Punjab Univ. J. Zool., Vol. 21 (1-2), pp. 009-017, 2006

STUDY OF SEASONAL VARIATIONS OF *DANAUS CHRYSIPPUS* (LINNAEUS) FROM LAHORE

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Abstract: The study is based on 80 specimens of *Danaus chrysippus* (Linn.) collected during autumn and spring for morphometric variations. Fifteen morphological characters were selected. Length of scent gland of hindwing of male autumn form was found highly variable and wingspan (WS) was found the least variable characters. Similarly in male spring form, the width of discoidal cell (DC) of forewing was found highly variable and body length was found the least variable characters. In case of female autumn form, length of costa of forewing was found highly variable while length of dorsum of hindwing was found the least variable characters. In female spring form, dorsum length of hindwing was found highly variable character. The least variable character was, length of DC of hindwing. The relationships of body length with remaining morphological characters were also studied by applying correlation and regression analysis. Body length BL was considered as independent variable and other characters were considered as dependent variable. There was positive correlation between body length and other characters, but the extent of increase in dependent parameters varied. As regard the comparison of different characters in butterflies collected during autumn and spring forms, the statistical analysis revealed non-significant difference between (BL) of male and female specimens.
Keywords: Butterflies, seasonal variation, morphmetric variation.

INTRODUCTION

With a growing awareness worldwide of the importance of biodiversity, many countries are now devoting more resources for research upon butterflies. Not only are butterflies very sensitive to habitat degradation, but they also have a much more rapid passage of generations than higher vertebrates and hence can be quicker to react to small changes in their environment than those declining bird and

0079-8045/06/0009-0017 $ 03.00/0

animal populations that have already been valued as sensitive indicators of environmental change and deterioration**.** They are therefore especially important and valuable to ecologists, environmentalists, and indirectly to government development planners, as well as to the scientists unraveling the complexities of evolutionary theory and the mechanisms of genetics**,** (Roberts, 2001). One hundred and thirty five species of butterflies have been reported from Pakistan (Roberts, 2001) but detailed morphometric variations in seasonal forms have not been studied, so far, regarding the butterflies species found in Pakistan**.** Some significant contribution about the butterfly fauna of oriental region has also been made by **(** Peile, 1937; Talbot, 1939; Mani, 1986; and Hasan, 1997 **).** In the present report morphometric variations in the autumn and spring forms and male and female sexes are described in detail.

MATERIALS AND METHODS

The study is based on butterflies collected from the Lahore during autumn of 2003 and spring of 2004. The butterflies were collected with the help of entomological net and preserved in the killing bottle containing potassium cyanide (KCN). The specimens were later on stretched and measured with the help of divider and scale in millimeter (mm). Eighty specimens including males and females were measured. Forty specimens pertained to autumn season and forty pertained to the spring season. The fifteen morphometric characters measured were Body length (BL) Wing span (WS) Length of forewing (LFW) Width of forewing (WFW) Length of discoidal cell of forewing (LDCFW) Width of discoidal cell of forewing (WDCFW) Length of dorsum of forewing (LDFW) Length of costa of forewing (LCFW) Length of hindwing (LHW) Width of hindwing (WHW) Length of discoidal cell of hindwing (LDCHW) Width of discoidal cell of hindwing (WDCHW) Length of dorsum of hindwing (LDHW) Length of costa of hindwing (LCHW) Length of scent gland of hindwing (LSGHW)

Special emphasis has been laid on relationship of various morphological features with the body size (head, thorax and abdomen collectively) considered as independent variable and the remaining fourteen characters were considered as dependent variables**.** The data were analyzed by using SPSS 8 and SPSS 10 versions for various statistical parameters:

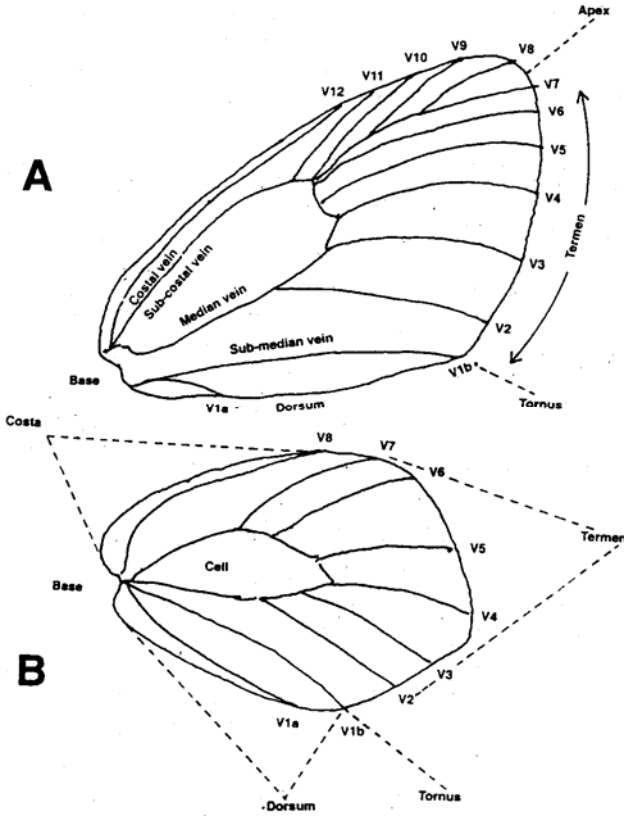


Figure 1: Wing Venation and Generalized Areas (After Roberts, 2001)
(A) Forewing venation
(B) (B) Hindwing venation

RESULTS

Forty specimens of autumn forms of *Danaus chrysippus* were measured. Table 1 gives detail of the measurements of male and female forms for fifteen parameters. Body length of the male varied from 20-25 mm and wingspan from 66-82 mm. Similarly the body length of the female autumn form varied from 20-25 mm and wingspan ranges from 66-82 mm. However, maximum variability (C.V= 15.94) was recorded for length of scent gland of hindwing (LSGHW) and minimum variable (C.V= 5.29) for wingspan of male autumn form. In case of female autumn form, length of

costa of forewing (LCFW) was found highly variable character (C.V. =13.50) and length of dorsum of hindwing (LDHW) was found the least variable character (C.V. = 7.49). As regards, spring forms, 40 specimens were measured. Table 2 gives detail of the measurements of males and females form for fifteen parameters. Body length of male of spring form varied from 20-25 mm and wingspan from 63-85 mm. Similarly body length of female spring form varied from 20-25 mm and wingspan from 64-81 mm. However, maximum variability (C.V. = 13.73) was recorded for width of discoidal cell of forewing (WDCFW) and minimum variable (C.V. = 6.81) for body length of male spring form. In female spring form, length of dorsum of hindwing (LDHW) was found highly variable character (C.V. =15.93). The least variable character found was, length of discoidal cell of hindwing (LDCHW; C.V. =6.03). Variations for other parameters are given in the Tables I and II.

Table I: The descriptive statistics of the *Danaus chrysippus* (Linn.)

Parameters of Male/ Female autumn forms	$\bar{X}$		MIN.		MAX.		S.D		C.V.	
	M	F	M	F	M	F	M	F	M	F
BL	23	22.470	20	20	25	25	1.314	1.699	5.71	7.56
WS	74.608	73.411	66	66	82	82	3.951	5.690	5.29	7.75
LFW	36.869	36.411	31	33	42	41	2.159	2.851	5.85	7.83
WFW	24.173	23.588	18	21	27	27	1.945	1.970	8.04	8.35
LDCFW	20.173	19.764	17	16	23	23	1.466	2.016	7.26	10.20
WDCFW	5.304	5.411	4	4	7	6	0.702	0.618	13.23	11.42
LDFW	22.130	21.941	20	16	26	26	1.486	2.192	6.71	9.99
LCFW	18.608	18.176	13	15	24	24	2.444	2.455	13.13	13.50
LHW	25.913	25.823	23	22	28	30	1.729	2.242	6.67	8.68
WHW	22.304	22.117	20	19	25	26	1.362	1.900	6.10	8.59
LDCHW	15.130	14.764	13	12	16	17	0.919	1.347	6.07	9.12
WDCHW	6.086	6.352	5	5	7	7	0.733	0.701	12.04	11.03
LDHW	14.521	13.764	12	12	17	15	1.410	1.032	9.71	7.49
LCHW	11.826	11.294	10	9	15	14	1.527	1.358	12.91	12.02
LSGHW	5	-------	4	---	6	----	0.797	-------	15.94	--------

For other abbreviations, see materials and methods section:
Male autumn form. N= 23 and Female autumn form. N= 17 (M= male; F=female; $\bar{X}$ = mean; MIN. = minimum; MAX. = maximum; S.D = standard deviation and C.V. = Coefficient of variability)

Table II: The descriptive statistic of the *Danaus chrysippus* (Linn.) of male spring form.

Parameters of Male/ Female spring forms	X^-		MIN.		MAX.		S.D		C.V.	
	M	F	M	F	M	F	M	F	M	F
BL	22.857	22.578	20	20	25	25	1.558	1.643	6.81	7.27
WS	72.238	72.157	63	64	85	81	6.015	4.991	8.32	6.91
LFW	35.476	35.789	31	32	39	40	2.542	2.439	7.16	6.81
WFW	23.238	23.684	20	20	26	28	1.813	2.056	7.80	8.68
LDCFW	19.523	19.526	16	16	23	22	1.860	1.576	9.52	8.07
WDCFW	5.095	5	4	4	6	6	0.700	0.666	13.73	13.32
LDFW	21.761	22	19	20	26	25	2.047	1.490	9.40	6.77
LCFW	18.619	19.105	16	15	23	23	2.519	2.051	13.52	10.73
LHW	26.333	26.789	21	23	29	30	2.033	1.960	7.72	7.31
WHW	21.142	22.052	17	19	24	26	1.796	1.747	8.49	7.92
LDCHW	14.619	14.052	13	13	17	16	1.283	0.848	8.77	6.03
WDCHW	6	5.842	5	5	7	7	0.632	0.602	10.53	10.30
LDHW	14.095	13.947	12	13	17	22	1.338	2.222	9.49	15.93
LCHW	11.142	11.052	9	9	13	15	1.424	1.544	12.78	13.97
LSGHW	4.571	-------	4	----	6	----	0.597	--------	13.06	------

For abbreviation used:
N=21 and Female spring form. N= 19 (M= male; F=female; X^- = mean; MIN. = minimum; MAX. = maximum; S.D = standard deviation and = C.V. = Coefficient of variability) Mean; X^-; Standard deviation S.D; Coefficient of variability= C.V.; Correlation coefficient; (R)= Regression analysis; Test "t" of Student *Correlation and Regression analysis of BL Vs dependent variables in males:*

The relationship between BL, independent variable and WS, which is a dependent variable, of male autumn form is shown in (Fig 2). The correlation analysis among the considered characters showed the existence of highest positive correlation between body length (BL) and wingspan (WS) (R=0.92782) of male autumn form and between the body length and length of forewing (LFW) (R=0.87630) of male spring form. There was positive and significant relationship between BL and WS. Regression analysis can be explained from the equation;

$$Y= 10.450+2.789(x)$$

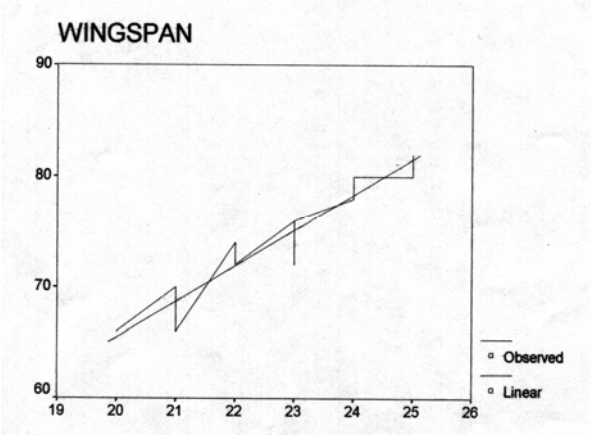


Figure 2: Regression analysis of Body length Vs. Wingspan of Male autumn form.

Other studied morphometric characters also showed positive correlation with body length but degree of relationship varied (Table III).

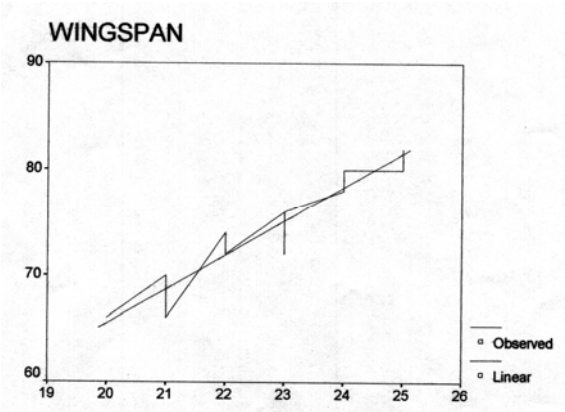


Figure 3: Regression analysis of Body length Vs. Wingspan of female autumn form.

Other studied morphometric characters of females showed positive relation with BL (Table III), but for the sake of brevity, figures are not given.

The highest correlation observed among the considered characters of female autumn form was between body length (BL) and wingspan (WS) (R=0.96079) and between the body length (BL) and length of hindwing (LHW; R=0.91934) of female spring form. The relationship between BL, independent variable and, WS, which is a dependent variable, of female autumn form is shown in (Fig 3). There was positive and significant relationship between BL and WS. Regression analysis can be explained from the equation;

$$Y=1.139+3.216(x)$$

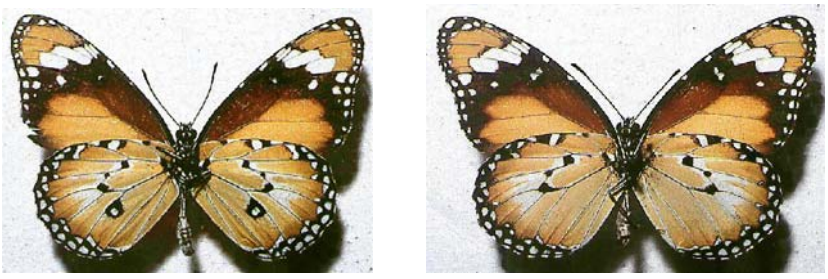
Table III: Correlation coefficient (R) value for different characters of male and female autumn and spring forms of *Danaus chrysippus*(Linn.). Body length (BL) was considered independent variable and others were dependent variables.

Parameters BL Vs.	R value of autumn forms		R value of spring forms	
	Male	Female	Male	Female
WS	0.92782	0.96079	0.84114	0.90231
LFW	0.82291	0.93738	0.87630	0.84938
WFW	0.79981	0.90116	0.70244	0.79678
LDCFW	0.58965	0.65425	0.76859	0.88352
WDCFW	0.49204	0.33927	0.82997	0.70978
LDFW	0.55842	0.72884	0.80382	0.81623
LCFW	0.77812	0.72752	0.82594	0.85392
LHW	0.91974	0.84286	0.86797	0.91934
WHW	0.79070	0.89124	0.77547	0.74325
LDCHW	0.71450	0.73340	0.67131	0.81382
WDCHW	0.84910	0.53307	0.71022	0.60268
LDHW	0.58869	0.35188	0.46243	0.67780
LCHW	0.38502	0.42347	0.52777	0.81882
LSGHW	0.91047	----------	0.78997	----------

For Abbreviation; see materials and methods section:
Correlation and Regression analysis of BL Vs dependent variables in females:

DISCUSSION

Danaus chrysippus(Linn.) is the most widely spread and the commonest butterfly found in Pakistan, throughout the plains and lower foothill areas, being much better adapted to dry areas than any of the other Daininae species. Also, unlike the other Daininae species in Pakistan, it can be encountered in every month of the year. (Roberts, 2001). This butterfly is also distributed in India, China, Japan, Malaysia, North Australia, and North Africa. (Hasan, 1997). *Danaus chrysippus* males and females can be morphologically differentiated on the basis of scent gland present on the hindwing of male (Roberts, 2001). The difference between male and female is shown in Fig.4 and 5. Inspite of the detailed description given by Roberts (2001), there is no literature available on morphometric variations in butterflies. Hasan (1997) and Roberts (2001) have mentioned only the wingspan from 70-80 mm. Present study revealed that there are also smaller specimens which were collected during autumn and spring, from Lahore and consequently the wingspan of male autumn form ranges from 66-82 mm, while that of spring form ranges from 63-85 mm. As regard the females, the wingspan ranges from 66-82 mm in autumn form and 64-81 mm in spring form. Test "t" comparison, for body length and wingspan doesn't revealed statistical significant differences (male; p=0.743 and female; p=0.847) between the specimens, collected during autumn and spring forms. Size ranges of other morphological characters discussed in the present report will be helpful for further studies for comparison of butterflies of Pakistan.



male (a) female (b)

Figure 4: *Danaus chrysippus,* male (a) and female (b).

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(Received: 20 November, 2005; Revised: 15 February, 2006)