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Mortality of a common Indian grasshopper exposed to dietary arsenic

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ABSTRACT: Studies on the effect of various doses of arsenic on the life span and mortality rate of *Oxya velox* a common acridid revealed that this insect was found vulnerable even in lower dose, whereas, it could try to overcome the effect with the increasing doses of arsenic. From this point, it is important to remark that this insect may act as bioindicator of this heavy metal in this region as it was found to accumulate this metal.

KEY WORDS : *Oxya velox*, arsenic, accumulation, stress, mortality.

Metal pollution is one of the serious problem that face mankind in the twenty first century (Montaser *et al.*, 2010).Arsenic contamination is a major problem of the Gangetic plains of West Bengal and Bangladesh. This toxic metal is available naturally in the silt deposition of this region and it is widespread in this delta. Bioaccumulation of arsenic in the branchial tissue of *Sabellas pallanzanii* gave the evidence of environmental origin of this metal (Fattorini*et al.,* 2004). Due to contamination, arsenic may accumulate in soil, leads to decrease in soil fertility, at the same time can be taken up by plants, ultimately enter the food chain (Meharg and Rahman, 2003). Lindsay and Sanders (1990) explained the process of arsenic uptake and transfer in an estuarine food chain from phytoplankton to upper trophic levels. As chemical analogs, arsenate and phosphate are processed by producers and inhibit ATP synthesis and growth (Blum, 1966; Sanders and Windom, 1980). Malakar *et al.* (2009) reported that survival, adult body weight and adult life span were significantly decreased due to application of heavy metals like Hg on *Oxya fuscovittata.* Grasshoppers serve as major food source for some species especially amphibian, reptiles, birds and small mammals and are ecologically significant. Nath *et al.* (2012) studied the effect of arsenic contamination in *Gesonula punctifrons* and observed the important alteration in haemocyte counts. Available research concerning arsenic contamination suggested that birds were found to be highly adapted compare with other terrestrial animals as observed by Koch *et al.* (2005). Grasshoppers can represent an important bioindicator of heavy metal contamination. The present paper deals with the effect of arsenic on the mortality rate and life span of *Oxya velox* by exposing them to three concentrations of arsenic.

Adult *Oxya velox* (Fabricius, 1787) was collected from the field (22.4962° N, 88.6157° E), near Kolkata, West Bengal. Plastic jars of 10 liter capacity containing 5.0 cm thick sand at the bottom were taken as the rearing cage. The open portion

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of the cages was covered with nylon net in order to maintain the air supply properly. Rearing was carried out in laboratory conditions,the temperature and relative humidity were maintained 30±1°C and 80± 1% respectively. The female laid eggs in the sand. After approximately 30 days of oviposition the first instars hatched out from the eggs. 100 first instar larvae for control as well as each dose were considered separately. The first instars and their successive stages including the adult insects were also reared following the same procedure.

Conical flask of 50 ml capacity containing food plant *Oryza sativa* Lin. was placed in the rearing jar for providing food to the insects. To study the effects of As, fresh leaves of *Oryza sativa* Lin. were collected from the cultivated field in the college campus and dip in the dosed distilled water treated with0.0125 mg l^{-1} (Asd1) , 0.025 mg l^{-1} (Asd2) and 0.050 mg l^{-1} (Asd3) Sodium arsenate for twelve hours. Nymphs and adults of *Oryza sativa* were fed with dosed paddy seedlings to study the effect of As on the life span and mortality. For control group of host plants were grown in As free water (Schmidt *et al.*, 1991). Food was changed after every 24 hours.

The study revealed a variation in the *O. velox* life span. At 0.0125mg l^{-1} (Asd1) mortality rate was found highest in the 1st instar nymph followed by 5th instar male nymph, whereas it was recorded lowest in 3rd instar male nymph followed by 4th instar male nymph in the same dose of arsenic (Fig 1). Rate of mortality of 2nd instar nymph (59.72%) was higher in (Asd2) and both fifth instar male (75%) and female (66.67%) in (Asd1)in comparison to control. Study also revealed that Asd1 has significant effect on the 1st instar and 5th instar stage (Table 1), it was on fifth instar at Asd2. Whereas 0.050 mg l^{-1} (Asd3) was effective in almost all the stages of the experimental grasshopper. In the last few decades, increasing concentration of arsenic in the water in different parts of the world including West Bengal, India is becoming the threats for the fauna and flora including human being (Dey, 2005). Arsenic which was taken up by plants sequester in the root, followed by straw and grain in case of paddy (Imamul Huq, 2006). Present study confirmed that arsenic exerts a significant effect on the life stages of *O. velox.* Rate of mortality at Asd1 was highest on 1stinstar and 5thinstar male. In a similar observation, it was found that mercury showed the highest effect on the life span of *Aiolopust halassinus* in comparison to other experimental metals (Devkota and Schmidt, 2000). Whereas, Asd3 was found to affect all the instars in comparison to other two doses and the rate of mortality was almost higher than the control except the male, where recovery was observed. Whereas, some stages of the experimental grasshopper exposed to Asd1 and Asd2 showed higher mortality and that might be due to differential accumulation of arsenic in the insect body than that of Asd3, as found in *Oxya fuscovittata* treated with Cd (Malakar *et al.,* 2009). Present study also revealed that rate of mortality depends on concentration of doses applied during the time of experiment. Augustyniak and Miguls (2000) reported that cadmium transfer rate from host plant to the grasshopper body depended on exposure time. Grasshopper as primary consumer helps in the transfer of arsenic to higher trophic level more efficiently as suggested by Schimdt (1986) during the work on the biotransfer of geogenic heavy metals via the grasshoppers to higher trophic level.

The present study reveals that both the sexes are affected due to exposure of various doses of arsenic. Devkota and Schmidt (2000a) reported that both sexes could accumulate the heavy metals equally in their bodies, so it was not essential to give preference to one sex of grasshopper during biomonitoring. The study also revealed that an average rate of mortality was observed in Asd3 which was lower than other two doses, though it was higher than that of control. Thus indicating the grasshopper could overcome the toxic effect of arsenic to make a balance between growth and metabolism as was found in pesticides treated fish (Aguigwo, 2002). Most insects grow a mechanism of internal decontamination when exposed to heavy metals (Ballon-Dufrancais *et al*., 1980; Jeantet et al.,1980). Moreover, Devkota and Schimidt (1999) has been reported that *Eypropocnemis plorans*, a short horned grasshopper could tolerate higher concentration of Mercury, that is, improvement of

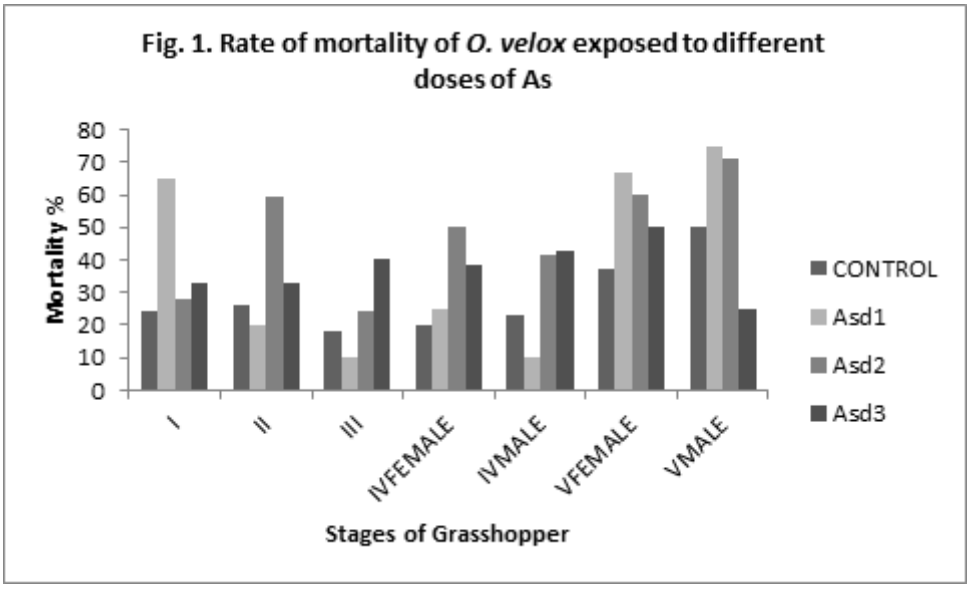

Table1. Showing the relation between Control and different doses of As

Doses	R^2	r	Regression	t-value
Control-Asd1	0.683	0.826	Y=9.62+0.966x	2.93*
Control-Asd2	0.816	0.903	Y=22.38+0.809x	4.21*
Control-Asd3	0.89	0.943	Y=16.75+0.785x	5.68*

*Significant $p<0.05$

health and growth by intaking this metal through food, indicated an affirmative effect which might be interpreted as hormesis (Hopkin, 1989). Specific heavy metals concentration dependent eclosion time of adult *Aedes aegypti* was also observed by Rayms-Keller *et al*. (1998). So the long term effect of arsenic was not only of interest in ecological direction but also for the development of the grasshopper.

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