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Physical Factors Affecting Consumption and Coefficient of Utilization of Various Food Plants by *Mythimina separata* (Walk.)

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Abstract: The leaves of sugarcane, rice and maize were utilized the maximum by *M. separate* with coefficient values of 71.06, 70.57 and 69.29 percent, respectively, while it was minimum in leaves of water grass (27.79%). Hair density did not show significant correlation with consumption values but it was significantly negative with coefficient of utilization. Thickness and moisture contents played a significant role with negative and positive responses with consumption and coefficient utilization, respectively. The actual contribution of Morpho-physical factors on cumulative basis was 52.1 and 68.9 percent for consumption and utilization, respectively.

Key words: Physical factors, food consumption, insect nutrition

Introduction

The losses in yield of rice crop caused by *Mythimina separate* (Walk.) were assessed from 3.6 to 22 percent (Pophali *et al.*, 1980) while 80-90 percent damage was recorded to the panicles (Prasad and Chand, 1980). In gram, yield losses were 10-30 percent at harvest (Chaudhary and Singh, 1980), whereas, 10 percent damage by feeding on the leaves of rye during early instars and on the ear in later instars had been reported by Singh and Manchanda (1981). Similarly 50-80 percent flag leaves of wheat were damaged and cultivated oats (grown as fodder) were preferred over wheat (Saini, 1981).

Berbulecu (1974) reported that *Mythimna (Cirphis) unipuncta* (Haw.) was found feeding on various cereals including rice, which was basic crop in Iran. The heaviest infestation was recorded in maize, sorghum, clover and mixed crops of bird's foot trefoil and 'timothy' grass with average population density, up to 170/m^2. Nasir (1979) concluded that sugarcane and wheat had a very high degree of consumption and utilization and were found to be highly preferred host plants for *C. unipuncta.* Oats, sorghum, maize, "bajra" and barley were the preferred food plants of the test insect. Rice, mung, mash, 'guara', 'kangni' and groundnut are likely to become potential hosts. Whereas, Jute, dib, watergrass and potato were not appreciated by the pest. The coefficient of utilization of the common weeds like 'Khabbal' grass was much higher than those of other field crops mentioned above except sugarcane. Elaidi and Akhtar (1984) reported that the effect of hairiness, thickness and moisture content on consumption and coefficient of utilization was non-significant for *Agrotis ipsilon* (Rott.). Ali (1993) found that moisture contents played a significant and positive role both for consumption and coefficient of utilization of various plants fed by *M. separata,* while thickness of leaf lamina showed a negative and significant effect on consumption and coefficient of utilization. The effect of hairiness of leaf lamina was significant and negative for coefficient of utilization, but it was non-significant for consumption. The cumulative effect of moisture content, hairiness and thickness of leaf lamina on the consumption and coefficient of utilization was reported to be 65.2 and 67.7 percent, respectively.

The present project was undertaken on 15 host plants with the objective to determine the physico-morphological factors responsible for the acquisition of resistance to *M. separata* through consumption and utilization.

Materials and Methods

Fresh tender leaves weighing 40 grams of each of fifteen host plant viz., 'chulai' (*Amarantus viridis* L.), 'dib' (*Typha angustata* L.), garlic (*Allium sativum* L.), gram (*Cicer arientinum* L.), 'khabbal' grass (*Cynodon dactylon* Pers.), 'korbooti' (*Euphorbia belioscopia* L.), lady's finger (*Hibiscus esculantus* L.), maize (*Zea mays* L.), 'makoh' (*Solanum nigrum* L.), onion (*Allium sativum* L), potato (*Solanum tuberosum* L.), rice (*Oryza sativa* L.), sorghum (*Sorghum vulgare* Pers.), sugarcane (*Saccharum officinarum* L.) and water grass (*Phragmites karka* L.) were washed with distilled water to remove dust and dirt and were shade-dried for one hour. The leaves of each host plant were divided into four lots and each lot contained 10 grams leaves. These leaves were cut into small pieces. Ten grams leaves of each host plant were put into glass beaker and each host plant had four beakers (250 ml capacity). It was replicated four times in Completely Randomised Design. These beakers were kept into rearing room under controlled conditions. Uniform sized larvae of 4th instar were obtained by mass rearing and one larva was liberated into each beaker for feeding. The larvae were starved for 24 hours before liberation and then were allowed to feed on the experimental foods for 24 hours. The data on consumption were recorded. The percent coefficient of utilization was calculated after Evans (1939).

Samples were collected from the Research Area of the University of Agriculture, Ayub Agricultural Research Institute, Faisalabad and two random spots from Farmer's fields around the city. Moisture percentage, Hair Density, Thickness of Leaf Lamina were determined for each food plant and these factors were correlated with the consumption and coefficient of utilization.

The data were analyzed on an IBM-PC Computer using MStat-C Package. Means were separated by Duncan's New Multiple Range Test (Duncan, 1955).

Results and Discussion

Table 1 reveals significant difference among host plants regarding consumption and coefficient of utilization. The consumption of the leaves of maize was found to be maximum i.e., 370.40 mgs which did not differ significantly from 364.28 and 358.28 mgs in sorghum and sugarcane, respectively. The minimum consumption was recorded to be 109.57 mgs in lady's finger which did not differ significantly from 120.79 mgs in potato.

Khabbal grass was found to be an alternate host for rice crop (282.70 mg/). The consumption of 196.42 mgs was found in gram which was at par with 195.93 mgs in 'makoh'. 'Dib' was observed to be an alternate host for potato and Lady's finger.

The leaves of sugarcane, rice and maize were utilized the maximum by *M. separata* with coefficient of utilization values of 71.06, 70.57 and 69.29 percent, respectively. The minimum

utilization of leaves was observed to be 27.79 percent in water grass (Table 2). These results are in line with those of Nasir (1979) who found that sugarcane and wheat had a very high degree of consumption and coefficient of utilization.

Table 1: Consumption and Coefficient of utilization of different food plants offered as food to 4th instar larvae of *Mythimina separata* Walk.

Plants	Consumption	Coefficient of Utilization (%)
Chulai	192.13 F	42.55 G
Dib	123.74 H	57.49 D
Garlic	175.82 G	24.31 K
Gram	196.42 F	31.38 I
Khabbal Grass	296.32 B	66.67 B
Korbooti	228.03 D	29.70 IJ
Lady's finger	109.57 I	29.28 F
Maize	370.46 A	69.29 AB
Makoh	195.93 F	46.79 F
Onion	216.13 E	39.25 H
Potato	120.79 HI	54.33 E
Rice	282.70 C	70.57 A
Sorghum	364.28 A	62.52 C
Sugarcane	358.28 A	70.06 A
Water Grass	179.01 G	27.79 J

Means sharing similar letters are not significantly different at p=0.01

Table 2: Influence of consumption on the dry weight of faeces in milligrams (dry weight basis) and coefficient of utilization (%) in various selected plants offered as food to a 4th instar larvae of *M. separata.*

Independent factor		Dependent Factors
		Coefficient of Utilization (%)
Consumption	r	0.579 *
	R^2	0.336

* = Significant at $p < 0.05$. r = Simple Correlation. R^2 = Coefficient of Determination

Table 3: Hair density, thickness of leaf lamina and mosture percentage in leaves of various selected plants offered as food to a 4th instar larvae of *M. separata.*

Plants	Hair Density on Leaf	Thickness Lamina	Moisture of Leaf (%)
Chulai	16.60 BC	0.70 F	78.34 CD
Dib	1.08 D	0.31 K	73.35 EF
Garlic	0.00 D	1.91 A	81.57 AB
Gram	108.28 A	0.62 FG	78.25 CD
Khabbal grass	0.00 D	0.52 GHI	76.81 D
Korbooti	9.85 CD	0.81 E	72.54 EF
Lady's finger	21.81 B	1.10 C	80.53 B
Maize	0.00 D	0.42 IJ	82.27 AB
Makoh	0.00 D	0.50 HIJ	79.25 BC
Onion	0.00 D	1.70 B	82.27 AB
Potato	0.00 D	0.95 D	74.65 E
Rice	0.00 D	0.50 HIJ	80.89 AB
Sorghum	0.00 D	0.41 JK	83.03 A
Sugarcane	0.00 D	0.60 FGH	81.45 AB
Water grass	5.83 D	0.60 FGH	71.38 F

Means sharing similar letters are not significantly different at p=0.01

Physico-morphological plant factors viz., hair density, thickness and moisture contents of the leaves of various selected plants showed significant differences in the identical parameters (Table 3). Although hair density played non-significant role in food consumption but its effect was significantly negative on coefficient of utilization (Table 4). The contribution towards susceptibility of hair density for coefficient of utilization was 13.4 percent only. Our findings are in conformity with those of Ali (1993), However, the results of Elaidi and Akhtar (1984) cannot be compared with the present findings because the insect tried by them was Agrotis ipsilon (Rott.).

Table 4: Effect of physico-morphological factors on the consumption and coefficient of utilization of various selected plants offered as food to a 4th instar larvae of *M. separata.*

		Hair density on leaf lamina (Number/cm^2)	Thickness of leaf lamina (MM)	Moisture content in leaves (%)
Consumption	r	-0.188	-0.363 **	0.470 **
	R^2	0.040	0.132	0.235
Utilization	r	-0.368 **	-0.548**	0.347**
	R^2	0.134	0.298	0.121

** = Significant at $p < 0.01$. r = Correlation Values
R^2 = Coefficient of Determination

Table 5: Linear multiple regression effects of physico-morphological factors on the consumption in milligrams (dry weight basis) and coefficient of utilization (%) of the leaves of various selected plants offered as food to a 4th instar larvae of *M. separata.*

		Regression analysis of variance		
S.O.V.	d.f.	M.S.	F. ratio	R^2
Regression	Consumption 3	66849.75773	18.54**	0.498
	Utilization	3568.32804	42.07**	0.693
Error	Consumption	3605.72128		
	Utilization	56	84.82725	

Regression Equation for Consumption =
Y = -675.722505 - 0.56639* X1 - 93.317** X2 + 12.464 X3

Regression Equation for Utilization =

Y = -90.59348 - 0.22638 X1 - 24.516 X2 + 2.0619 X3

** = Significant at $p < 0.01$ * = Significant at $p < 0.05$

Adjusted R^2 for consumption = 0.471
Adjusted R^2 for utilization = 0.676

Where, X^1 = Hair density
X^2 = Thickness of leaf lamina
X^3 = Moisture contents.

Thickness of leaf lamina showed significantly negative correlation both with food consumption and coefficient of utilization and the coefficient of determination values were found to be 0.132 and 0.298 percent, respectively. The present results are quite comparable with those of Painter (1951) who reported that

thickness of cuticle of the leaves instituted plant resistance to insects (Table 5). Therefore, it can safely be said that smooth leaved plants with less thickened leaves were more liked by the insect and vise verse as it was observed in case of garlic which showed the maximum thickness and smooth leaves verses minimum value of coefficient of utilization.

Moisture in the leaves of different selected food plants was found to be an other important factor showing significantly positive correlation both with food consumption and coefficient of utilization. The R^2 values for consumption and coefficient of utilization was found to be 0.235 and 0.121, respectively. Similar conclusions were drawn by Ali (1993) whereas, Elaidi and Akhtar (1985) reported variable results.

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