

Morphometric Variations in the Local Populations of *Chrotogonus Trachypterus* (Blanchard)

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The observed linear morphometric variations within the local species of the surface grasshopper, *Chrotogonus trachypterus* (Blanchard) was evident as per mean values for the different traits measured during a study in 2006-07. The lengths of antennae, tegmina, hind wing, body up to genitalia/ wing tip, pronotum, and the sternal region were relatively more for the females than the males; similarly the width of tegmina, body, pronotum, and the sternal region were also relatively more for the females. Variations in the linear measurements of the mouthparts and the legs of the grasshopper evinced that the females had relatively more length and width than that of the males for the different parameters observed; however, the maximum coefficient of variation was noted for the length of the galea (21.45 %) and for the tarsal region of the fore legs in either sex of the grasshopper. Comparison of the compounded ratios for some of the morphological traits showed that the ratio between length of hind femur and width of vertex (F/v) was the maximum (7.335 ± 0.132 and 7.151 ± 0.124 for the males and females, respectively). The lowest ratio happened to be for the ratio between the length and width of the pronotum (P/p) for both the males as well as the females (0.686 ± 0.014 and 0.624 ± 0.009).

Keywords: Surface grasshopper, *Chrotogonus trachypterus*, , morphometrics

INTRODUCTION

Surface grasshoppers are widely distributed in the orient and Africa. In India, *C. trachypterus* is reportedly more common in the north, whereas *C. oxypterus* in the south. The surface grasshopper is a pest of pastures almost throughout the year. The common desert representative of the genus collected from western Rajasthan is *Chrotogonus trachypterus trachypterus* (Kevan, 1959); is widely distributed, most frequently collected in the nurseries, gardens and the wheat fields. A dense population of 46 individuals per unit area (228m x 1.52m) was recorded from the *Kelwara* locality of Udaipur district with similar incidence noticed from other localities as well (Kushwaha and Bhardwaj, 1977). Akhtar (1971) recorded the nymphs and adults to feed on leaves of cotton and wheat, particularly in the areas adjoining wastelands. Species-level taxonomic studies usually include detailed morphological descriptions of taxa. Linear morphometrics provides more accurate identification than subjective visual differentiation and the best result was achieved by combined linear measurements and their ratios. Hence, with a view to visualize morphological variation in size of different body parts the present study was undertaken in the Department of Entomology, Rajasthan College of Agriculture, Udaipur.

MATERIALS AND METHODS

Linear measurements of various body parts of male and female grasshoppers were measured under Stemi 2000 C Stereo Binoculars (Carl Zeiss) using the Axio Vision LE 4.5 software. The terminology

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used by Albrecht (1955) was adopted for denoting different parts of the body of the grasshopper. Similarly, counting of number of antennal segments and hind tibial spurs was done using the binocular. Twenty specimens of the grasshopper species were observed for the study during the winter season (*Rabi*) 2006-07. The major linear measurements taken have been tabulated hereunder:

<i>S. No.</i>	<i>Body Parameters</i>	<i>Defined as</i>
1.	Length of the antenna (Λ)	The distance from the basal segment, the scape up to the terminal segment
2.	Length of the tegmina (I)	The distance from the base of the radius and media to the apex of the tegmina
3.	Width of the tegmina (t)	The distance between the two parallel lines touching the anterior and the posterior boundaries of the tegmina
4.	Length of the wing (W)	The distance from the base of the costa to the apex of the wing
5.	Width of the wing (w)	The distance between the two parallel lines touching the anterior and posterior boundaries of the wing when fully stretched
6.	Length of the body up to wing tip (BW)	The distance from the anterior end of head to the apex of the tegmina
7.	Length of the body up to genitalia (BG)	The distance from the anterior end of head to the apex of the genitalia
8.	Width of the body (b)	The widest part of the thorax near the first abdominal segment
9.	Length of the pronotum (P)	The distance from the anterior end to the posterior end of the pronotum, measured along the medial pronotal carina
10.	Width of the pronotum (p)	The distance between the tips of the lateral edges of the pronotum
11.	Length of the fore leg (FL)	The distance from the base of the trochanter to the tip of the claw
12.	Length of the middle leg (ML)	The distance from the base of the trochanter to the tip of the claw
13.	Length of the hind leg (HL)	The distance from the base of the trochanter to the tip of the claw
14.	Length of fore femur (FF)	The maximum length from base to the apex
15.	Length of middle femur (MF)	The maximum length from base to the apex
16.	Length of hind femur (HF)	The maximum length from base to the apex
17.	Width of the hind femur (hf)	The maximum width of femur from margin to margin
18.	Maximum head length (H)	The distance between the vertex to the posterior end of labrum
19.	Maximum head width (h)	The maximum width of head at the genal region
20.	Vertical diameter of eyes (VD)	The length of eyes in longitudinal direction
21.	Horizontal diameter of eyes (VD)	The length of eyes in horizontal direction

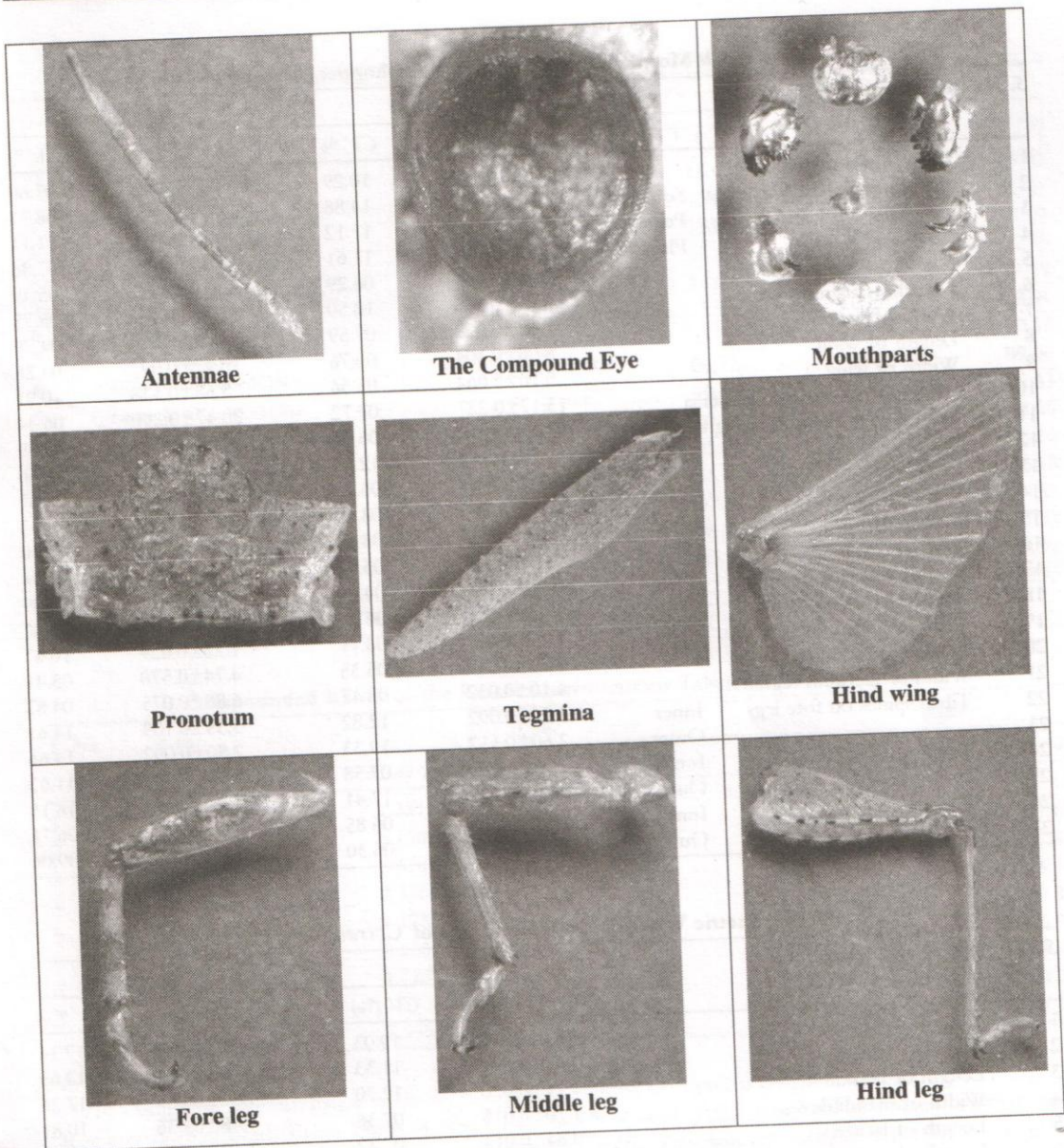


Plate: Major Body Pars Taken for Analyzing Variations in Linear Measurements

Table 1
Variation in Adult Morphometry of Surface Grasshopper, *C. trachypterus*

S. No.	Measurements (mm)	Male		Female		
		Mean \pm S. Em	CV %	Mean \pm S. Em	CV %	
1	Length of antenna	4.48 \pm 0.103	10.29	5.34 \pm 0.091	07.60	
2	Length of parts of antenna	Scape	0.46 \pm 0.015	14.88	0.54 \pm 0.011	08.71
3		Pediceal	0.25 \pm 0.006	11.12	0.21 \pm 0.007	11.11
4		Flagellum	3.78 \pm 0.098	11.61	4.49 \pm 0.079	07.86
5	No. of antennal segments	11.85 \pm 0.167	06.29	12.40 \pm 0.152	05.49	
6	Length of tegmina	8.71 \pm 0.205	10.50	12.58 \pm 0.162	05.75	
7	Width of tegmina	1.68 \pm 0.029	07.59	2.92 \pm 0.031	04.79	
8	Length of wing	8.06 \pm 0.104	05.76	10.12 \pm 0.097	04.28	
9	Width of wing	5.16 \pm 0.064	05.56	5.68 \pm 0.138	10.91	
10	Length of body up to genitalia	13.17 \pm 0.227	07.72	20.47 \pm 0.290	06.34	
11	Length of body up to wing tip	13.82 \pm 0.215	06.96	21.36 \pm 0.334	06.99	
12	Width of body	3.93 \pm 0.109	12.43	6.83 \pm 0.081	05.30	
13	Length of pronotum	2.79 \pm 0.041	06.65	4.26 \pm 0.065	06.87	
14	Width of pronotum	4.08 \pm 0.080	08.74	6.83 \pm 0.082	05.35	
15	Length of head	2.14 \pm 0.043	08.97	2.87 \pm 0.074	11.50	
16	Width of head	2.37 \pm 0.031	05.94	2.37 \pm 0.031	05.94	
17	Width of vertex	0.90 \pm 0.009	04.68	1.26 \pm 0.017	06.09	
18	Vertical diameter of eye	1.23 \pm 0.017	06.23	1.37 \pm 0.021	06.82	
19	Transverse diameter of eye	1.09 \pm 0.021	08.71	1.22 \pm 0.029	10.67	
20	Length of sternum region	3.33 \pm 0.040	05.35	4.74 \pm 0.570	05.41	
21	Width of sternum region	4.10 \pm 0.032	03.47	6.88 \pm 0.075	04.87	
22	Tibial spines on fore legs	Inner	3.20 \pm 0.092	12.82	3.35 \pm 0.109	14.61
23		Outer	2.60 \pm 0.112	19.33	2.80 \pm 0.092	14.66
24	Tibial spines on mid-legs	Inner	2.95 \pm 0.050	07.58	3.15 \pm 0.082	11.63
25		Outer	2.70 \pm 0.105	17.41	2.75 \pm 0.099	16.15
26	Tibial spines on hind legs	Inner	7.45 \pm 0.114	06.85	7.80 \pm 0.117	06.71
27		Outer	7.10 \pm 0.100	06.30	6.60 \pm 0.134	09.06

Table 2
Morphometric Variations in Mouth Parts of *C. trachypterus*

S. No.	Measurements (mm)	Male		Female		
		Mean \pm S.Em	CV (%)	Mean \pm S.Em	CV (%)	
1	Length of labrum	1.05 \pm 0.045	19.03	1.36 \pm 0.052	17.14	
2	Width of labrum	1.63 \pm 0.041	11.33	2.22 \pm 0.063	12.65	
3	Length of mandible	1.11 \pm 0.030	12.20	1.52 \pm 0.059	17.26	
4	Width of mandible	1.10 \pm 0.018	07.36	1.48 \pm 0.036	10.81	
5	Length of lacinia	0.84 \pm 0.014	07.32	1.19 \pm 0.024	09.01	
6	Length of galca	0.76 \pm 0.029	16.98	1.23 \pm 0.059	21.45	
7	Length of segments of maxillary palpi	I	0.24 \pm 0.007	13.54	0.29 \pm 0.010	15.30
		II	0.23 \pm 0.006	12.47	0.24 \pm 0.006	12.13
		III	0.32 \pm 0.007	09.67	0.39 \pm 0.011	12.74
		IV	0.37 \pm 0.011	13.02	0.46 \pm 0.013	12.91
		V	0.57 \pm 0.011	08.90	0.57 \pm 0.013	10.26
8	Length of labium	0.82 \pm 0.027	14.81	1.09 \pm 0.044	17.93	
9	Width of labium	1.22 \pm 0.026	09.63	1.56 \pm 0.048	13.63	
10	Length of segments of labial palpi	I	0.29 \pm 0.005	07.86	0.40 \pm 0.010	10.67
		II	0.31 \pm 0.006	08.92	0.40 \pm 0.013	14.51
		III	0.51 \pm 0.012	10.85	0.59 \pm 0.020	15.49

Table 3
Morphometric Variations in Legs of *C. trachypterus*

S.No	Measurements (mm)	Male		Female	
		Mean ± S. Em	CV (%)	Mean ± S. Em	CV (%)
1	Length of fore leg	5.62±0.147	11.63	7.02±0.155	09.82
2	Length of fore femur	2.33±0.071	13.61	2.97±0.074	11.21
3	Length of fore tibia	2.04±0.063	13.82	2.69±0.066	11.02
4	Length of fore tarsus	0.67±0.020	15.86	0.72±0.021	12.75
5	Length of fore pretarsus	0.62±0.020	14.65	0.64±0.016	11.19
6	Length of mid-leg	7.12±0.089	5.58	9.02±0.162	08.01
7	Length of mid femur	2.99±0.035	05.26	3.78±0.090	10.61
8	Length of mid tibia	2.74±0.054	08.72	3.56±0.072	09.06
9	Length of mid tarsus	0.72±0.017	10.43	0.91±0.020	09.63
10	Length of mid pretarsus	0.67±0.015	10.18	0.78±0.015	08.56
11	Length of hind leg	14.17±0.19	05.93	19.11±0.22	05.16
12	Width of hind femur	1.99±0.025	05.72	2.92±0.042	06.48
13	Length of hind femur	6.57±0.105	07.14	9.00±0.091	04.51
14	Length of hind tibia	5.62±0.068	05.43	7.61±0.133	07.83
15	Length of hind tarsus	1.08±0.024	09.83	1.46±0.029	08.98
16	Length of hind pretarsus	0.91±0.025	12.08	1.07±0.020	08.55

Table 4
Compounded Ratios of the Linear Measurements Taken for *C. trachypterus*

S. No.	Ratio	Males		Female	
		Mean ± S.Em	CV (%)	Mean ± S.Em	CV (%)
1	T / F	1.331±0.035	11.80	1.401±0.023	07.44
2	T / t	5.166±0.057	04.96	4.304±0.030	03.14
3	T / h	3.676±0.074	08.95	5.326±0.093	07.81
4	F / h	2.776±0.047	07.61	3.810±0.057	06.70
5	P / h	1.178±0.021	07.85	1.803±0.036	08.87
6	P / p	0.686±0.014	09.30	0.624±0.009	06.44
7	p / h	1.723±0.029	07.61	1.803±0.036	08.87
8	O / v	1.373±0.022	07.15	1.089±0.024	09.72
9	F / v	7.335±0.132	08.07	7.151±0.124	07.72

Compounded Ratio for:
(T/F) - length of tegmina/length of hind femur; (T/t) - length of tegmina/width of tegmina; (T/h) - length of tegmina/width of head; (F/h) - length of hind femur/ width of head; (P/h) - length of pronotum/ width of head; (P/p) - length of pronotum/ width of pronotum; (p/h) - width of pronotum/ width of head; (O/v) - length of vertical eye/width of vertex; (F/v) - length of hind femur/ width of vertex

RESULTS AND DISCUSSION

The linear morphometric variations in the different body parts of the locally collected adult surface grasshoppers, *C. trachypterus* were evident and the mean values with standard deviations have been presented in the Table (1). Intra-specific variation for the morphological characters is more often natural and can possibly be attributed to their feeding behaviour. The grasshoppers were collected from wheat/ barley crops with a more or less common weed flora including *Chenopodium murale*, *C.*

album, *Fumaria parviflora*, *Avena* sp., *Cynodon dactylon* and *Phalaris minor*. Feeding on some of these weeds apart from wheat and/ or barley could have implications on the growth and development of the surface grasshoppers. The coefficient of variation worked out for the different morphometric variations was the maximum for the numbers of spines on the outer fore legs in males (19.33%) and outer middle legs in females (16.15%). In both males and females the lower sternum width showed the lowest coefficient of variation (3.47 and 4.87% respectively). The lengths of antennae, tegmina, hind wing, body up to genitalia/ wing tip, pronotum, and the sternal region were relatively more for the females than the males; similarly the width of tegmina, body, pronotum, and the sternal region were also relatively more for the females. Earlier, Kushwaha and Bhardwaj (1977) have reported the linear biometrical data for the surface grasshopper, *C. trachypterus*, recording the body length up to wing tip, up to genitalia, tegmina, femur and the pronotum to be relatively more for the females than for the males.

From the Tables (2) and (3) depicting the morphometric variations in the mouthparts and the legs of the grasshopper, respectively, the females had relatively more length and width than that of the males for the different parameters observed. Among the variations recorded in the mouthparts, the maximum coefficient of variation was noted for the length of the galea (21.45 %). The variation in the legs of the grasshopper was more pronounced for the tarsal region of the fore legs in either sex of the grasshopper.

A comparison of the compounded ratios for some of the morphological traits as presented in Table (4) showed that the ratio between length of hind femur and width of vertex (F/v) was the maximum (7.335 ± 0.132 and 7.151 ± 0.124) for the males and females, respectively). The lowest ratio happened to be for the ratio between the length and width of the pronotum (P/p) for both the males as well as the females (0.686 ± 0.014 and 0.624 ± 0.009). Conspicuous difference between the ratios of some morphological characters for the males and the females was observed by Kundu and Mathur (1963).

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