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Biological Studies on the Surface Grasshopper, *Chrotogonus Trachypterus* (Blanchard) at Udaipur

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Studies on the biology of the surface grasshopper, C. trachypterus were carried out under laboratory conditions for two successive rabi seasons (Nov. 2005 – March 2006 and Nov. 2006 – March 2007) at the Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur. The females laid eggs in moist soil at a depth of 2-4 cm. Egg pods were hard, elongated and cylindrical with a slight bend at the middle. The average eggs laid per female were 65.500 ± 4.365. The average incubation period was 22.975 ± 1.015 days under laboratory conditions. The total nymphal period ranged from 43.50 to 53.50 (48.513 ± 0.496) days; with the first, second, third, fourth, fifth and sixth instars taking an average of 9.900 ± 0.238, 8.613 ± 0.302, 8.300 ± 0.173, 7.186 ± 0.191, 6.625 ± 0.146 and 7.913 ± 0.232 days, respectively. The pre-oviposition, oviposition and post-oviposition periods were 18.000 ± 0.793, 36.150 ± 2.075 and 12.250 ± 1.039 days, respectively. Adult longevity of male and female was observed as 54.350 ± 3.005 and 66.400 ± 3.210 days, respectively under laboratory conditions. The average linear biometrical data of egg pods, eggs, six nymphal instars and the adults (male and female) have also been presented.

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

INTRODUCTION

Surface grasshoppers are widely distributed in the orient and Africa. In India, *C. trachypterus* is more common in the north, whereas *C. oxypterus* in the southern regions. It is a pest of pastures almost throughout the year and is a polyphagous minor pest of agricultural crops. The common desert representative of the genus and all the specimens collected in the western Rajasthan appeared to belong to *Chrotogonus trachypterus trachypterus* (Kevan, 1959). The genus is distributed in the plains of India, Orissa, South Arcot, Madura, Coimbatore, Bellary, Madhya Pradesh and Rajasthan. Species of *Chrotogonus* are geophilous and occur for the most part on bare (including cultivated) soil, especially near water, where humidity is relatively higher. A highly dense population, up to 46 per unit area (228m x 1.52m) was noticed in the *Kelwara* area of Udaipur district (Kushwaha and Bhardwaj, 1977).

MATERIAL AND METHODS

Studies on the biology and bionomics of *C. trachypterus* were carried out under laboratory conditions for two successive *Rabi* seasons (Nov. 2005–March 2006 and Nov. 2006–March 2007). The surface grasshopper was reared in the laboratory maintaining the room temperature at 28 ± 2°C with a relative humidity of 60 ± 5 per cent.

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Biology

Oviposition in the Laboratory: Adults of *C. trachypterus* were collected from wheat and barley fields of farmers within 25 km radius of Udaipur. The collected surface grasshoppers were maintained in wooden frame wire gauge cages (50 cm x 50 cm x 60 cm) with a glass covered top. One pair of adults was kept in one cage and a total of 10 such cages were maintained. Fresh food comprising wheat seedlings (*Triticum aestivum*) was provided regularly. The seedlings were kept fresh by inserting the stems in a plastic bowl (500 ml) containing moist sterilized soil. Distilled water was used to prepare fresh food and was provided every alternate day. In order to facilitate climbing, moulting, basking, *etc.* a dry twig with branches was also provided in the cage. Sterilized, sieved dry sand with 15 per cent moisture was provided in a plastic bowl (500 ml. cap 18 cm height) for oviposition (Norris, 1968). Two to three containers were provided in each cage, which was replaced every day with fresh container after initiation of oviposition by the female. The egg pods laid by the females were collected for further study.

Incubation of Eggs: The egg pods laid by the females were kept in a glass vials (100 ml.) separately (one in each vial) and repeated 10 times. The pods were covered with sand (medium) and kept in a BOD incubator at 30°C and 70 per cent R.H., as suggested by Pradhan and Peswani (1961). Care was taken to keep the soil moist using distilled water. The duration and number of nymphs that hatched out were recorded.

Nymphal Stages: Immediately after hatching young nymphs were transferred into the rearing cages. Ten nymphs were confined to one cage and to such sets were maintained. The rearing cages were maintained at 28 ± 2°C and relative humidity 60 ± 5 per cent. The date of each moulting was recorded carefully by observing the exuviae to ascertain the number of instars and duration of each nymphal period till it matured.

Pairing and Oviposition: After attaining maturity, one pair each of male and female was transferred to rearing cage described earlier and five such cages were maintained providing the oviposition media. The date when female started first oviposition was noted. After initiation of oviposition the plastic container with moist soil was replaced every day and number of egg pods laid by female if any was counted and the date of egg-laying was also recorded.

Eggs: The eggs were laid in an egg pod, the coat of which was hard. In order to study the egg and number of eggs per pod, the freshly laid eggs within the pod were kept in distilled water over night in a Petri dish. The next day (after 24-26 hrs) the Petri dish along with egg pod was shaken gently to separate the soil particles glued. The eggs were collected and counted. Ten egg pods were examined in this way to know the number of eggs per pod.

Bionomics

The linear morphological measurements i.e., length and width of egg pod, length and width of eggs, length and width of body, length of antenna, length and width of head, length and width of pronotum, width of vertex and length of hind femur of all six instars and the adult males and females were measured under Stereo Binoculars (Stemi 2000 C of Carl Zeiss) using the Axio Vision LE 4.5 software for linear measurement. Ten specimens were observed for recording linear measurement.

RESULT AND DISCUSSION

Data pertaining to the biology and linear measurements (mean of 10) of the surface grasshopper have been presented in Tables (1) and (2). The females laid eggs in moist soil at a depth of 2-4 cm. Egg pods were hard, elongated and cylindrical with a slight bend at the middle. The average length and width of egg pods were 32.845 ± 0.519 mm and 2.485 ± 0.029 mm respectively, with an average number of egg pods per female as 7.500 ± 0.249. The freshly laid eggs were yellow that later turned to light brown, having an elongated shape, tapering at both the ends. The average length and width of the egg was 3.483 ± 0.064 mm and 0.955 ± 0.010 mm, respectively, with an average of 9.050 ± 0.560 eggs per pod. The average eggs laid per female were 65.500 ± 4.365. The average incubation period was 22.975 ± 1.015 days under laboratory conditions.

The first instar nymph was light yellow in colour with an average body length , length of antenna , length of head , length of pronotum , width of vertex and length of hind femur measured 3.441 ± 0.064 , 1.241 ± 0.022 , 0.783 ± 0.013 , 0.669 ± 0.011 , 0.297 ± 0.005 and 1.687 ± 0.015 mm respectively. The duration of first instar nymph was 9.900 ± 0.238 days. The second instar nymph was yellow in colour immediately after moulting that turned to dark yellow later. The duration of second instar was 8.613 ± 0.302 days, with length of body measuring 6.191 ± 0.114 mm, length of antenna 1.527 ± 0.021 mm, length of head 1.054 ± 0.013 mm, width of pronotum 1.695 ± 0.023 mm and length of hind femur 2.134 ± 0.026 mm. The duration of third instar was 8.300 ± 0.173 days with body length 7.005 ± 0.094 mm, antenna length 1.917 ± 0.043 mm, head length 1.359 ± 0.009 mm, pronotum length 2.511 ± 0.033 mm and hind femur length 3.177 ± 0.025 mm. The body length of fourth instar was 9.508 ± 0.099 mm, with length of antenna 2.745 ± 0.034 mm, length of head 1.604 ± 0.012 mm and length of pronotum 2.008 ± 0.026 mm respectively. The duration of fourth nymph was 7.186 ± 0.191 days with length of hind femur 4.587 ± 0.013 mm. The fifth instar nymphal period lasted 6.625 ± 0.146 days with body length measuring 10.686 ± 0.120 mm. The length and width of head measured 1.883 ± 0.011 mm and 2.158 ± 0.011 mm respectively. The length of pronotum and hind femur was 2.450 ± 0.012 and 5.342 ± 0.014 mm respectively. The duration of sixth instar nymph was 7.913 ± 0.232 days with length of body measuring 12.409 ± 0.095 mm, length of antenna 3.611 ± 0.018 mm, length of head 2.076 ± 0.017 mm and width of head 2.298 ± 0.011 mm respectively. The width of vertex was 0.852 ± 0.008 mm and the length of pronotum was 2.738 ± 0.014 mm. The total nymphal period ranged from 43.50 to 53.50 (48.513 ± 0.496) days.

The length of adult male body was 14.983 ± 0.077 mm, with antennal length 4.508 ± 0.150 mm. The length and width of head, length and width of pronotum, width of vertex and length of hind femur measured 2.229 ± 0.030 mm, 2.413 ± 0.029 mm, 2.911 ± 0.040 mm, 4.195 ± 0.047 mm, 0.904 ± 0.013 mm and 6.732 ± 0.129 mm respectively. The female was distinctly bigger than male, having length and width of body , length of antenna , length and width of head ,length and width of pronotum , width of vertex and length of hind femur measured as 20.436 ± 0.506 mm , 6.797 ± 0.119 mm , 5.291 ± 0.131 mm , 2.791 ± 0.097 mm , 3.625 ± 0.083 mm , 4.250 ± 0.088 mm , 6.791 ± 0.121 mm , 1.275 ± 0.026 mm and 8.953 ± 0.147 mm respectively. The pre-oviposition, oviposition and post-oviposition periods were 18.000 ± 0.793, 36.150 ± 2.075 and 12.250 ± 1.039 days, respectively. Adult longevity of male and female was observed 54.350 ± 3.005 and 66.400 ± 3.210 days, respectively under laboratory conditions. Chahal and Sohi (1964) gave a comprehensive account of the life history of *C. trachypterus*, including detailed tabulated information on egg numbers,

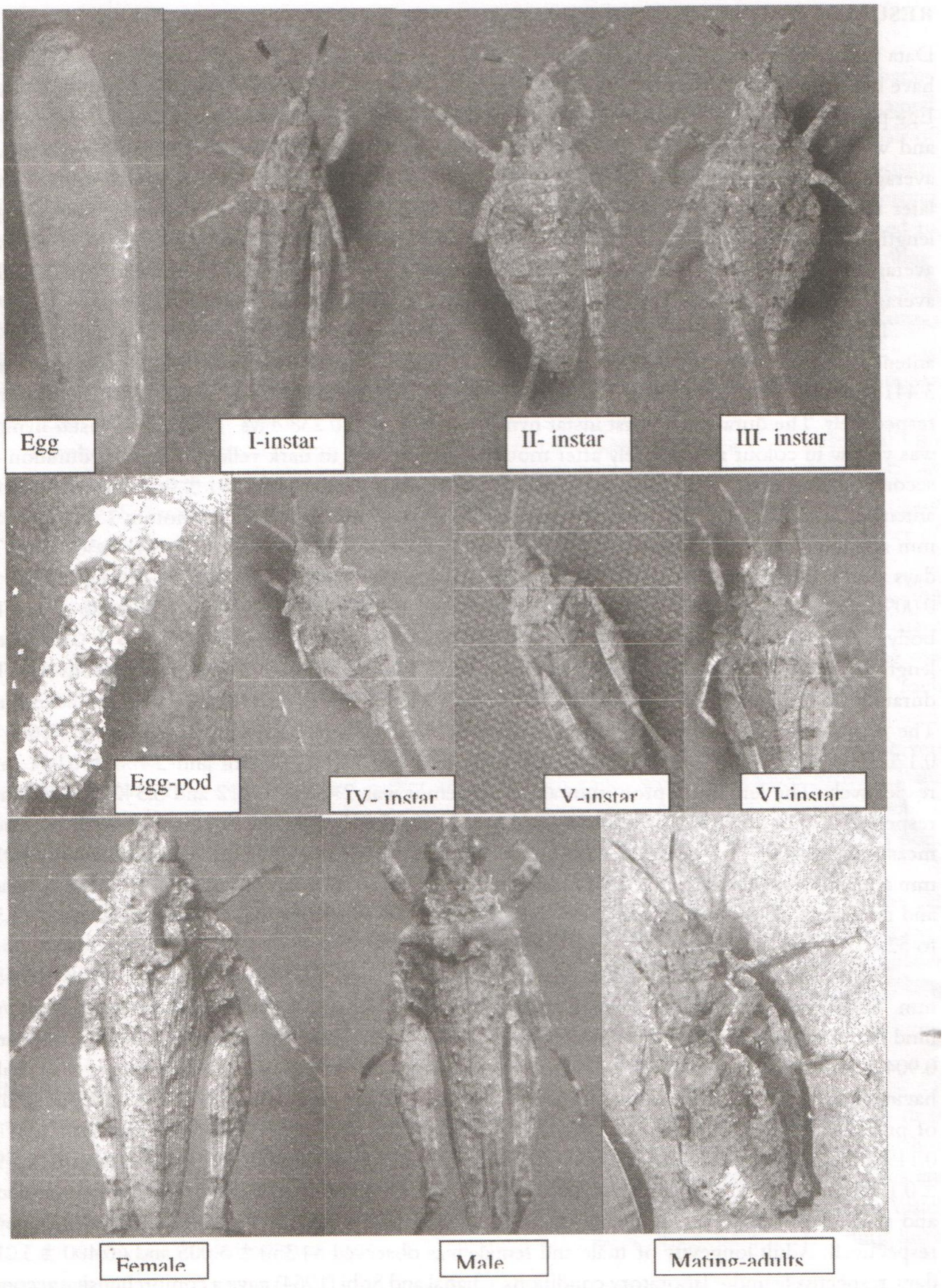

Plate: Life Stages of the Surface Grasshopper

longevity, sex ratio, and duration of various stages, incubation period and viability. Kushwaha and Bhardwaj (1977) studied some of the linear biometrical data of *Chrotogonus trachypterus*. Parihar (1987) has given a detailed account on the biology of *Chrotogonus trachypterus* and other grasshoppers. Asad *et al.* (2001) observed the incubation period to be 48.2 ± 10.9, 25.57 ± 4.10 and 19.85 ± 1.12 days at constant temperatures of 25 ± 1, 30 ± 1 and 35 ± 1 °C, respectively. At 30 °C, the males and females of *C. trachypterus trachypterus* took 103.0 ± 16.4 and 133.3 ± 13.8 days, respectively, to complete their development. Females lived longer than males. A female, on an average, laid 71.10 ± 24.54 eggs. The highest fertility of egg was observed at an average room temperature of 29.6 °C. The pre-oviposition, oviposition and post-oviposition periods for *C. trachypterus* were 16.4 ± 9.24, 36.9 ± 15.71 and 12.00 ± 9.04 days, respectively.

Table 1
Biology of the Surface Grasshopper, *C. trachypterus*

S. No.	*Criteria (days)*	*2005-06*			*2006-07*			*Pooled*
		Mean ± S. Em	*Max.*	*Min.*	*Mean ± S. Em*	*Max.*	*Min.*	*Mean ± S. Em*
1.	Adult longevity male	54.20± 3.038	72.000	33.000	54.50± 2.972	72.000	32.000	54.350 ± 3.005
2.	Adult longevity female	66.100± 3.247	87.000	43.000	66.70± 3.186	90.000	44.000	66.400± 3.217
3.	Pre-oviposition period	17.850± 0.789	24.000	13.000	18.15± 0.796	25.000	13.000	18.000± 0.793
4.	Oviposition period	36.150± 2.129	52.000	25.000	36.15± 2.020	52.000	24.000	36.075± 2.075
5.	Post-oviposition period	12.100± 1.078	19.000	4.500	12.40± 0.999	18.000	5.000	12.250± 1.039
6.	No. of egg pods/female	7.350± 0.254	10.000	6.000	7.650± 0.244	10.000	6.000	7.500± 0.249
7.	No. of eggs/pod	8.950± 0.555	13.000	5.000	9.150± 0.564	13.000	5.000	9.050± 0.560
8.	Total eggs/female	65.400± 4.412	96.000	40.000	65.60± 4.318	94.000	38.000	65.500± 4.365
9.	Incubation period	23.100± 1.071	30.000	17.000	22.85± 0.958	31.000	17.000	22.975± 1.015
10.	I instar	9.750± 0.237	11.500	8.000	10.05± 0.238	12.000	8.000	9.900± 0.238
11.	II instar	8.650± 0.319	11.000	6.500	8.575± 0.284	11.500	7.000	8.613± 0.302
12.	III instar	8.225± 0.160	9.000	7.000	8.375± 0.185	9.500	7.000	8.300± 0.173
13.	IV instar	7.100± 0.187	8.500	6.000	7.275± 0.194	9.000	6.000	7.186± 0.191
14.	V instar	6.500± 0.158	7.500	5.500	6.750± 0.133	7.500	6.000	6.625± 0.146
15.	VI instar	7.850± 0.233	9.500	6.500	7.975± 0.231	10.000	6.000	7.913± 0.232
16.	Total nymphal period	48.025± 0.518	53.500	43.500	49.00± 0.473	53.000	45.000	48.513± 0.496

Table 2
Linear Morphometric Data of *C. trachypterus*

S. No.	*Criteria*	*Length of egg*	*Width of egg*	*Length of egg pod*	*Width of egg pod*
1.	*Mean ± S. Em.*	*3.483 ± 0.064*	*0.955 ± 0.010*	*32.845 ± 0.519*	*2.485 ± 0.029*
2.	*Maximum*	*3.780*	*0.990*	*35.200*	*2.600*
3.	*Minimum*	*3.140*	*0.900*	*30.920*	*2.330*

	Measurement (mm)		*Nymphs*						*Adults*	
			I instar	*II instar*	*III instar*	*IV instar*	*V instar*	*VI instar*	*Male*	*Female*
4.	Length of body	M. ± S.Em.	3.441± 0.064	6.191± 0.114	7.005± 0.094	9.508± 0.099	10.686± 0.120	12.409± 0.095	14.983± 0.077	20.436± 0.506
		Maxi.	3.720	6.840	7.400	9.920	11.210	12.910	15.330	22.430
		Min.	3.060	5.780	6.390	9.020	10.190	12.010	14.650	17.270
5.	Width of body	M. ± S.Em.	1.363± 0.028	2.134± 0.058	2.743± 0.055	3.264± 0.034	3.889± 0.040	4.271± 0.036	4.733± 0.037	6.797± 0.119
		Maxi.	1.520	2.440	2.980	3.420	4.040	4.420	4.920	7.310
		Min.	1.250	1.910	2.420	3.140	3.680	4.080	4.530	6.190
6.	Length of antenna	M. ± S.Em.	1.241± 0.022	1.527± 0.021	1.917± 0.043	2.745± 0.034	3.310± 0.007	3.611± 0.018	4.508± 0.150	5.291± 0.131
		Maxi.	1.360	1.620	2.310	2.890	3.340	3.690	5.420	6.120
		Min.	1.130	1.420	1.720	2.600	3.280	3.520	3.770	4.570
7.	Length of head	M. ± S.Em.	0.783± 0.013	1.054± 0.013	1.359± 0.009	1.604± 0.012	1.883± 0.011	2.076± 0.017	2.229± 0.030	2.791± 0.097
		Maxi.	0.840	1.120	1.410	1.670	1.950	2.160	2.400	3.550
		Min.	0.710	0.980	1.310	1.560	1.830	2.010	2.120	2.460
8.	Width of head	M. ± S.Em.	0.857± 0.010	1.035± 0.013	1.487± 0.019	1.967± 0.013	2.158± 0.011	2.298± 0.011	2.413± 0.029	3.625± 0.083
		Maxi.	0.900	1.980	1.560	2.020	2.220	2.360	2.530	4.07
		Min.	0.810	0.980	1.410	1.910	2.110	2.230	2.260	3.200
9.	Length of pronotum	M. ± S.Em.	0.669± 0.011	0.876± 0.017	1.390± 0.031	2.008± 0.026	2.450± 0.012	2.738± 0.014	2.911± 0.040	4.250± 0.088
		Maxi.	0.720	0.960	1.440	2.150	2.500	2.810	3.080	4.670
		Min.	0.620	0.810	1.180	1.890	2.390	2.670	2.740	3.600

table contd.

S. No.	Criteria		Length of egg	Width of egg	Length of egg pod	Width of egg pod
1.	Mean ± S. Em.		3.483 ± 0.064	0.955 ± 0.010	32.845 ± 0.519	2.485 ± 0.029
2.	Maximum		3.780	0.990	35.200	2.600
3.	Minimum		3.140	0.900	30.920	2.330

	Measurement (mm)		Nymphs						Adults	
			I instar	II instar	III instar	IV instar	V instar	VI instar	Male	Female
10.	Width of pronotum	M. ± S.Em.	1.299±	1.695±	2.511±	2.778±	3.477±	4.004±	4.195±	6.791±
			0.023	0.023	0.033	0.014	0.018	0.018	0.047	0.121
		Maxi.	1.400	1.790	2.690	2.850	3.560	4.090	4.420	7.310
		Min.	1.210	1.580	2.410	2.710	3.390	3.920	3.990	6.190
11.	Width of vertex	M. ± S.Em.	0.297±	0.362±	0.420±	0.670±	0.745±	0.852±	0.904±	1.275±
			0.005	0.006	0.029	0.011	0.010	0.008	0.013	0.026
		Maxi.	0.320	0.390	0.490	0.720	0.800	0.890	0.990	1.430
		Min.	0.270	0.340	0.170	0.620	0.700	0.820	0.820	1.180
12.	Length of hind femur	M. ± S.Em.	1.687±	2.134±	3.177±	4.587±	5.342±	6.013±	6.732±	8.953±
			0.015	0.026	0.025	0.013	0.014	0.015	0.129	0.147
		Maxi.	1.750	2.250	3.290	4.670	5.410	6.080	7.330	9.690
		Min.	1.610	2.020	3.020	4.520	5.280	5.920	6.150	8.430

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