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Weed Infestations in Boro Rice in the Haor Agro-ecosystem as Affected by Weeding Regime and Urea Top Dressing

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Phytosociology of weeds was studied in boro (winter) rice in haor area in relation to weeding regime and urea top dressing through a weed survey. 16, 18 and 13 weed species were recorded in the fields receiving three different regimes of weeding., *Scirpus juncoides* was the most dominant species. A wide range of dissimilarity in weed infestation was observed in those fields. The fields receiving 15-20, 8-14 and 0-7 kg ha^{-1} of urea as top dressing recorded 14, 21 and 17 weed species respectively. *Scirpus juncoides* was also the most dominant weed species. A wide range of dissimilarity and severe weed infestation was observed in the fields receiving urea as top dress.

Key words: Weed survey, Boro rice, Relative abundance, Hoar area.

Introduction

Weed infestations in a field are determined by a number of factors. Cultural practices followed for the growth of a crop have a great influence on the weed flora present in the filed. Weeding and using fertilizer are two such cultural practices. Weed infestations decrease with an increase in the number of weeding done in a crop field. Fertilizer application enhances weed growth together with crop nourishment. Semi-dwarf modern varieties, which require high rates of fertilizers, suffer more from weed competition than tall local varieties (Singh and Sinha 1989). The effect of these factors on weed population also depends on the agro-ecosystem where the crop is grown. The haor is a vast depressed area that remains inundated with water during the monsoon season and becomes arable only after receding of accumulated water from its upper parts in winter. Topography and water regime together with other factors determine the weed population in this area. To effectively control weeds, interactions among crop, weed and other factors need to be thoroughly understood. This study was therefore undertaken to investigate the phytosociology of weeds in boro rice in the haor area in relation to weeding regime and different rates of urea used as top dressing.

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Materials and Methods

The study was conducted in the farmers fields as researcher managed the experiments. Farmers carried out all the cultural practices in consultation with the researcher, whereas researcher was responsible for supervision, monitoring and data collection.

The haor area selected for conducting the study was situated in Jawar village in Tarail thana (administrative unit) under Kishoregonj district. The soils of these boro lands were of grey floodplain type with loamy to clayey texture (Anon 1990). The boro fields of the haor belonged to low and very low land types as shown in Table 1 (UNDP/FAO 1988). For convenience of the study those boro fields were further classified into high, medium and low land types (Salim 1990). Fifty fields of 50 different farmers were randomly selected of which 20, 18 and 12 fields were situated in high, medium and low lands, respectively. The average size of each field was 1500 m^2. Since BR3 was the most common rice cultivar in the area, that was selected for the study. All the cultural practices done in the fields were recorded.

Three weeding regimes i.e., twice-weeded, once-weeded and unweeded were practiced by the farmers in those fields. Weeding was done manually. In case of twice-weeding, weeds were

Table 1
Boro land classification systems in the study area

Land Classification (Salim 1990)	Land classification used in this study	National Land Classification (UNDP & FAO 1988)	
		Land type	Characteristics
	B-H	Boro high	Low	Normally inundated upto 180-300 cm
	B-H-L	Boro medium	Very low	Normally inundated up to 300cm
	B-M			
Boro land	B-L	Boro low		
	Charr			

B, Boro; H,High; M, Medium; L, Low; Charr, land available for cultivation after receding flood water at the latest.

Table 2
Distribution of boro rice fields according to weeding regime and urea top dressing as practiced by the farmers

Weeding regime	Urea top dressing (kg ha^{-1})			Total
	0-7	8-14	15-20	
Unweeded	5	7	5	17
Once-weeded	6	5	5	16
Twice-weeded	5	6	6	17
Total	16	18	16	50

controlled at 30 and 45 days after transplanting (DAT), while for once-weeding it was at 35 DAT. Since these lands were fertile, farmers usually used low amount of urea as top dress. The rate of urea used in these fields were grouped into three classes i.e. 15-20, 8-14 and 0-7 kg ha^{-1}. To study the effect of urea top dressing a 5 m wide strip of land along one side of each was kept unweeded to record weed species. Distribution of fields according to weeding regime and urea top dressing has been shown in Table 2. Effect of weeding regime and urea top dressing on weed infestation pattern was observed through weed survey done in these 50 fields.

Data were collected separately for both the parameters; number of weeds were recorded species wise whereas, weed populations were counted at 60 DAT when the crop was at panicle initiation stage. Data were collected from each field with a quadrate measuring 0.25m^2 area. Ten samples were collected from each field. Data thus collected were summarized and analyzed according to the formulae used by Thomas (1985).

Frequency (F). It is the number of fields in which a species occurred. It is expressed as a percentage of the total number of fields.

$$F_k = \frac{Y_i}{n} \times 100$$

Where, F_k=Frequency value for species k; Y_i=Presence (1)or absence (0) of species k in field i; n=Number of fields surveyed.

Field uniformity (FU). It is number of sampling locations (10 quadrates per field) in which a species occurred. It is expressed as a percentage of the total number of samples. This measure is used to estimate the area infested by a species.

$$U_k = \frac{X_{ij}}{n} \times 100$$

Where, Uk=Field uniformity values for species k; X_{ij}=Presence (1) or absence (0) of species in quadrate j in field i; n=Number of quadrate (usually 10)

Mean field density (MFD). It is the number of an individual weed species occurred in one square meter area. The mean field density value is obtained by totalling each field density (D) and dividing by the total number of fields.

$$D_i = \frac{Z_j}{10} \times 4$$

$$MFD_k = \frac{D_i}{n} \times 4$$

Where, D_i=Density (No/m^2) value of species in field i; Z_j=Number of plants in quadrate j; MFD_k=Mean field density for species k; n=Number of fields surveyed.

Relative abundance (RA). In order to summarize the abundance of a species, the above mentioned three measures were combined into a single value which is referred to as relative abundance and is calculated from relative frequency, relative field uniformity and relative mean field density measured as follows:

Relative frequency for species k

$$RF_k = \frac{\text{Frequency value of species k}}{\text{Sum of frequency value for all species}} \times 100$$

Relative field uniformity for species k

$$RFU_k = \frac{\text{Field uniformity value of species k}}{\text{Sum of field uniformity value for all species}} \times 100$$

Relative Mean Field Density for species k

$$RMFD_k = \frac{\text{Mean Field Density value of species k}}{\text{Sum of Mean Field Densityvalues of all species}} \times 100$$

Now, Relative Abundance (RA) value for species k

$$RA_k = RF_k + RFU_k + RMFD_k$$

The relative abundance measure will have a value of 300. This calculation assumes that the frequency, field uniformity and field density measures are of equal importance in estimating the abundance of a species. If only one species occurs in a community, the relative abundance value for that species will be 300. If more than one species occur, the total value of 300 will be shared by them. The greater the share of a species the greater is the importance of a species. In this paper only relative abundance values are presented in tables rather than frequency, field uniformity and mean field density as relative abundance value was derived from these values.

Coefficient of Similarity (%). The weed community found to grow in different weeding or urea classes were compared on the basis of coefficient of similarity (%) as per the methods described by Newsome and Dix (1968). It was determined using the following formula:

$$C = \frac{2w}{a+b} \times 100$$

Where, C=Coefficient of similarity (%) of two communities. w=The sum of lower of the two mean field densities for species shared by the two communities. a = The sum of mean field density values for the first community. b = The sum of mean field density values for the second community.

Results and Discussion

Effect of weeding regime on weed infestation. Twice-weeded fields recorded 16 weed species and the most important weed species was *Scirpus juncoides* with the highest relative abundance value of 89.04 (Table 3). The next two

Table 3

Relative abundance of weed in boro rice field as affected by weeding regime

S No.	Scientific name	Family	Relative abundance		
			Twice-weeded	Once-weeded	Unweeded
1.	*Scirpus juncoides*	Cyperaceae	89.04	80.91	44.12
2.	*Lindernia anagallis*	Scrophulariaceae	51.05	17.14	16.39
3.	*Monochoria hastata*	Pontederiaceae	31.32	36.52	63.07
4.	*Aponogeton natans*	Aponogetonaceae	25.75	24.16	35.12
5.	*Echinochloa crusgalli*	Gramineae	21.60	32.55	11.59
6.	*Hygrorhiza aristata*	Gramineae	20.21	12.93	39.59
7.	*Alternanthera phyloxeroides*	Amaranthaceae	19.27	19.20	24.61
8.	*Jussiaea repens*	Onagraceae	13.22	8.15	16.60
9.	*Limnanthemum indicum*	Gentinaceae	10.15	10.47	31.11
10.	*Oxalis corniculata*	Oxalidaceae	6.30	14.55	8.22
11.	*Cyperus compressus*	Cyperaceae	3.87	-	-
12.	*Fimbristylis miliacea*	Cyperaceae	2.58	-	-
13.	*Pseudoraphis minuta*	Gramineae	1.54	2.13	-
14.	*Leersia hexandra*	Gramineae	1.53	1.64	4.92
15.	*Sagittaria trifolia*	Alismataceae	1.28	-	-
16.	*Cyperus diformis*	Alismataceae	1.28	2.73	-
17.	*Echinochloa colona*	Gramineae	-	23.54	-
18.	*Rotteboellia protensa*	Gramineae	-	6.08	-
19.	*Hydrocotyle asiatica*	Umbellifereae	-	2.74	-
20.	*Cyperus exaltatus*	Cyperaceae	-	2.72	-
21.	*Eclipta alba*	Compositeae	-	1.84	-
22.	*Eichhornia crassipes*	Pontederiaceae	-	-	2.61
23.	*Sagittaria guayanensis*	Alismataceae	-	-	2.05

Table 4

Total relative abundance of weed types grown in association with boro rice at different weeding regime

Weeding regime	Life cycle type			Morphology type									Total
				Grass			Sedge			Broadleaf			
	A	P	Total	A	P	Total	A	P	Total	A	P	Total	
Weeded	94.89	205.11	300	21.61	23.28	44.89	7.73	89.04	96.77	65.55	92.79	158.34	300
	(31.63)	(68.37)	(100)	(7.2)	(7.76)	(14.96)	(2.58)	(29.68)	(32.26)	(21.85)	(30.93)	(52.78)	(100)
Once weeded	86.83	213.17	300	56.09	22.78	78.87	5.45	80.91	86.36	25.29	109.48	134.77	300
	(28.94)	(71.06)	(100)	(18.7)	(7.59)	(26.29)	(1.82)	(26.97)	(28.79)	(8.43)	(36.49)	(44.92)	(100)
Unweeded	44.58	255.42	300	11.95	44.51	56.10	0	44.12	44.12	32.99	166.79	199.78	300
	(11.86)	(85.14)	(100)	(3.86)	(3.86)	(18.70)	--	(14.71)	(14.71)	(11.00)	(55.60)	(66.60)	(100)

A, Annual; P, Perennial; Figures in parenthesis indicate percent of relative abundance of weed type.

dominant weed species were *Lindernia anagallis* and *Monochoria hastata.* In the once-weeded fields 18 weed species were found and *S. juncoides* was also the most dominant weed species as indicated by the highest relative abundance value. *M hastata* and *Echinochloa crusgalli* were the second and third dominant species, respectively. Thirteen weed species were recorded in the unweeded fields. The most dominant weed species was *M hastata* whereas *S juncoides* and *Hygrorhyza aristata* were the next two dominant species.

Total relative abundance values of perennial weed types were much higher than annuals in these boro fields irrespective of weeding regimes (Table 4). Perennial weeds increased in importance as compared to annuals with decrease in weeding frequency. Irrespective of weeding frequency, broadleaf weeds had higher dominance and ecological success as compared to sedges or grasses. Importance of broadleaf weeds decreased with the decrease in weeding frequency.

Density of weed types as affected by weeding regime (Fig 1) clearly showed that weed density (No/m^2) was the highest in the unweeded fields while it was the minimum in the twice-weeded fields. It might be due to that in the unweeded fields, weeds were allowed to grow and compete with the crop plants, while in the weeded fields their growth were under control through manual weeding. In all the weeding cases it was noticed that perennial weeds always dominated over the annuals. It might be due to their better withstanding capability in the low lying areas. This situation was also reported earlier by Bari *et al* (1995).

The highest coefficient of similarity (82.5%) was observed between once-weeded and twice-weeded fields which was followed by 51.16% between unweeded and once-weeded fields and 46.12% between unweeded and twice weeded fields. Results indicated that similarity of weed infestation was higher between the weeded fields.

Effect of urea top dressing on weed infestations. Fourteen weed species were recorded from the boro rice fields

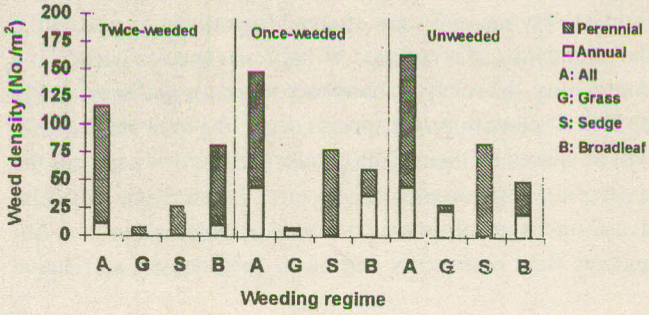

Fig 1. Density(No/m^2) of weed types as affected by weeding regime.

where urea was top dressed @ 15.20 kg ha^{-1} (Table 5). *S juncoides* was the most dominant weed species in these fields with the highest relative abundance value. The next three dominant weed species were *Aponogeton natans, M hastata* and *L anagallis.* Twenty-one weed species were recorded from the boro fields fertilized with urea @ 8-14 kg ha^{-1}. *S juncoides* was also the most dominant weed species with the highest relative abundance value and it was followed by *E crusgalli* and *M khastata*, respectively. Seventeen weed species were identified in the boro fields where 0-7 kg ha^{-1} of urea was applied. *S juncoides* was also the most important species in these boro fields. The next two important weed species were *M hastata* and *Hygrorhyza aristata.* Therefore, irrespective of different amounts of urea used as top dress *S juncoides* was the most dominant weed species. Number of weed species was the maximum in the fields fertilized with urea @ 8-14 kg ha^{-1} and the minimum in the fields fertilized with urea @ 15-20 kg ha^{-1}.

Total relative abundance values of perennial weeds were much higher than that of annuals irrespective of different rates of urea used (Table 6). Total relative abundance values of perennials decreased with decrease in the rate of urea applied. It might be due to that perennial weeds increased with the increase in the rate of urea applied. Sedges dominated over

broadleaf and grass weeds in the fields fertilized with urea @ 8-14 kg ha^{-1}. In case of the fields which received other two fertilizer rates, broadleaf weeds remained dominant.

Density of weed types as affected by urea top dressing has been shown in (Fig 2). It was observed that weed build-up

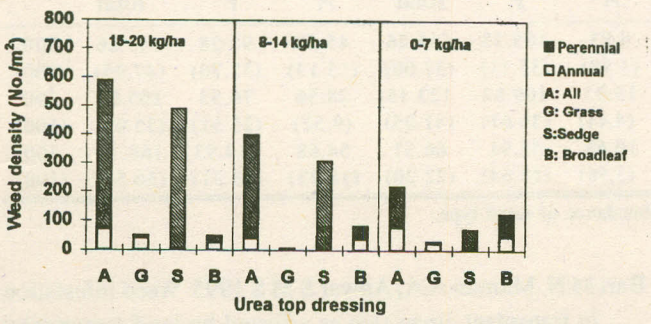

Fig 2. Density(No/m^2) of weed types as affected by urea top dressing.

increased with the increase in the rate of urea top dressing which indicated their performance in utilizing the added nitrogen. The highest weed (No /m^2) was observed in the fields where urea was applied @ 8-14 kg ha^{-1} and the lowest density was found in the fields where 0-7 kg ha^{-1} of urea was applied. In all the cases perennial weeds outnumbered the annuals which indicated their comparative ability to utilize added nitrogen.

Coefficient of similarity (%) of weeds grown in association with boro rice as affected by urea top dressing were also studied. The highest similarity (72.52%) was observed between 15-20 kg ha^{-1} and 8-14 kg ha^{-1} of urea used as top dress. The lowest similarity (33.5%) was observed between top dressing @ 0-7 and 8-14 kg ha^{-1} and the intermediate (43.75%) between top dressing @ 0-7 and 15-20 kg ha^{-1}. Results indicated that with the increase in the amount of urea top dressing the similarity of weed infestation increased.

Table 5

Relative abundance of weeds in boro rice as affected by urea top dressing relative abundance

SNo.	Scientific name	Family	Urea @ 15-20 kg ha^{-1}	Urea @ 8-14 kg ha^{-1}	Urea @ 0-7 kg ha^{-1}
1.	*Scirpus juncoides*	Cyperaceae	105.33	109.82	55.92
2.	*Aponogeton natans*	Aponogetonaceae	31.28	11.67	25.11
3.	*Monochoria hastata*	Pontederiaceae	27.86	25.80	49.75
4.	*Lindernia anagallis*	Scrophulariaceae	27.34	16.61	33.11
5.	*Hygrorhyza aristata*	Gramineae	22.88	13.21	29.89
6.	*Echinochloa crusgalli*	Gramineae	22.00	32.32	24.08
7.	*Jussiaea repens*	Onagraceae	16.56	9.95	24.08
8.	*Alternanthera philoxeroides*	Amaranthaceae	15.72	20.35	14.62
9.	*Limnanthemum indicum*	Gentinaceae	12.37	4.19	20.52
10.	*Oxalis corniculata*	Oxalidaceae	7.11	10.41	15.32
11	*.Cyperus compressus*	Cyperaceae	3.96	-	5.51
12.	*Sagittaria trifolia*	Alismataceae	3.94	-	-
13.	*Fimbristylis miliacea*	Cyperaceae	1.97	3.42	4.73
14.	*Limnophila sessiliflora*	Scrophulariaceae	1.68	-	-
15.	*Pseudoraphis minuta*	Gramineae	-	9.54	-
16.	*Echinochloa colona*	Gramineae	-	7.47	-
17.	*Cyperus diformis*	Cyperaceae	-	5.66	5.67
18.	*Cyperus exaltatus*	Cyperaceae	-	4.25	5.95
19.	*Leersia hexandra*	Gramineae	-	3.29	-
20.	*Rotteboellia protensa*	Gramineae	-	3.22	4.26
21.	*Echinochloa stagnina*	Gramineae	-	2.71	-
22.	*Centipida minima*	Compositeae	-	2.09	-
23.	*Eclipta alba*	Compositeae	-	2.02	-
24.	*Hydrococtyle asiatica*	Umbellifereae	-	2.00	-
25.	*Utricularia stellaris*	Lentibulariaceae	-	-	
26.	*Sagittaria guayanensis*	Alismataceae	-	-	1.44
27.	*Eichhornia crassipes*	Pontederiaceae	-	-	1.35

Table 6

Total relative abundance of weed types grown in association with boro rice at different urea dressing

Weeding regime	Life cycle type			Morphology type									Total
				Grass			Sedge			Broadleaf			
	A	P	Total	A	P	Total	A	P	Total	A	P	Total	
Urea @ 15.20	73.51	226.49	300	22.00	22.88	44.88	5.93	105.33	111.26	45.58	98.28	143.86	300
kg ha^{-1}	(24.50)	(75.50)	(100)	(7.33)	(7.63)	(14.96)	(1.98)	(35.11)	(37.09)	(15.19)	(32.76)	(47.95)	(100)
Urea @ 8-14	87.68	212.32	300	45.79	25.97	71.76	13.33	109.82	123.15	28.56	76.53	105.09	300
kg ha^{-1}	(29.32)	(70.77)	(100)	(15.26)	(8.66)	(23.92)	(4.44)	(36.61)	(41.05)	(9.52)	(25.51)	(35.03)	(100)
Urea @ 0-7	99.27	200.73	300	33.91	29.89	63.80	10.68	55.91	66.51	54.68	114.93	169.70	300
kg ha^{-1}	(33.09)	(66.91)	(100)	(11.30)	(9.96)	(21.26)	(3.56)	(18.64)	(22.20)	(18.23)	(38.31)	(56.54)	(100)

A, Annual; P, Perennial; Figures in parenthesis indicate percent of relative abundance of weed type.

Study of the phytosociology of weeds is important for identifying the weed communities grown in association with a particular crop and also to identify the most important weed species which might cause damage to crops at economic threshold level. Thus, in turn, economic weed management programmes can be outlined. In this study *S. juncoides, M hastata* and *L anagallis* were found as three important weeds in the rice fields of haor agro ecosystem. So, controlling these weeds may help to profitable rice production in the area. However, further in-depth study is needed in this regard.

References

Anon 1990 Physical and agricultural environment of Bangladesh and JSARD project villages In: *Key Question and Issues from Village-based Studies 1986-89,* JSARD projecdt team, JICA, Dhaka, Bangladesh pp 19-20.

Bari M N, Mamun A A, Anwar S M S 1995 Weed infestation in transplant aman rice as affected by land topography and time of transplanting. *Bangladesh J Agril Sci* **22** (2) 227-235.

Newsome R D, Dix R L 1968 The forests of the Cypress hill, Alberta and Saskatchewan, Canada.*The American Midland Naturalist* **80** (1) 137.

Singh S, Sinha K K, Mishra S S 1989 *Indian J Weed Sci* **21** (1&2), 27.

Salim M 1990 Development of boro rice cultivation in the low lying areas of Bangladesh-Case studies in haor and beel areas, a thesis submitted to the Division of Tropical Agriculture, Graduate School of Agriculture, Kyoto University, Japan, for Ph D degree.

Thomas A G 1985 Weed survey systems used in Saskatchewan for cereal and oilseed crops. *Weed Sci* **33** (1) 36-37.

UNDP/FAO, 1988 *Land Resources Appraisal of Bangladesh for Agricultural Development, Agroecological regions of Bangladesh,* Report 2, FAO, Rome pp 105-229.