SUITABILITY OF MORPHOMETRIC STUDIES FOR THE IDENTIFICATION OF INSTAR AND SEX OF HOPPERS IN *MIRAMIA PERPOLITA* UVAROV. (ORTHOPTERA: ACRIDIDAE)

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Morphometric studies on the number of antennal segments, total antennal length, length of apical antennal segments, head width, length and height of pronotum, length of tegminal and wing rudiments, length of hind femur, total body length, the E/H (elyteron/head width) ratio, E/F (elyteron/femur) ratio and body weight of *Miramia perpolita* Uvarov, were carried out for the separation of sex and instar. The suitability of each of these criteria has also been assessed.

INTRODUCTION

Grasshoppers are detrimental to crops both in their adult and nymphal stages. This necessitates identificatication of both nymphs and adults in each grasshopper species for the estimation of their population and control operations. The adults can very easily be distinguished so it is imperative that some criteria/keys for the identification of different post embryonic stages of the grasshoppers be worked out.

Ahmad (1958, unpublished, Ayaz (1959 unpublished) and Chohan (1960, unpublished) have established some such criteria in the case of hoppers of *Chrotogonus trachypthrus* Blanchard, *Acrotylus humbertianus* Saussure and *Alolopus* spp. respectively. The criteria used by these workers only covered the number of antennal segments, measurements of some body parts and body weight in different hopper stages of the aforementioned insects. Further, they did not separate the sex of hoppers within the some species. Uvarov (1933) and Mistschenko (1952) have given preliminary description of *Miramia perpolita* in the adult stage, and thus this species has remained neglected in the past.

These studies were carried out in Entomological laboratories of West Pakistan Agricultural University, Lyallpur during 1960-62.

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MATERIALS AND METHOD

Miramla perpolita Uv. is a univoltine insect and it is active only from may/June to August/September. The rest of the year is passed in diapause in the egg stage. The pods laid by the females during August, 1961, were collected and placed for hatching in small glass tubes, measuring 9" x 1.5" each. A one inch layer of moist sterilized sand was provided over the top as well as under the bottom end of the egg-pod. The open end of each tube was covered by a small piece of muslin cloth tightly spread over the mouth of the tube by applying closely fitting rubber band. These glass tubes were placed on a wooden rack in the laboratory. The hoppers were isolated after emergence in glass tubes measuring 6" x 1.5" each. The open end of each tube was covered by means of a small muslin cloth, as already described, to avoid the escape of hoppers. This arrangement allowed a certain amount of air circulation for the insects confined in the tube.

Nymphs were fed on fresh leaves of "sarkanda" (*Saccharum sera*), "baru', (*Sorghum halepense*), "jowar" (*Andropogon sorghum*) and sugarcane (*Saccharum officinarum*), depending upon their availability. The insect is very small in size in the Ist and 2nd nymphal instars. Whole mounts of these two stages were prepared by clearing in 10 per cent KOH, dehydrating in ascending grades of alcohol, staining with Acid Fuchsin and mounting in canada balsam. Eye piece and stage micrometer were used for taking measurements of these two stages. The wing and tegminal rudiments could not be measured in the first instar because these were not well differentiated. For recording measurements, the nymphs were first narcotized with anesthetic either. The insects were weighed in an electric balance giving reading up to four decimal points. The number of observations in each case is 15.

RESULTS AND DISCUSSION

The utility of each criteria has been determined for the following four categories of identification on the basis of considerations mentioned against each category separately.

1. *The identification of different hopper instars when the two sexes have been treated independently of each other* :- In this case only those instars of the sexes concerned have been considered separable from each other on the basis of a particular criterion in whooe case the ranges of value of that criterion have shown no mutual overlapping.

2. *The identificatian of any hopper stage in a mixed population without regard to sex* :- In this behalf, only those instars have been considered

TABLE 1. *Mean and Standard Deviation of the Various Criteria*

Criteria	Sex*	INSTAR					
		1st	2nd	3rd	4th	5th	Adult
1. Number of antennal segments.	M.	15.5±0.5	18±1	21±1	24±1	27.5±0.5	29.9±0.5
	F.	15.5±0.5	18±1	22±1	25±1	27.5±0.5	29.5±0.5
2. Total antennal length. (mm)	M.	1.80±0.5	2.97±0.28	4.32±.67	6.65±.65	10.11±1.10	14.13±.87
	F.	1.82±.06	3.57±0.67	5.00±.68	7.81±.61	11.08±0.92	16.00±2.00
3. Length of apical antennal segment. (mm)	M.	0.18±0.2	2.22±0.02	0.31±.00	0.37±.02	0.38±0.01	0.40±0.02
	F.	0.18±.01	0.25±0.01	0.40±.02	0.42±.02	0.45±0.03	0.48±0.04
4. Head width. (mm)	M.	1.91±.06	2.65±0.05	3.30±.20	4.25±.25	5.15±0.27	5.60±0.15
	F.	1.95±.05	2.75±0.10	3.64±.19	4.74±.26	6.10±0.30	7.60±0.10
5. Length of pronotum (mm)	M.	0.52±.02	1.37±0.12	2.40±.25	3.40±.25	4.93±0.21	5.27±0.12
	F.	0.53±.02	1.46±0.14	2.80±.24	4.05±.45	5.85±0.42	7.25±0.29
6. Height of pronotum (mm)	M.	1.24±.02	2.25±0.10	3.50±.25	4.80±.30	7.10±0.40	8.04±0.45
	F.	1.26±.02	2.40±0.15	3.92±0.32	5.67±.57	7.62±0.52	10.7±1.25
7. Length of tegminal rudiments. (mm)	M.		0.94±0.2	1.50±0.14	3.85±.35	8.32±0.17	31.75±1.75
	F.		0.95±0.02	1.83±0.26	4.52±.27	13.07±0.42	38.00±2.00
8. Length of wing rudiments (mm)	M.		0.92±0.01	1.48±0.13	3.36±.09	8.25±0.25	30.75±0.75
	F.		0.94±0.01	1.77±0.27	4.07±.42	12.75±0.25	33.30±0.70
9. Length of hind femur (mm)	M.	4.01±.04	6.54±.15	8.72±0.47	11.87±.37	13.97±0.52	17.00±0.50
	F.	3.98±.04	6.78±0.24	9.87±0.12	12.82±.17	15.92±0.97	19.67±1.32
10. Total body length (mm)	M.	8.97±.12	14.60±0.60	20.25±0.75	24.50±.50	30.75±0.75	44.25±0.75
	F.	9.90±.10	14.95±0.95	20.75±1.25	28.75±1.75	41.50±1.50	51.75±2.25
11. E/H (elytron/head width) ratio.	M.		.338±.005	.534±.067	.901±.067	1.610±.072	5.654±.686
	F.		.047±.008	.479±.021	.981±.040	2.033±.109	5.014±.214
12. E/F (elytron/femur length) ratio.	M.		.142±.004	.172±.008	.325±.021	0.591±.014	1.899±.088
	F.		.143±.005	.190±.028	.368±.028	0.812±.012	1.886±.074
13. Body weight (grams)	M.	.094±.01	.132±.01	.265±.064	.65±.026	0.564±.007	4.595±.007
	F.	.094±.01	.158±.02	.347±.037	.601±.012	1.642±.127	2.082±.249

*M. = Male
F. = Female

TABLE 2 : *The Hopper Stages in which the Different Criteria have proved Reliable for the Different Categories of Identification*

Criterion	Category 1	Category 2	Category 3	Category 4
1.	All stages	1st, 2nd and 5th stage.	—NIL—	—NIL—
2.	All stages	Ist and 5th	—NIL—	—NIL—
3.	3rd stage male Ist and 2nd stage female	NIL	3rd, 4td and 5th stage	3rd stage male
4.	All Stages	All stages	5th stage	5th stage female
5.	All stages	All stages	—NIL—	—NIL—
6.	All stages	All stages	Ist, 2nd, 3rd and 4th stage	5th stage male and female
7.	All stages	All stages	4th and 5th stage	4th and 5th stage, male and female
8.	All stages	All stages	4th and 5th stage	4th and 5th stage, male and female
9.	All stages	Ist, 2nd and 3rd stage	3rd and 5th stage	3rd stage male and female
10.	All stages	Ist, 2nd and 3rd stage	4th and 5th stage	4th stage male and female
11.	All stages	All stages	5th stage	5th stage male and female
12.	All stages	All stages	5th stage	5th stage male and female
13.	All stages	Ist, 2nd and 5th stage	4th and 5th stage	4th stage female 5th stage male and female

separable on the basis of a particular criterion in whose case the ranges of value of that criterion have shown no mutual overlapping.

3. *The identification of sexes in corresponding hopper instars when the identity of the instars concerned is already known* :- Only those criteria have been considered reliable for the purpose of this category of identification, in whose case no overlapping of the ranges of value has occurred in the male and female hoppers in the respective instars.

4. *The identification of the instar and sex of hoppers in a mixed population* :- The utility of a criterion, for this purpose, has been judged by the fact that the range of value of that criterion in a particular instar for a particular sex stands totally apart, without overlaping, from the range of value of that criterion for the other sex in the same instar for either sex in any other/instar.

The data for the thirteen criteria under study have been presented in a consolidated form in Table 1. The conclusions drawn from these data have been given collectively, at one place in Table 2.

The criteria have evidently proved to be more useful for categories 1 and 2, but of sporadic utility for 3 and 4. These studies also reveal that if such keys are worked out for other grasshopper species, common parameters could be drawn for population estimation.

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