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EFFECTS OF ARSENIC ON DIVERSITY OF RICE FIELD WEEDS

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In Bangladesh use of groundwater for irrigation and drinking is increasing the arsenic contamination allarmingly.(1) Studies in home and abroad confirmed that a substantial amount of this heavy metal is absorbed by plants(2-5) and it affects PO_4-P absorption(2,5) thereby preventing ATP generation.(5-7) A survey of rice fields at. Sonargaon in Narayanganj district revealed that farmers use arsenic (476 - 497 µg/l) contaminated shallow tube well water for irrigation. Attempts were therefore taken to see if the diversity of weeds in rice field irrigated with the arsenic contaminated groundwater is affected.

An experiment was carried out to determine the effect of arsenic on the diversity of rice field weeds at Nilkanda Union under P.S. Sonargaon in Narayanganj district, which lies between 23° 32´ and 23° 46´ N and 90° 31´ and 90° 41 E´. The study area is situated in the Meghna floodplain in Silmondi and Narailbag soil series. The experiment was conducted in 19×19 m plots of five replicates arranged in a complete randomized block design. High yield rice variety (BR-28) was grown and irrigated with pond water (as control) and contaminated groundwater from a shallow tube well. The water quality and soil characteristics are described elsewhere.(8) Recommended doses of NPK fertilizers were applied to all plots.

The weed vegetation in the rice plots was studied after two months of transplantation. The important vegetational attributes which may be measured readily are size, number and distribution of component parts. The use of small, square areas (quadrat) of known size as the basic study unit for the investigation of these attributes has been recommended.(9,10) A 1×1 m wooden quadrat was used in the present study. A total of five quadrats were randomly placed in each plot. Number of plants fall in each quadrat were listed and counted. From the data the phytosociological analysis was done. Besides, Shannon-Weaver(11) and Simpson(12) indices of diversity were determined.

A total of 14 weeds were recorded from the experimental plots, a list of which and their presence or absence in the control and treatment plots are given in Table 1. It was revealed that the control plot showed higher species diversity (11 taxa) than the plots irrigated with arsenic contaminated water (eight taxa).

Phytosociological analysis and various indices were determined from the data of five quadrats of a plot which are shown in Table 2. Maximum importance value index (IVI) was recorded 50.04 in *Lindernia antipoda* and *Eriocolon* sp. and minimum was 17.29 in *Hediotis corymbosa* in the control. In the treatment *Lindernia antipoda* had maximum IVI (70.46) followed by *Eriocolon* sp. and *Panicum* sp., whereas a minimum value of 19.26 was found in *C. rotundus*, i.e. both the control and treatment were dominated by *Lindernia antipoda* and *Eriocolon* sp. Arsenic appears to enhance growth of *Cyperus rotundus, Eclipta alba* and *Fimbristilis* sp., while *Cynodon dactylon, Echinochloa colonum, Enhydra flactuans* and *Lippia nodiflora* are sensitive to arsenic (Table 2). Arsenic has been found to increase the growth and yield of citrus plants at low concentration (below 20 mg/kg dry soil, an upper permissible limit) of arsenic in the soil.(13) The study area had 2.5 - 8.0 mg/kg dry soil. Plants tolerant to large arsenic applications (670 ppm) to soils have been reported.(14) Genotypic variation in tolerance to arsenic toxicity among *Brassica juncea* L. genotype have been observed.(15) The sensitivity of some weeds to even low concentration of soil arsenic may be due to competitive uptake of arsenic to phosphorus by these plants, thereby prevents ATP generation.(5-7) Marked yield reduction of sweet corn occurred at 5 ppm of extractable arsenic.(16)

Table 1. List of weeds present in plots irrigated with pond water (9.50 ±0.50 µg/l arsenic) and arsenic contaminated (476 ± 3 µg/l) water from a shallow tube well. Presence (+) or absence (-) are also shown.

Name of the weeds	Pond water	Shallow tube-well water
Alternanthera sessilis	+	-
Cynodon dactylon	+	-
Cyperus exceltatum	+	+
C. rotundus	-	+
Eclipta alba	-	+
Echinochloa colonum	+	-
Enhydra flactuans	+	-
Eriocaulon setaceum.	+	+
Fimbristilis sp.	-	+
Hediotis corymbosa	+	-
Hydrocotyle rotundifolia	+	+
Lindernia antipoda	+	+
Lippia nodiflora	+	-
Panicum sp.	+	+

Importance value index indicated that *Cynodon dactylon, Echinochloa colonum, Enhydra flactuans* and *Lippia nodiflora* are very sensitive to arsenic; *Lindernia antipoda* and *Eriocaulon setaceum* were not affected at all, while growth of *Cyperus rotundus, Eclipta alba* and *Fimbristilis* sp. were enhanced in presence of arsenic.

It was revealed that the control (irrigated with pond water) showed higher species diversity than the treatment (irrigated with arsenic contaminated water). It was suggested that because of the so called soil/plant barrier effect, elevated arsenic concentrations in soil may well reduce crop production substantially before enhanced food chain accumulation occurred.[17]

Table 2. Phytosociological analysis, Shannon index (H) and Simpson's index (D) of diversity of weeds in plots irrigated with pond water and Shallow tube well water (arsenic contaminated).

Shallow tube well water	Density	Fre-quency	Abun-dance	Relative density	Relative frequency	Relative abundance	IVI	H	D
Alternanthera sessilis	0.2 (-)	0.2 (-)	1.0 (-)	1.96 (-)	3.86 (-)	4.76 (-)	10.57 (-)		
Cynodon dactylon	0.6 (-)	0.2 (-)	3.0 (-)	5.88 (-)	3.85 (-)	14.28 (-)	24.01 (-)		
Cyperus exceltatum	0.6 (0.4)	0.6 (0.2)	1.0 (2.0	5.88 (8.33)	11.54 (7.69)	4.76 (14.81)	22.18 (30.83)	3.135 (2.751)	0.865 (0.836)
C. rotundus	- (0.2)	- (0.2)	- (1.0)	- (4.16)	- (7.69)	- (7.41)	- (19.26)		
Eclipta alba	- (0.4)	- (0.2)	- (1.0)	- (8.33)	- (7.69)	- (7.41)	- (19.26)		
Echinochloa colonum	1.0 (-)	0.4 (-)	2.5 (-)	9.8 (-)	7.69 (-)	11.9 (-)	29.39 (-)		
Enhydra flactuans	0.6 (-)	0.4 (-)	1.5 (-)	5.88 (-)	7.69 (-)	7.14 (-)	20.71 (-)		
Eriocaulon setaceum	2.2 (0.8)	0.8 (0.4)	2.75 (2.0)	21.57 (16.66)	15.38 (15.38)	13.09 (14.81)	50.04 (46.85)		
Fimbristilis sp.	- (0.6)	- (0.4)	- (1.5)	- (12.5)	- (15.38)	- (11.11)	- (38.99)		
Hediotis corymbosa	0.4 (-)	0.2 (-)	2.0 (-)	3.92 (-)	3.85 (-)	9.52 (-)	17.29 (-)		
Hydrocotyle rotundifolia	0.6 (0.4)	0.6 (0.4)	1.0 (1.0)	5.88 (8.33)	11.54 (15.38)	4.76 (7.41)	22.18 (31.12)		
Lindernia antipoda	2.2 (1.4)	0.8 (0.4)	2.75 (3.5)	21.57 (29.16)	15.38 (15.38)	13.09 (25.92)	50.04 (70.46)		
Lippia nodiflora	0.6 (-)	0.4 (-)	1.5 (-)	5.88 (-)	7.69 (-)	7.14 (-)	20.71 (-)		
Panicum sp.	1.2 (0.6)	0.6 (0.4)	2.0 (1.5)	11.76 (12.5)	11.54 (15.38)	9.52 (11.11)	32.82 (38.99)		

Data in the parentheses indicate the values of arsenic contaminated irrigated plot. n=5.

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