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ASSESSMENT OF POLLEN STRUCTURE OF WEED (*COMMELINA* SP.) AFTER ACCUMULATING ELEMENTS IN FLOWER AROUND SOLID WASTE DUMPING GROUND, BERHAMPUR, WEST BENGAL, INDIA

Environmental Science

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ABSTRACT

The objective was to determine lead (Pb), cadmium (Cd), and arsenic (As) in root and stem, leaf, and flower of the weed (*Commelina* sp.) and morphological features of pollen grains collected from municipal solid waste (MSW) dumping ground. The Pb, Cd and As accumulation was estimated in the different parts by using atomic absorption spectrophotometer. Measurement of the length of the polar axis (P) and the equatorial axis (E) were performed from 20 pollen grains of MSW site compared to non-MSW site. The Pb and As content (mg/Kg) was higher in leaf followed by stem and root but lower Pb and below detection limit (BDL) As in flower were recorded while the Cd content (mg/Kg) was higher in stems and roots followed by leaves and BDL in flower were recorded. The P was significantly ($P<0.001$) increased in experimental site (100.0 ± 6.67) when compared to control site (82.0 ± 6.32) of pollens while E was significantly ($P<0.001$) decreased in experimental site (45.0 ± 8.50) when compared to control site of pollens (66.0 ± 6.99). The pollen abnormalities viz. rapture of outer membrane, rectangular shape and wider of E were found. In conclusion, this weed may be suitable for phytoremediation of metals and metalloid from the medium but the Pb accumulation in flower may alter the structure of pollens.

KEYWORDS

Phytoremediation, Weed, Metal & metalloid pollution, Bioaccumulation, Pollen morphology

INTRODUCTION

Generally municipal solid wastes (MSW) dumping ground contains biodegradables and non-biodegradable wastes. Moreover, the designated landfill is made as solid waste dumping ground in which many metals and metalloids may cause environmental pollution.[1,2] The leachate runoff from open dumping sites showed dominant source of heavy metals in the surface water and underground source, soil, and plants.[3-13]

A recent study reported that Pb, Cd and As uptake by two weed species and these weeds are potential for phytoremediation in the MSW dumping ground.[14] Many investigators also reported that that some weeds are capable of uptake the metals from the soil and could remediate easily from the medium both *in situ* as well as *ex situ* conditions.[15-23]

But the uptake of metals or metalloids in the anthers of flower may hamper fertilization due to abnormal pollen grains. If fertilization hampers, then germination may not take place and phytoremediation potential weeds can be threatened. It is well established that metals affect the male gametes of plant species.[24-29] The information is lacking regarding elemental levels in the flower and pollen structural abnormality around solid waste dumping ground of Berhampur Municipality, West Bengal, India.

The present study was attempted to determine Pb, Cd and As in root and stem, leaf and flower of the weed (*Commelina* sp.) and morphological features of pollen grains to detect detrimental effect of male gametes.

Materials and Methods

Selection of study site

The study site was selected as per earlier study by Biswas et al.[14] The weed specimen was selected as *Commelina* sp. inhabited in the study site.

Selection of heavy metals and metalloid

Two heavy metals viz. Pb and Cd and one metalloid As were selected to know the accumulation in different parts of the weed.

Sample collection and analysis

Different parts viz. stem and root, leaf and flower were separately collected from above-mentioned study site and sun-dried samples were kept in ziplock plastic packet with proper coding. For each sample, the digestion was done in concentrated nitric acid as per the protocol of Goldberg et al.[30] and the elements viz. Pb, Cd, and As were estimated separately by using atomic absorption spectrophotometer (AAS model: Agilent Technology 200 Series AA).

Microscopic study of pollen grains

The pollen grains were taken from five flowers of control area and above-mentioned experimental site. All material was fixed in Carnoy's fixative (6:3:1 (v/v) ethanol–chloroform–acetic acid) for 10 min. followed by Eosin staining for 2 min as per the protocol of Chang et al.[31] with some modification. The examination of pollen structure was performed by using a binocular microscope (Olympus). Measurement of the length of the polar axis (P) and the equatorial axis (E) were measured from 20 pollen grains.

Statistical analysis

A statistical analysis especially student 't' test was done to compare between control versus experimental pollen data by using statistical software, PAST (PAleontological STatistics version 3.26) developed by Hammer et al.[32] A statistical significance was considered as $P<0.05$.

RESULTS

Table 1 shows the data of accumulation of elements in different parts viz. stems and roots, leaves, and flower of weed (*Commelina* sp.) inhabited around the dumping ground. For Pb content (mg/Kg), the mean ± standard deviation of about 13.78 ± 1.50 in stems and roots, 20.06 ± 0.70 in leaves and 3.62 ± 0.48 in flower were recorded. For Cd content (mg/Kg), the mean ± standard deviation of about 1.53 ± 0.80 in stems and roots, 1.08 ± 0.20 leaves and below detection limit (<0.5) in flower were recorded. For As content (mg/Kg), the mean ± standard deviation of about 1.79 ± 0.90 in stems and roots, 2.30 ± 1.30 in leaves and below detection limit (<0.2) in flower were recorded.

Table 1: Elemental accumulation in different parts of Commelina sp.

Plant parts	Pb	Cd	As
Stem & Root	13.78 ± 1.50	1.53 ± 0.80	1.79 ± 0.90
Leaf	20.06 ± 0.70	1.08 ± 0.20	2.30 ± 1.30
Flower	3.62 ± 0.48	<0.5	<0.2

n = 6 for each part

Table 2 measures the pollen morphology between MSW site in comparison with non-MSW site. The polar axis was significantly ($P<0.001$) increased in experimental site (100.0 ± 6.67) when compared to control site (82.0 ± 6.32) of pollens while equatorial axis was significantly ($P<0.001$) decreased in experimental site (45.0 ± 8.50) when compared to control site of pollens (66.0 ± 6.99).

Table 2: Pollen morphology of *Commelina* sp.

Study	Polar axis (µm)	Equatorial axis (µm)	Abnormal features
Control	82.0 ± 6.32	45.0 ± 8.50	None
Experimental	100.0 ± 6.67*	66.0 ± 6.99*	Rapture outer membrane, rectangular and wider of equatorial axis

n = 20 in each case; *P<0.001

Fig 1 A and B represent photomicrograph of pollens of *Commelina* sp. in which normal shape was observed in control site while rapture outer membrane, rectangular shape and wider of equatorial axis were found in experimental site (Table 2).

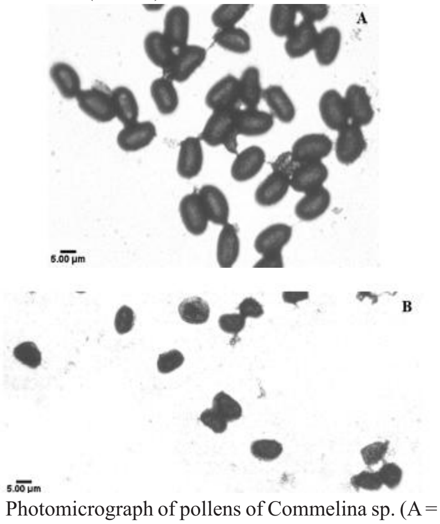

Figure 1: Photomicrograph of pollens of Commelina sp. (A = Control site and B = experimental site)

DISCUSSION

In the present study, the accumulation of elements viz. Pb, Cd and As in different parts viz. stems and roots, leaves, and flower of weed (*Commelina* sp.) obtained in and around the MSW dumping ground. But least amount of Pb was accumulated in the flower compared to other parts like root and stem and leaf of studied weed while Cd and As were observed below detection limit.

An earlier study by Sekabira et al.[33] reported that accumulation (mg/Kg) of Pb and Cd were 11.57 and 0.79 in leaves, 14.32 and 1.04 in stems and 20.18 and 1.62 in roots of *Commelina benghalensis* collected from the solid waste dumping ground. This finding has some contradiction with the present study where leaf observed maximum accumulation of Pb.

A similar observation was reported Waoo et al.[34] that the Pb and Cd accumulated (mg/Kg) of about 262.2 and 49.4 as well as 88.4 and 28.76 in the leaves and shoots of *Lantana camara*. In the present study, the As content was lower values in the plant parts like leaves, stems and roots of the studied weed compared to earlier study of Fu et al.[22] Whereas Chu et al.[35] documented metalloid and metals accumulation in which As content of 1.18 mg/Kg, Pb content of 594.0 mg/Kg and Cd content of 0.26 mg/Kg, respectively in the shoot of *Commelina communis*.

A similar observation was found in earlier study by Hajar et al.[36] in which the flower of *Stevia rebaudiana* was accumulated As (0.3135 mg/Kg) and Cd (0.2266 mg/Kg). These elements have toxic effect in which pollen structure might be altered as observed in the present study. Many studies found that metals affect the male gametes of plant species.[24-29]

CONCLUSION

It is concluded that the studied weed may be suitable for phytoremediation of metals and metalloid from the medium but the Pb accumulation in flower may alter the structure of pollen of *Commelina* sp. This study is a preliminary observation during pre-monsoon season. It is suggested to study for post-monsoon season to know as bioindicator potential of metals and metalloid as well as the fertilization potential of this specimen.

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Conflict of interest

Authors declare no conflict of interest in the present study and manuscript.

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