ORIGINAL RESEARCH PAPER

Zoology

COMPARATIVE STUDY ON THE MORPHOMETRY AND KINEMATICS IN DIFFERENT SPECIES OF GRASSHOPPERS

KEY WORDS: Grasshopper, Morphometry, Kinematics, Speed, Velocity, Hop distance

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ABSTRACT

Objective: is to study the relation between morphometry and kinematics in different species of grasshoppers.
Materials and methods: Six species of grasshoppers collected in the Mysuru city during 2016-2017. The morphometry carried out by digital caliper and kinematics estimated by measuring tape and stop watch.
Results and discussion: Among three species of grasshopper nymphs, *Phlaeoba panteli* was fastest with highest velocity but least body length and hind leg length. *Gastrimargus africanus* was with highest body weight, body length and hind leg length but with least distance covered per hop. *Oxya nitidula* was with lowest body weight, speed, velocity but highest distance covered per jump. Among four species of adult grasshoppers, *Phlaeoba panteli* was fastest with highest length of hind leg, speed and velocity. This indicated that the length of hind leg might have increased the speed, velocity and the distance per hop. *Aiolopus thalassinus* was with highest body weight but least speed, velocity and distance per hop. This result suggested that the body weight may decrease the speed, velocity and hop distance in grasshoppers.
Conclusion: In grasshoppers decrease in the body weight, increase in the body length and hind leg length may increase the speed, velocity and hop distance. To bring more precise correlation between morphometry and kinematics further study should be carried out in different species of grasshoppers

INTRODUCTION

Grasshoppers are well known for their ability for speed movements, agility also traverse some difficult terrains. They can navigate sparse or rocky grounds, climbing vertical surfaces, even stable to walk upside down. In addition to walking grasshoppers jump to escape from predators, to increase their speed across land abled by their long rear legs leap longer distances than insects of comparable mass with shorter legs[1]. Because of the challenge of these mechanisms of grasshopper had been studied as a good source for bio-robotics by many researchers.

Jumping mechanism in insects is propelled by faster movement of third pair of legs across the insects that have been studied, two mechanical arrangements of the hind legs have been found that constrain the mechanism of jumping [2,3,4,5]. In the first type the hind legs moves in plane laterally displaced on either side of the body, as in case of grasshoppers and fleas [6,7]. In the second type an undercarriage arrangement is used, in which the hind legs push out in the horizontal plane beneath the body. Such type of arrangements have been well studied in tree hoppers. It is observed in jumping insects that outstanding performance of hop is achieved through catapult mechanism in which slow contraction of the thoracic muscles takes place while the hind legs remain stationery. Grasshoppers possess six legs that are grouped into three pairs: front, middle and hind legs. The hind legs are much bigger than the middle and front legs, which is advantageous for jumping.

The jump and speed of grasshopper varies from species to species that could be measured using the principle of kinematics. The kinematics describes motion of bodies, points (objects) and systems of bodies (group of objects) without considering the force that caused the motion. Here, the required parameters are speed, displacement, velocity and acceleration along the distance covered in a time. The kinematics was studied in different species of tree hoppers [8]. Several studies carried out on the morphometry in grasshoppers [9,10,11]. But the study of kinematics in grasshoppers has not been worked out to the larger extent. So in this study a correlation analysis between kinematics and morphometry of grasshopper is carried out.

MATERIALS AND METHODS

Six species of grasshoppers collected from the Mysuru city and these are *Gastrimargus africanus africanus* (fig-1), *Morphacris citrina* (fig-2), *Aiolopus thalassinus* (fig-3), *Phlaeoba panteli* (fig-4) *Oxya nitidula* (fig-5), *and Oedaleus abruptus* (fig-6) during 2016-17. The morphometric measurement of the body parts was carried out by using digital caliper, jump distance was measured by measuring tape and the time taken for jump recorded in the stop watch. The kinematics calculated as Speed= distance travelled/ time taken SI unit m/sec, Displacement= shortest distance/time taken SI unit m/sec, Velocity= displacement/time taken SI unit m/sec

RESULTS AND DISCUSSION

The morphometry and kinematics for three species of nymph grasshoppers depicted in the table l. According to the result, *Phlaeoba panteli* body weight was 0.5 gm, body length was 16.56 mm, hind leg length 25.3 mm. This covered longest distance (0.42 mtr) per hop with fastest (19.73 mtr /sec) and highest velocity (903.66 mtr/sec). *Gastrimargus africanus* body weight was 1.39 gm, body length was 23.05 mm, hind leg length 33.16 mm. This covered distance of 0.29 mtr per hop with a speed of 18.68 mtr /sec and a velocity of 409.6 mtr/sec. *Oxya nitidula* body weight was 0.45 gm, body length was 18.98 mm, hind leg length 29.38 mm. This covered distance of 0.692 mtr per jump with a speed of 14.28 mtr /sec and a velocity of 270.71 mtr/sec. Among these three nymphs of grasshoppers, *Phlaeoba panteli* was fastest with highest velocity. The body length and hind leg length was least among these three nymphs of grasshoppers. *Gastrimargus africanus* was with highest body weight, body length and hind leg length but with least distance covered per hop. *Oxya nitidula* was with lowest body weight, speed, velocity but highest distance covered per jump.

The morphometry and kinematics for four species of adult grasshoppers depicted in the table 2. According to the result, *Oedaleus abruptus* was with lowest body weight 0.70 gm, body length 24.87 mm and hind leg length 25.61 mm. This covered a distance of 0.656 mtr per hop with a speed of 74.5 mtr /sec and highest velocity of 78.936 mtr/sec. *Phlaeoba panteli* body weight was 0.74 gm, body length was 28.41 mm, longest hind leg of 36.41 mm. This covered longest distance of 1.23 mtr per hop with a highest speed of 98.2 mtr /sec and a velocity of 65.35 mtr/sec. *Morphacris citrina* was with body weight of 1.45 gm, highest body length of 31.04 mm, hind leg length of 31.34 mm. This covered lowest distance of 0.286 mtr per jump with a lowest speed of 39.1 mtr /sec and a lowest velocity of 45.59 mtr/sec. *Aiolopus thalassinus* was with highest body weight of 1.68 gm, body length of 30.46 mm, hind leg length 33.74 mm. This covered distance of 0.522 mtr per jump with a speed of 65.44 mtr /sec and a velocity of 73.212 mtr/sec. Among these four species of adult grasshoppers, *Phlaeoba panteli* was fastest with highest length of hind leg, speed and velocity. This indicated that the length of hind leg might have increased the speed, velocity and the distance per hop. *Aiolopus thalassinus* was with highest body weight but least speed, velocity and distance per hop. This result suggested that the body weight may decrease the speed, velocity and hop distance in grasshoppers. To bring correlation between morphometry and kinematics further study should be carried out in different species of grasshoppers

CONCLUSION

In grasshoppers decrease in the body weight, increase in the body length and hind leg length may increase the speed, velocity and hop distance. To make such precise correlation several studies to be carried out in different species of grasshoppers.

Table-1: Morphometric measurement and kinematics of three species of nymph grasshoppers.

Sl no	Species name	Body weight (gm.)	Body length (mm)	Leg length (mm)			(m/sec) Distance covered /hop (m)	Speed (m/sec)	Velocity
		0.50		Fore leg	Mid leg	Hind leg			
1	*Phlaeoba panteli*		16.56	6.47	10.38	25.3	0.42	19.73	903.66
2	*Gastrimargus africanus*	1.39	23.05	8.95	14.53	33.16	0.29	18.56	409.6
3	*Oxya nitidula*	0.45	18.98	6.11	12.2	29.38	0.692	14.28	270.71

Table-2: Morphometric measurement and kinematics of four species of adult Grasshoppers.

Sl no	Species	Body weight (gm.)	Body length (mm)	Leg length (mm)			Distance covered /hop (m)	Speed (m/sec)	Velocity (m/sec)
				Fore leg	Mid leg	Hind leg			
1	*Oedaleus abruptus*	0.70	24.87	5.26	8.5	25.61	0.656	74.5	78.936
2	*Phlaeoba panteli*	0.74	28.41	1.26	3.44	36.41	1.23	98.2	65. 35
3	*Morphacris citrina*	1.45	31.04	5.06	12.8	31.34	0.522	65.44	73.212
4	*Aiolopus thalassinus*	1.68	30.46	8.85	11.4	33.74	0.286	39.1	45.59

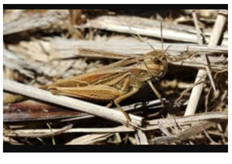

Fig-1: *Gastrimargus africanus africanus*

Fig-2: *Morphacris citrina*

Fig-3: *Aiolopus thalassinus*

Fig-4: *Phlaeoba panteli*

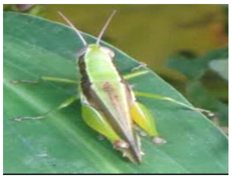

Fig-5: *Oxya nitidula*

Fig-6: *Oedaleus abruptus*

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