pupa such that the pupation was reached early in the same host plants that the pest fed the most.

The experiment concluded that the larvae preferred highly on the cabbage, broad bean and other crucifers whereas the least preferred host plants were mulberry and castor.

Thus, the effective measures for controlling pest population are to be adopted so as to reduce its damage extent either by chemical use or by botanical extracts as an alternative.

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