

## Studies on *Aptopus opata* and its Consequences on different Weed and Crops; A Novel Approach from Sindh-Pakistan

Shabana Mangi<sup>1\*</sup>, Waheed Ali Panhwar<sup>1</sup>, Abdul Manan Shaikh<sup>1</sup>, G. Sarwar Solangi<sup>2</sup>, Khalid Hussain Rind<sup>3</sup>, Nazir Ahmed Abro<sup>4</sup>, Zaibun-nisa Memon<sup>1</sup>, Gul Hafeeza Lund<sup>1</sup> and Paras Somroo<sup>1</sup>

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### Abstract

*Aptopus opata* (Johnson. Pj, 2018) is a native to Mexico that was first time reported from village Gadeji, district Khairpur Sindh Province of Pakistan during 2018-19. The instant species causes significant damage to crops, feeding on different weeds including; *Gnaphalium*, *Convolvulus arvensis*, *Amaranthus* and *Cortaderia sellona*, while the crops include; maize, potatoes, tomatoes, sugar cane. Its larva is known as wireworm that is yellowish to brown in color. The members of this genus badly affect the economy of the growers in the affected areas. *Aptopus opata* is a differ from the closely related species on the taxonomical basis including male genitalia and external morphology represented as its body is lengthened, brown to blackish in body coloration, with densely coarse punctures on whole body, frons depressed, pronal angles tapered, lengthened, scutellum shield shaped trigonal spots, 1<sup>st</sup> to 3<sup>rd</sup> antennomers quadrates, clypeus bigonal, legs lengthened, tarsi denticated, 5 claws on tarsi, meta tarsi slightly smooth. Male genitalia (aedeagus) is wider than longer, base broader, lateral lobe of parameres slightly bigonal, lateral margins with golden hairs, median lobe of parameres broad at base, rapidly narrowing apically, hairs like structure view from the ventral aspects. The instant discovery will help the growers and technical personals to identify the instant species easily and its identification will help in these control of the referred species. Further studies are suggested to explore its nature of damage.

**Keywords:** *Aptopus opata*; host plant; Weeds; Gadeji Khairpur, Sindh-Pakistan

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<sup>1</sup>Department of Zoology, Shah Abdul Latif University Khairpur Mirs.

<sup>2</sup>Department of Entomology Sindh Agricultural University Sub-campus Umerkot.

<sup>3</sup>Department of Molecular Biology and Genetics, Shaheed Benazir Bhutto University Shaheed Benazirabad.

<sup>4</sup>Department of Entomology, Sindh Agricultural University Tandojam.

<sup>4</sup>State Key Laboratory of Plant Disease and Insects Pest, Institute of Plant Protection, Chinese Academy of Agricultural Sciences Beijing, China.

\* Correspondence author Email. [mangishabana52@gmail.com](mailto:mangishabana52@gmail.com).

## Introduction

Genus *Aptopus* (Eschscholtz 1829) was belong to subfamily Cardiophorinae, the Cardiophorinae is an ecologically diverse subfamily of predatory, herbivorous and pollinator Elateridae inhabiting most terrestrial biomes, it is classified into 34 genera and 1200 species are distributed in all over major zoogeographic regions (Calder *et al.*, 1996). Subfamily Cardiophorinae is belong to the family Elateridae commonly known as Click beetles. It contains the 2 tribes Nyctorini and Cardiophorini and contains 38 genera and 1100 species widely distributed worldwide, including Chihuahua, Sinaloa, Baja California, Arizona, New Mexico, Iran, India, Pakistan, Afghanistan, Indohimalayan, United States of America, Guatemala, Nicaragua, Costa Rica, Panama, Ecuador, Bolivia, Brazil, Paraguay, Uruguay and Argentina, also distributed in Oriental as well as in Palaearctic regions (Akhter *et al.*, 2011- 2014 and Platia *et al.*, 2016). Two new species had been reported from the México and Argentina including: *Aptopus ameca* and *Aptopus riojanus* (Aranda *et al.*, 2005). Three species were recorded from the America and was identified on the basis of its pronotum having a marginal carina and third represents the carinae on the episternum, anterior lateral margins of pronotum slightly concave, 1<sup>st</sup> to 3<sup>rd</sup> antennomers of antennae trigonal, scutellum shield shaped and posterior lateral margins of elytra denticated (Aranda *et al.*, 2008). Six species were documented from the Catamarca, Santiago del Estero, Tucumán, Salta, La Rioja, La Pampa, Mendoza including *Aptopus angusticollis* (Schwarz 1906), *Aptopus golbachi* (Aranda 1996), *Aptopus maculatus* (Aranda 1996), *Aptopus luridus* (Aranda 1996), *Aptopus suniyana* (Aranda 2004), *Aptopus riojanus* (Aranda 2005) recognized on the taxonomical characteristics included body lengthened, frons depressed, vertex slightly impressed, femur thick cylindrical, prortal angles slighted tapered. Seven subfamilies, 12 tribes, 24 genera and 62 species were recorded from the Guerrero, Mexico included the

*Aptopus omiltemanus* (Champion, 1895), *Aptopus constrictus* (Champion, 1895) were mentioned by (Zurita-García and Martin Leonely *et al.*, 2015). Additional current huge influence from the various localities from the Northern areas of Pakistan, contains the 18 new species and 20 new records were found (Platia, 2015a). Current species is first time recorded from weeds and crops, e.g. *Gnaphalium*, *Convolvulus arvensis*, *Amaranthus*, *Cortaderia sellona*, red, green, yellow type of flowers, small grasses and crops maize, potatoes, tomatoes, and sugar cane. Weeds create various problems in terrestrial ecosystem and thus affect the economy (Douglas *et al.*, 2017). The current investigation aimed to provide the information on the *Aptopus opata* (Click beetle). This genus as well as species was first time recorded from village Gadeji, district Khairpur province Sindh as well as in Pakistan level before this work had not been recorded but recorded at worldwide. This work will support entomologist for the confirmation of taxonomical status, habitats of *Aptopus opata* (Click beetles). According to all available literature of the selected family were documented. First time this work has been done on Click beetles (Family Elateridae), its larva (wireworm) of click beetles are dangerous for crops as well as germinating seeds of the referred crops and weeds.

## Materials and Methods

### Area of study

The Present research was conducted during 2018-19. The instant beetle was first time captured from the village Gadeji of district Khairpur Sindh-Pakistan. The samples were kept at the Entomology laboratory, Department of Zoology, Shah Abdul Latif University Khairpur-Pakistan for experimental use.

### Sampling

The research used the purposive random sampling method, the insects were captured by hand picking method as well as lights traps, from different crops and weeds including potatoes, pigweed, cudweed, bindweed, pampas grass, vegetables, herbs, shrubs from the village Gadeji of district Khairpur Sindh

Pakistan and that samples were kept into plastic bottles. The photographs of insects as well as host plants were taken with the help of CCD Sterozoom

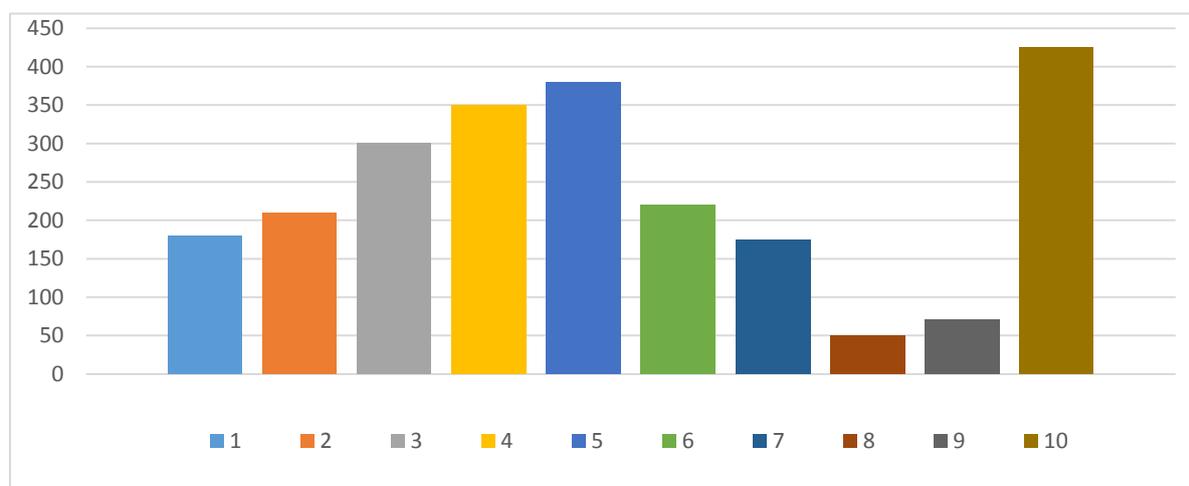
Microscope of Meiji analysis image infinity software (Panhwar, W.A. *et al.*, 2018).

**Table 1. Common and scientific names of host plant of genus *Aptopus*.**

S.No	Common names	Scientific names
1	Pampas grass	<i>Cortaderia sellona</i>
2	Garlic powder herbs	<i>Allium sativum</i>
3	Potatoes	<i>Solanum tuberosum</i>
4	Tomatoes	<i>Solanum lycopersicum</i>
5	Bindweed	<i>Convolvulus arvensis</i>
6	Yellow sweet clover	<i>Melilotus Officinalis</i>
7	Flat sedge	<i>Cyperus eragrostis</i>
8	Wheat	<i>Tritium aestivum</i>
9	Lucerne	<i>Medicago sativa</i>
10	Sweet potatoes	<i>Ipomoea batatas</i>
11	Wild oat	<i>Avena fatua</i>
12	Mustard	<i>Brassica spp.</i>
13	Witch weed	<i>Panicum capillare</i>
14	Pigweeds	<i>Amaranthus spp.</i>
15	Cud weeds	<i>Gnaphalium spp.</i>

**Table 2. Month-wise collection and numbers of samplings of Click beetles.**

S.No	Localities(Districts)	Month of year	Number of samples
1	Larkana	March	180
2	Shikarpur	April	210
3	Naushahro Feroz	May	300
4	Sukkur	June	350
5	Jamshoro	July	380
6	Hyderabad	August	220
7	Dadu	September	175
8	Mirpurkhas	October	50
9	Thatta	November	70
10	Khairpur	December	425



**Figure 1.** Sampling of click beetles from various crops from different districts of Sindh Pakistan.

### Methods of killing and preservation

The samples were put in chloroform jars for (5 to 10 minutes), from which the samples were transferred very carefully and kept properly in specific wooden insect's boxes, labeled and kept the naphthalene balls in wooden insect's boxes to be protected from predators (ants), fungus. The samples were identified with the help of literature; while the taxonomical studies were performed through a dissecting microscope (Shabana, M *et al.*, 2019).

### Dissection of male genitalia

Male genitalia (aedeagus) were dissected from the abdomen and put in (10 % KOH) for boiling (10-15) minutes, washed with tap water and observed under microscope. After observations, the male genitalia (aedeagus) was kept into micro vials with a drop of glycerin for permanent conservations (Shabana, M *et al.*, 2020).

### Measurements and drawings (Illustrations) male genitalia

The measurements of different external body parts (morphology) head, pronotum, elytra, antennae are taken with the CCD Sterozoom company and software use for analyzing the photography infinity software through binocular dissecting microscope (Platia *et al.*, 2016).

## Results and discussion

### Family Elateridae (Leach, 1815)

### Subfamily Cardiophorinae Candeze (1860)

### Tribe Cardiophorini

### Genus *Aptopus* (Eschscholtz 1829)

### *Aptopus opata* (Johnson, Pj. 2018)

#### Description

*Aptopus opata* is inhabitants on different weeds including *Gnaphalium spp.*, *Convolvulus arvensis*, *Amaranthus spp.*, and *Cortaderia sellona*, red, green, yellow type of flowers and small grasses, this species identified the taxonomical characteristics. Body coloration dark brownish, frons black, reddish brown paraclypeus and clypeus, antennae deeply brownish black. 1<sup>st</sup> antennomeres deeply brown, 2<sup>nd</sup> reddish brown, pronotum blackish brown, pronotal angles black, scutellum black, abdomen deeply brownish, elytra blackish, ventral side of

sample light brownish with deeply blackish punctuation, legs (femora), joints have various colors coxae light brown, tibia blackish, tarsi reddish brown, meta tarsi dark brown, frons circular, wider than longer, clypeus paraclypeus almost equal and bigonal in shape. The eyes are distinctly visible, antennae have a 12 antennomeres, 1<sup>st</sup> antennomeres attached to head, 2<sup>nd</sup> antennomeres cylindrical in shape longer than other, 3<sup>rd</sup>, 4<sup>th</sup> antennomeres conical in shape, 8<sup>th</sup>, 9<sup>th</sup> antennomeres trigonal, 11<sup>th</sup> subcylindrical in shape, 12<sup>th</sup> antennomeres elliptical in shape. Pronotum longer than wider, anterior margins convex, posterior concave, dorsal surface convex, densely coarse punctuation on the head and pronotum, punctures are in various size, shapes and measurements, with different locations, mostly umbilical in shape, visible punctuation on head and pronotum, lateral margins of pronotum smaller than elytra, pronotal angles highly lengthened, tapered, no space between the pronotum and dorsum. Pronotal angles reached to dorsum, scutellum distinctly visible small rounded, anterior side of scutellum smaller than posterior sides. Abdomen covered with parallel lines with punctuations, anterior portion of abdomen wider than posterior portion, small space between the lines, elytra longer than pronotum, elongated than lateral sides of pronotal, have a slightly dents, femora robust thicker than tibia and tarsi, tibia thin lengthened, tarsi truncated, 4 triangular sections last section tapered, this specimens is male, male genitalia is aedeagus (1.2 mm) wider than longer, strongly arched, base rounded, median lobe phallobase apex pointed, narrowly rounded; outer margins of paramere slightly curved, broad at basal, rapidly narrowing apically, hairs like structure view from the ventral aspects.

*Aptopus opata* population have been recorded from the Village Gadeji on the river bank from various weeds and crops having apointed spiny plants(thorndike) along national highway; with latitude (27.250), longitude (68.483), above sea level. The climate of this area in summer season is long, and winter is short. The temperature is very high reaching up to

(48°C) in June, July, August and minimum in December (25°C). The area receives low rain in monsoon and

sometime has been light rain in this season. The region is somewhat humid, arid, high summer season.

**Table. 3. Morphometric analysis of *Aptopus opata* (Johnson, P.J. 2018).**

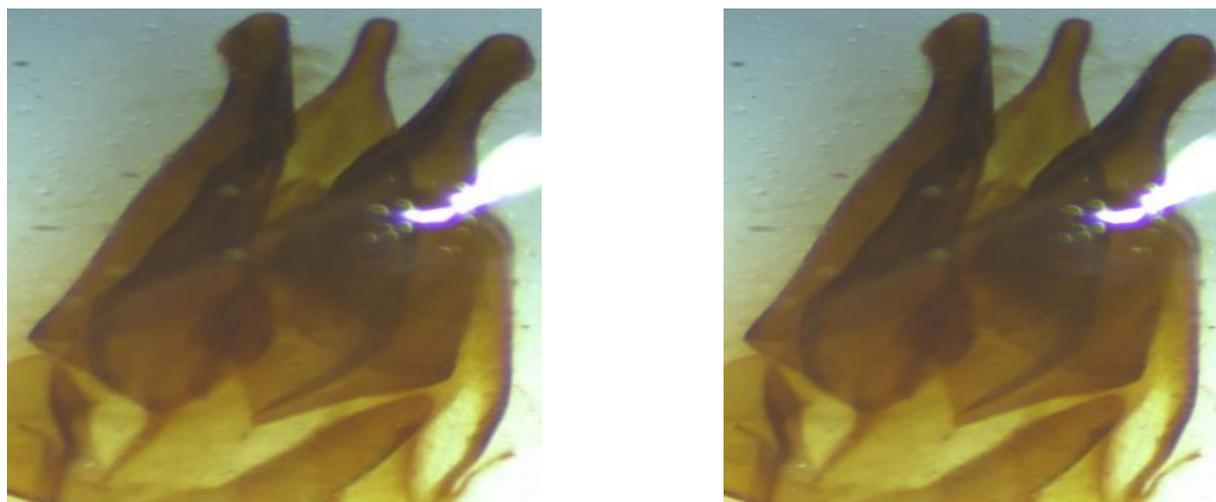
S.No	Body parameters	Average-Standard deviation	Range
1	Body length	12.4 ±3.71	16.1-8.6
2	Head length	2.2±0.7	2.9-1.5
3	Head width	2.4±1.1	3.5-1.3
4	Eye length	0.5±2.1	2.6-1.6
5	Eye width	1.2±1.0	2.2-0.2
6	Antennae length	2.9±1.0	3.9-0.9
7	Antennae width	1.2±1.0	2.2-0.2
8	Pronotum length	2.9±1.7	4.6-1.2
9	Pronotum width	2.6±1.1	3.7-1.5
10	Elytra length	2.5±1.2	3.7-1.3
11	Elytra width	2.2±1.0	3.2-1.2
12	Femur	3.1±1.2	4.3-1.9
13	Tibia	1.1±1.3	2.4-0.2
14	Tarsi	0.7±1.2	1.9-0.5

**Table 4. Comparative morphological characteristics, measurement, and features of *Aptopus opata* (Johnson, P.J, 2018)**

Body parts	Current species	<i>A.purica</i> Johnson 2018	<i>A.rugiceps</i> Schaefer 1916	<i>A.subcarinatus</i> Schaefer 1916
<b>Body size</b>	2.6mm lengthened	2.2-2.5mm elongated	2.4-2.6mm longer than wider	2.5mm Elongated slightly circular
<b>Coloration</b>	dark brownish	Dark infusate to black	Dark black	Dark brown to black
<b>Head</b>	Head (0.4mm) rounded, semicircular	(0.3)Circular with densely punctuations	Rounded	Slightly bigonal
<b>Antennae</b>	1 <sup>st</sup> section attached to head, 2 <sup>nd</sup> section longer than other sections cylindrical in shape, 3 <sup>rd</sup> , 4 <sup>th</sup> sections conical, 8 <sup>th</sup> , 9 <sup>th</sup> sections trigonal, 11 <sup>th</sup> subcylindrical in shape, 12 <sup>th</sup> section conical in shape	Lengthened 1= 1.0, 2=1.6,3= 2.4,4= 2.2,5=2.6	Antennae 13 sections,1=1.2,2 =1.4,3=1.0, 4=1.1,5=1.6, 6=1.8,7=1.9	Elongatened 12 sections,1=0.2,2=0.4,3=0.2 4=0.5,5=1.6,6=1.7, 7=1.8
<b>Anteocular distance</b>	0.4	1.4	0.3	0.2
<b>Pronotum, length, width, and prontal angles</b>	(.9mm) anterior sides convex, posterior concave, dorsal surface convex, humeral angles highly lengthened, pointed needle-shaped,	Longer than wider has a black color, prontal angles lengthened, Length1.4mm and width .9mm	Elongated than broader with dark brown spots, prontal angles slightly pointed, length (1.2mm), width (.8mm).	Rounded longer than wider, lateral margins convex with dark punctuations, prontal angles rounded Length(1.1mm), Width (.8mm).
<b>Scutellum</b>	Scutellum short rounded distinctly visible	Circular spot like	Heart-shaped	Triangular dark black

<b>Elytra</b>	elytra(1.3mm) elongated than lateral sides of pronotal,	Longer than pronotum slightly convex	Elongated, convex	Longer than pronotum abdomen u shaped
<b>Male genitalia</b>	Aedeagus 1.2 mm long, base rounded, median lobe phallobase apex pointed, outer margins of Paramere slightly curved, broad at basal, rapidly narrowing apically, hairs like structure view from the ventral aspects	Longer than wider(1.5mm) basal piece length(0.27m m),median parameres lobe length(0.73m m),apex narrow	Elongated, less width, base straight, lateral lobes parameres slightly convex, apex rounded, median parameres lobe longer than lateral, apex circular. Length(1.4mm), Lateral lobe(0.2mm), Median lobe(0.3mm)	Longer than wider base bigonal (1.3mm), lateral parameres pointed (0.4mm), median longer than lateral (0.2mm) apex bigonal.
<b>Locality</b>	Gadeji district Sindh, Pakistan	Mexico sonar light trap	Huachuca mountain of south-central Arizona	Mexico sonar light trap





**Figure 2: (A),** Adult dorsal view **(B),** Adult ventral view **(C),** Aedeagus dorsal view **(D),** Aedeagus ventral view.

### Discussion

*Aptopus opata* species usually called as a click beetles already recorded from the Mexico, Huachuca Mountain of south central Arizona. But the current species was first time recorded from the village Gadeji and consequently from Khairpur district of Sindh Pakistan. It was collected during 2018-19. *Aptopus opata* is the only species that feed on the various weed species viz. *Gnaphalium spp*, *Convolvulus arvensis*, *Amaranthus spp* and *Cortaderia sellona*. They referred to species of this beetle was recognized but no specific literature on the referred genus have been reported before in Pakistan regarding the male and female genitalia and its morphology. The current description of this species, its body lengthened, dark brown to blackish with densely coarse punctuations, pronotal angles lengthened, tapered, scutellum blackish spot like, legs lengthened, aedeagus wider than longer, base broader, lateral lobe of parameres slightly bigonal, with golden hairs at apex, median lobe of parameres base broader at apex and rounded. We presume that the instant taxonomical description of *Aptopus opata* will help the entomologist to further study this beetle. Moreover, four species of genus *Aptopus* were reported from Sonora, Mexico, but the current new recorded specie of *Aptopus opata* from Sindh Pakistan that a bit different from the other species of the same genus.

*Aptopus pullatus* was recorded from the Dimmit County and Texas; this species is synonymies from the *Eniconyx pullatus* into *Enisonyx pullatus* into *Aptopus pullatus*, it varies in body coloration, punctuations, pronotum wider than longer and antennae lengthened (Horn *et al.*, 1894). *Aptopus boliviensis*, *Aptopus guatemalis* and *Aptopus trancas*, these are three new species that were recorded from the United States of America, Mexico, Guatemala, Nicaragua, Costa Rica, Panama, Ecuador, Bolivia, Brazil, Paraguay, Uruguay and Argentina. Based on the identification that present marginal carinae on the pronotum and the third present's carinae on the episternum (Aranda *et al.*, 2008). *Aptopus purica*, body feebly, pronotum sides wider and arcuate, deep brown to black color elytra, thin serrate antennae, first three antennomers reached up to anterior margins pronotal angle, length and width of pronotum almost equal, carina thin and smooth (Schenkling *et al.*, 1927). *Aptopus rugiceps* lengthened body, dark brown to blackish in coloration, elytra longer than pronotum (Lane and Fisher 1941). *Aptopus subcarinatus* surface roughly, aedeagus lengthened, thick dark punctuations, femur thick, cylindrical, various from the *A. allita*, *A. subcarinatus* (Schaeffer *et al.*, 1916).



**Figure 3.** (A), Pampas grass (B), Yellow sweet clover grass (C), Bind weed (D), Stones and rocky areas.

### Conclusion

It was concluded from the current studies that the ecological features of Village Gadeji district Khairpur Sindh Pakistan have a vast diversity of samplings of insects including *Aptopus opata* (click beetles) of the family Elateridae. The current species was first time recorded from weeds that affect maize, potatoes, tomatoes, germinating seeds, sugar cane. The weeds of these crops are very destructive in habitats in the terrestrial ecosystem that pose major losses to the economy. Since the synthetic herbicides have many health issues, that were communicated by world health organization time to time. We pretend that the referred species of beetle may reduce weed population in the said crops. It will help to minimize the use of synthetic sprays.

### Author's contribution.

Shabana Mangi wrote the paper, Waheed Ali Panhwar and Abdul Manan Shaikh Analyzed the data, Ghulam Sarwar Solangi, Khalid Hussain Rind, were analysis the statically measurments and graph, labortical equipment's, Nazir Ahmed Abro arranged the paper in grammatically, who had given the idea about the write-up, Zaibun-nisa Memon, Gul Hafeeza Lund and Paras Somroo<sup>1</sup> supportive in sampling.

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