

Description of Morphological Variation in Three Species of the Genus *Oxya* (Serville)

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Abstract: The systematic state of the genus *Oxya* is in such disarray that it has almost impossible to identify specimens with stable names or in many cases, to separate one species from another. The present studies revealed the comparative external morphology of three grasshoppers species *Oxya hyla hyla*, *O. velox* and *O. fuscovittata* on the basis of seventeen different important characters out of which five characters introduced for the first time given here.

Key words: Morphological variation, genus *Oxya*

Introduction

Grasshoppers are polyphagous and have great economic importance because of constant threat to cash crops all over the world. Grasshopper species of the genus *Oxya* (Serville) belong to the subfamily Oxyinae of the family Acrididae are well known cosmopolitan creatures. The study of insect morphology provide a basis for proper comprehension of insect physiology but also serve as bedrock for all taxonomic work and no further development is possible both in pure and applied fields. Gangwere (1960) studied the morphology of mouthparts and reported that labrum is emarginate type while in (1965) he described the lacinial mexadents in graminivorous grasshoppers. Structure of mandibles studied by Isely (1944), Chapman (1964), Chernyakovsky (1968) and Feroz and Chaudry (1975). Willemse (1925) differentiated the *Oxya ocuminata*, *Oxya multidentata* and *Oxya eleneri* from *Oxya hyla* and one another on characters such as width of hind femur, eye size and degree of reclamation of the frons.

Bei-Bienko and Mishchenko (1951) described and classified 8 species of *Oxya* and reported that hind tibia with external and internal distal spines. Uvarov (1926) stated that *Oxya hyla* does not differ in female genitalia from Indian *Oxya multidentata* but later is more slender with longer tegmina. While Hollis (1971) described the genitalia of 18 species of *Oxya*. He also reported and classified the *Oxya hyla hyla*, *Oxya fuscovittata*, *Oxya japonica* and *Oxya ningpoensis* on basis of number of spines, space between them and shape of posterior margin of female subgenital plate.

This experiment is therefore undertaken to investigate the comparative external morphology of three grasshopper species *Oxya hyla hyla*, *Oxya velox* and *Oxya fuscovittata* to identify specimens with stable names. Some new characters are also added along with sketches and measurement (mm).

Materials and Methods

The adult of *Oxya hyla hyla*, *Oxya velox* and *Oxya fuscovittata* were collected from the rice, tomato, watermelon, sorghum, maize and grasses fields by using hand net. The specimens were killed in a cyanide bottle and preserved in a solution of 70% alcohol and glycerin (10:1) in wide-mouthed glass bottles. Some insects were also pinned and properly set for keeping in the insect store boxes in dry condition for use in further studies.

For morphological studies, different body parts were detached from the specimens and put in 10% potassium hydroxide solution for clearing them. The harder parts were boiled for 1-2 hours in above solution to get parts become transparent,

they were put in glacial acetic acid for 5-10 minutes to remove the remains of potassium hydroxide and finally washed with distilled water for 10 minutes in watch glass to remove the tracer of salts. After washing the parts properly, they were stained in acid fuchsin for 10 minutes in watch glass. For proper dehydration and removal of excessive stain, the parts were passed through ascending grades of alcohol i.e., 30%, 50%, 70%, 95%, and absolute alcohol for 5-10 minutes. Then they were dipped in xylene for 5-10 minutes to remove the excessive alcohol on it. They were thereafter, kept in clove oil for twelve hours to fix the stain and to clear them. After giving a dip in xylene, the parts were mounted on slides in Canada balsam. Some of delicate parts were mounted directly in Hoyer's medium.

The prepared slides were examined under the binocular microscope wild M3B for studying the morphological features. The measurements of morphological important body parts were taken with ocular and stage micrometer. The illustrations were prepared with the help of camera Lucida. For the presentation of results, terminology of Snodgrass (1935) and Uvarov (1966) was followed for general description. The terminology of Hollis (1971) and Wagan (1984) was followed for describing the genitalia and mouthparts, respectively.

Results and Discussion

The structure and comparative diversity of various body parts of three species of the genus *Oxya* (*Oxya hyla hyla*, *Oxya velox*, *Oxya fuscovittata*) have been presented in the Table 1 and depicted in Figs. 1-11 (a-c). Generally the body size of *Oxya hyla hyla* in male 19-23 mm and female 25-30 mm, *Oxya velox* in male 24-25 mm and female 27-28 mm and *Oxya fuscovittata* in males 19-21 mm and female 27-32.25 mm.

Head: The head of *Oxya hyla hyla* is oval and broader than pronotum but oval and as broad as the pronotum in *Oxya fuscovittata* but oval and slightly broader than pronotum in *Oxya velox* and it is partially in conformity with the results of Ahmad (1958) who described the head as wide as the pronotum. Epicranial sulcus complete and distinct in *Oxya velox* but it is incomplete and ill defined in *Oxya hyla hyla* while it is absent in *Oxya fuscovittata* (Table 1, Fig. 1a-c). This character has been studied for the first time in this genus. Fastigium is short with deeply rounded apex and with shallow longitudinal carinula in *Oxya hyla hyla* and with slightly deep in *Oxya velox* whereas, it is short with slightly obtuse from

Al-Hariri *et al.*: Variation in three *Oxya* species

Table 1: Comparative characters of three species of the genus *Oxya* (Serville)

<i>Oxya hyla hyla</i>	<i>Oxya velox</i>	<i>Oxya fuscovittata</i>
Head is oval and broader than pronotum (Fig. 1a)	Head is oval and slightly broader than Pronotum (Fig. 1b).	Head is oval and broad as pronotum (Fig. 1c).
Epicranial suture incomplete and ill defined (Fig. 1a)	Epicranial suture well developed (Fig. 1b).	Epicranial suture absent (Fig. 1c)
Antennal segments range is 24-25	Antennal segments range 22-24.	Labrum somewhat oval with vary shallow apical notch (Fig. 2c).
Labrum strongly oval with slightly oval with slightly shallow apical notch (Fig. 2a).	Labrum subrectangular with moderate apical notch (Fig. 2b).	Labrum somewhat oval with very shallow apical notch (Fig. 2c).
Parastipes conical (Fig. 2a).	Parastipes long rectangular strip (Fig. 3b).	Parastipes somewhat long triangular (Fig. 3c).
Palpifer moderately broad (Fig. 3a).	Palpifer narrow and ill defined (Fig. 3b).	Palpifer strongly broad and looks like the Part of maxillary palpus (Fig. 3c).
Pronotum slightly flattened, hardly narrowing forwards and with rounded posterior margin of metazona (Fig. 4a).	Pronotum slightly flattened and slightly narrowing forwards with widely obtuse angular posterior margin of metazona medium longitudinal carina absent (Fig. 3b).	Pronotum flattened parallel sides and with slightly rounded posterior marging of metazona (Fig. 4c).
Median longitudinal carina divides the scutum as well as Scutellum (Fig. 4a).	Median longitudinal carina absents (Fig. 4b).	Median longitudinal carina divides only scutum (Fig. 4c).
Male tegmen with medium length and width.	Male tegmen greater in length and width.	Male tegmen lesser in length and width.
Relative measurement (mm) of tegmen. Male Length 16-20 Width 3-3.5 Female Length 22.5-22.5 Width 3.5-4.5	22-21 3.5-4 28-30.5 4-4.25	20-21 2.5-3 28-30.5 5-5.5
Radial sector of male tegmen has three branches Rs_1 , Rs_2 , Rs_3 (Fig. 5a).	Radial sector of male tegmen is unbranched (Fig. 5b).	Radial sector of male tegmen has two branches Rs_1 , Rs_2 (Fig. 5c).
Hind femur medium length and width	Hind femur long and wide.	Hind femur small in length and width.
Relative measurement of hind femur. Male Length 12-13.5 Width 2.75-3 Female Length 14.5-17 Width 3-4	14-15 4-4.25 16-16.75 4.25-4.5	10-11.5 2.25-2.5 18.5-19 3-3.5
Cercus conical or compressed laterally with subacute apex (Fig. 6-7a).	Cercus conical with subacute apex (Fig. 6-7b).	Cercus strongly compressed and bifid (Fig. 6-7c).
Supra-anal plate bears tubercle on each side of the median apical process (Fig. 6-7a).	Supra-anal plate without tubercles (Fig. 6-7b).	Supra-anal plate with more pronounced tubercles (Fig. 6-7c).
Subgenital plate bear a pair of short median spines on posterior margin (Fig. 8a).	Subgenital plate with widely spaced median spines (Fig. 8b).	Subgenital plate emarginate medially α with two very median spines (Fig. 8c).
Epiphallus consists of curved hook like outer lophi and well developed tooth like inner lophi (Fig. 9a).	Epiphallus with hook like outer and large tooth like inner lophi (Fig. 9b).	Epiphallus with boot shaped outer and tooth like inner lophi having left lophus is always less developed than the right one (Fig. 9c).
Valvular plate of cingulum bears small margination at apex (Fig. 10a).	Valvular plate of cingulum very large, upcurved rotted almost into a cylinder with enlarged apex (Fig. 10b).	Valvular plate of cingulum bears shallow and well-defined margination at apex (Fig. 10c).

Al-Hariri et al.: Variation in three *Oxya* species

Posterior ventral basivalvular sclerite bears very small spinelets on inner ventral margin (Fig. 11a).	Posterior ventral basivalvular sclerite with out spines (Fig. 11b).	Posterior ventral basivalvular sclerite with small spines (Fig. 11c).
Body measurement of male (mm) 19-23	24-25	19-21
Body measurement of female (mm) 25-30	27-28	27-32.25

Table 2: List of Abbreviations

Head	
E = Compound eye	Ep = Epicranium
Es = Epicranial Suture	Fa = Fastigium
Fs = Frontal furrow	Oc = Occiput
Vx = Vertex	
Mouth parts	
Es = Epipharyngeal sulcus	Ex = Epipharynx
Ga = Galea	H = Hair
Il = Incisor lobe	Lc = Lacinia
Jca = Juxta - Cardo	Le = Labral margination
Md = Mxodents	Mxp = Maxillary Palpus
Pas = Parastipes	Pf = Palpifer
Se = Setae	Sh = Sensory hair
St = Stipes	Tm = Torma
Vca = Vera-cardo	
Thorax	
Mc = Median carina	Mz = Metazona
No = Notalia	Pz = Prozona
Tf = Transverse furrow	
Wings	
1A = Anal -1	2A = Anal -2
C = Costa	Ou = Cubitus
Ou ₁ = Cubitus-1	Ou ₂ = Cubitus-2
I = Intercalate vein	M = Media
Ma = Anterior media	Mp = Posterior media
Pc = Precoasta	Pcu = Post-cubitus
R = Radius	R1 = Radial branch
Rs = Radial sector	Rs1 = Radial sector branch
Rs2 = Radial sector branch	Rs3 = Radial sector branch
Sc = Subcoasta	
Abdomen	
a = Dorso-pleural line	Aov = Ventral ovipositor valve
Ap = Apical valve of penis	Apd = Apodeme of Cingulum
B = Bridge of epiphallus	Bp = Basal valve of penis
Cer = Cercus	Eppt = Epiproct (supra- and plate)
Il = Inner lophus	La = Lateral apodeme
Lc = Lateral longitudinal ridge	Lbs = Lateral basivalvular Sclerite
Lfi = Lateral fleshy lobe of cingulum	Lov = Dorsal ovipositor valve
Ms = Marginal spines	OI = Outer lophus
Papt = Paraproct	Pov = Inner ovipositor valve
Ppc = Posterior process of cingulum	Pvbs = Postero ventral Basivalvular sclerite
S9 = 9th sternum	Sgp = Subgenital plate
T8 = 8th abdominal tergum	T9 = 9th abdominal tergum
T10 = 10th abdominal tergum	Tm = Tympanum
Vpc = Valvular plate of cingulum	

above in *Oxya fuscovittata*. This agrees with the investigation of Hollis (1971). The median ocellus is located in the middle of the frontal furrow on *Oxya fuscovittata* and it agrees with

the results of Bei-Beinko and Mishchenko (1951) who described it in *T. cylindrica obtusa* while slightly shifted posteriorly in the frontal furrow in *Oxya velox* and *Oxya hyla hyla*. These results are not in conformity with the results of Bei-Beinko and Mishchenko (1951). The antennal segments range from 24-25 in *Oxya hyla hyla* but 26-28 in *Oxya fuscovittata* and 22-24 in *Oxya velox*. The same is true with the results of Hollis (1971) and Wagan (1984) in case of *Oxya hyla hyla*, *Oxya velox* and *Oxya fuscovittata* (Table 1). The labrum is strongly oval with a slightly shallow apical notch in *Oxya hyla hyla* but it is somewhat oval with very shallow apical notch in *Oxya fuscovittata* while it is subrectangular with moderate apical notch in *Oxya velox* Table 1, Fig. 2 (a-c). These observations agree with those of Gangwere (1960) and Wagan (1984) who reported similar results on margin feeders acridids. The three arms of epipharyngeal sulcus have same length in *Oxya velox* but median arm is smaller than the lateral one in *Oxya hyla hyla* and *Oxya fuscovittata*. This character has been studied in this genus for the first time. The classification of mandibles, based on the shape and number of denticles given in the present study agree with those proposed by Isely (1944), Chapman (1964) and Gangwere (1965). The parastipes represents roughly long rectangular strip in *Oxya velox* but somewhat long triangular strip on *Oxya fuscovittata* while it represents conical strip in *Oxya hyla hyla* Table 1, Fig. 3 (a-c) and this has been studied for the first time in this genus. Labium is the least specialized mouthparts in terms of external morphology and showed little variation and the same is reported by Gangwere (1965).

Thorax: The pronotum bears three well developed and one ill defined transverse pronotal furrows but one ill defined low median carina in *Oxya velox* and it is partially in conformity with the results of Bei-Bienko and Mishchenko (1951) who reported only three well developed transverse pronotal furrows whereas, the latter consists of three well developed transverse pronotal furrows with one well defined low median carina in *Oxya hyla hyla* and *Oxya fuscovittata*. Pronotum is slightly flattened, hardly narrowing forwards and with rounded posterior margin of metazona in *Oxya hyla hyla* but it is flattened, parallel sided and with slightly rounded posterior margin of metazona in *Oxya fuscovittata* Table 1, Fig. 4 (a-c). This finding resembles with those of Hollis (1971). Presternal process is constricted at the base, distinctly wide and swollen in the middle part and with a wide subacute apex in *Oxya velox* while distinctly wide and depressed in the middle part in *Oxya hyla hyla* and *Oxya fuscovittata* and it is partially matched with the findings of Bei-Bienko and Mishchenko (1951) who described it distinctly wide in its middle part with a wide slightly pointed apex in *Oxya manzhurica*. A median longitudinal carina divides the scutum as well as scutellum in *Oxya hyla hyla* but it divides only scutum in *Oxya fuscovittata* while it is absent in *Oxya velox*. This character has been reported first time in the genus *Oxya*. The mesosternal space is narrow and more open in *Oxya hyla hyla* as compared to *Oxya velox*, and *Oxya fuscovittata* and thus not agree with Bei-Bienko and Mishchenko (1951) who reported contiguous mesosternal lobes in *Oxya rufostriata*.

Al-Hariri *et al.*: Variation in three *Oxya* species

Male tegmen is longer (22.00-23.00 mm) and wider (3.50-4.00 mm) in *Oxya velox*, but medium with length (16.00-20.00 mm) and width (2.500-3.00 mm) in *Oxya hyla hyla* while smaller length (20.00-21.00 mm) and width (2.50-3.00 mm) in *Oxya fuscovittata* (Table 1). Similar observations were also made by Suhail (1994) who also recorded the same observations in these species.

In *Oxya hyla hyla*, the radial sector (Rs) is subdivided into three branches named Rs₁, Rs₂ and Rs₃ in *Oxya fuscovittata* while it is unbranched in *Oxya velox* (Table 1, Fig. 5a-c) and this character has also been reported for the first time.

The hind femur is long (14.00-15.00 mm) and wide (4.00-4.25 mm) in *Oxya velox*, but medium with length (12.00-13.50 mm) and width (2.75-3.00 mm) in *Oxya hyla hyla* while small length (10.00-11.50 mm) and width (2.25-2.50 mm) in *Oxya fuscovittata* (Table 1). Similar observation was made by Willemse (1925) and Suhail (1994) in the genus *Oxya*. Outer an dinner margin if hind tibia bears 8 and 9 spines respectively in *Oxya hyla hyla* and *Oxya fuscovittata* while 8 and 10-11 spines in *Oxya velox*. These agree with the investigation 6 Bei-Bienko and Mishchenko (1951) of the genus *Oxya*.

Abdomen: In *Oxya hyla hyla*, cercus is conical or compressed laterally with subacute or truncate apex but in *Oxya velox*, it is conical with subacute apex while it is strongly compressed and bifid in *Oxya fuscovittata* (Table 1, Fig. 6-8a-c). In *Oxya hyla hyla*, supra-anal plate bears tubercle on each side of the median apical process, making the plate trilobate but it is without tubercles and with slightly less developed posterior lobe on *Oxya fuscovittata* (Table 1, Fig. 8a-c). These investigations are in conformity with those of Hollis (1971), Suhail (1994), Majeed (1995) and Baig (1966). The subgenital plate in female bears a pair of short median spines on posterior margin in *Oxya hyla hyla* but emarginate medially or with two very median spines in *Oxya fuscovittata* while with widely spaced median spines in *Oxya velox* (Table 1, Fig. 9 a-c). This is in accordance with that of Hollis (1971), Suhail (1994), Majeed (1995) and Baig (1996) in these species of the genus *Oxya* but not with Bei-Bienko and Mishchenko (1951) who reported that the latter is smooth with its posterior margin rounded in *Oxya fuscovittata* while it is with at least 4 teeth and median pair are somewhat drawn from the lateral pair. Epiphallus consists of curved hook like outer lophi and well developed tooth like inner lophi in *Oxya hyla hyla* and with tooth like outer and large tooth like inner lophi in *Oxya velox* and with boot having left lophus is always less developed than right one in *Oxya fuscovittata* (Table 1, Fig. 10a-c). In *Oxya hyla hyla*, the apical valves of penis is short and stubby but with moderate length and thick in *Oxya fuscovittata*, while it is long slender, upward and almost completely enclosed with in the valvular plate of cingulum in *Oxya velox*. Valvular plates of cingulum bears small margination at apex in *Oxya hyla hyla* but shallow and well defined margination at apex in *Oxya*

fuscovittata while it is very large, upcurved and rolled almost into a cylinder with enlarged apex on *Oxya velox* (Table 1, Fig. 11a-c) and same structure were reported by Dirsh (1956) and Hollis (1971).

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