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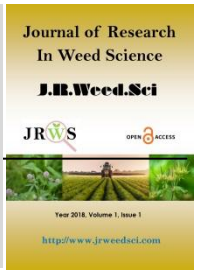

Floristic composition of weeds in T. *aman*-potato-*boro* rice cropping pattern in Bangladesh

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Abstract

The survey was conducted in the farmers' field of Durba Chara village of Gauripur upazilla under Mymensingh district to find out the floristic composition of weeds in three crops i.e. summer rice, potato and winter rice under T. *aman*-potato-*boro* cropping pattern. Five farmers' fields were surveyed by using a quadrat of 0.5m × 0.5m size in four spots from each field randomly. The data were summarized using frequency, field uniformity, mean field density, and relative abundance. A total of 27 weed species belonging to 11 families were found in T. *aman*, potato and *boro* rice, of which 22 species were under 11 families in T. *aman*, 15 species under seven families in potato and 20 species were under nine families in *boro* rice. *Echinochloa crusgalli* was the most abundant weed in both potato and *boro* rice while in T. *aman*, *Ludwigia hyssopifolia* dominated over others. *Echinochloa crusgalli* and *Polygonum hydropiper* were common in both potato and *boro* rice. The other three dominant weed species i.e. *Cyperus rotundus*, *Cynodon dactylon* and *Panicum distichum* in potato and *Eclipta alba*, *Cyperus difformis*, *Eleocharis atroperpurea* in *boro* were completely different from each other. In T. *aman*, five completely different weed species i.e. *Ludwigia hyssopifolia*, *Alternanthera sessilis*, *Polygonum orientale*, *Fimbristylis miliaceae* and *Hedyotis corymbosa* were found dominant. Broadleaf weeds were dominant in both T. *aman* and *boro* but in potato, grasses dominated over others.

Keywords: Cropping pattern, floristic composition, potato, rice, weed

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1. Introduction

Weeds are a major biological constraint for crop production. They interfere with crop growth and development through competition for water, nutrients, light, and space and cause adverse impacts on crop yields. Weeds affect plant height, leaf architecture, growth pattern and life duration of crops and thus cause lower yield. Amarjit et al. (1994) reported that poor weed control is one of the major factors for yield reduction depending on the type of floristic composition and weeds intensity. So proper weed management is essential for crop production. In Bangladesh, rice dominates over all other crops and covers 75% of the total cropped area of which around 79% is occupied by high yielding rice varieties (BBS, 2016). Karim (1987) estimated that due to uncontrolled weed growth, yield losses in rice ranges from 27 to 100%. Mamun (1990) reported that weed growth reduced the grain yield by 45% in T. *aman* rice and 22.36% in *boro* rice. This loss is, therefore, a serious threat to the food deficit countries like Bangladesh. Weeds can also have a detrimental impact on potato tuber yield when compared to potatoes grown in weed-free conditions (Love et al. 1995; Nelson and Thoreson, 1981). Love et al. (1995) found a reduction in vine biomass, tuber biomass, and total yield in weedy plots compared to weed-free plots. Weedy conditions also resulted in a greater number of small tubers and fewer US No. 1 grade tubers compared to weed-free conditions. Nelson and Thoreson (1981) found that competition with the weeds reduced both the average tuber size and the number of tubers. Aside from the impacts on the physiological formation of yield during the season, weeds present at harvest can be detrimental to yield. The extent of yield losses depends on the type of weed flora, their intensity, and duration of weed competition and soil and climatic factors. The composition of weed flora may differ depending on location (Janiya and Moody, 1983), water supply (Bhan, 1983), cultural practices (Bernasor and De Datta, 1983) the inherent weed flora in the area and the crop grown. In a given environment, however, the weed vegetation is strongly affected by cultural practices such as irrigation, fertilizer management, cultivar, herbicide and crop rotation (Kim et al. 1983). Understanding the nature and extent of the floristic composition of weeds in a particular field situation is more important for efficient planning and executing an effective weed control measure rather than a countrywide recommendation weed control measure. Therefore, the purpose of the present study was to assess and compare the floristic composition, and dominant weedspecies prevailing in three crops under T.*aman*–potato-*boro* rice cropping pattern.

2. Materials and Methods

The survey on weed composition was carried out at the farmers' field of DurbaChara village at Gouripurupazilla under Mymensingh district during the period of June 2015 to May 2016. The study areas belonged to Old Brahmaputra Floodplain Agro-Ecological Zone (AEZ 9) having soil of silty clay texture and low contents of organic matter. T. *aman*–potato–*boro* is the most commonly practiced cropping pattern by the farmers' in this

area.Five fields were randomly selected and assessed for weed composition under T. *aman*–potato–*boro* cropping pattern having summer rice as T. *aman* and winter rice as *boro* rice. Twenty spots, four from each of the five fields were surveyed at random for T. *aman* rice. The transplanted variety of *aman* was BINA dhan 7. At the time of the survey, the rice plants were at their tillering stage. Similarly, 20 spots were surveyed in the potato field and in *boro*rice. The planted potato variety was *Challisha*. The survey on weed composition was performed at sprouting stage of potato. The variety of *boro* rice was BRRI dhan 28 and the survey was done at the tillering stage. A quadrate of 0.25 m^2 (50cm × 50cm) was placed in each spot and total weeds within the quadrat were counted species-wise. Weed species that could not be identified in the field were tagged, pressed and transported for later identification. Collected data were summarized according to the following quantitative measures as described by Thomas (1985); frequency, field uniformity, mean field density, relative frequency, relative field uniformity, relative mean field density and relative abundance value.

***Frequency*:** It is the number of fields in which a species occurred and expressed as a percentage of the total number of fields. It is expressed as follows:

$$F_k = \frac{\sum_{i=0}^{n} Y_i}{n} \times 100$$

Where, F_k = Frequency value for species K, Y_i = Presence or absence of K in the field i, n = Number of field survey.

***Field uniformity (FU)*:** It is the sampling locations (4 quadrats per field) in which a species occurred, expressed as a percentage of the total number of samples. This measure was used to estimate the area infested with a species. It is expressed as follows:

$$U_k = \frac{\sum^{n} \sum^{4} X_{ij}}{4n} \times 100$$

Where, U_k = field uniformity values for species K, X_{ij} = Presence or absence of the species K in quadrat j of the field i

***Density (D)*:** It is the number of individual of a species per square meter.

$$D_i = \frac{\sum^{4} Z_j}{n} \times 4$$

Where, D_i = Density (expressed as number per m^2), Z_j = Number of plants in quadrat j (a quadrat in 0.25 m^2).

***Mean field density (MFD)*:** It is the value that is obtained by totaling each field density (D) and dividing by the total number of fields. It is expressed as follows:

$$MFD_k = \frac{\sum^{n} D_i}{n}$$

Where,MFD_k = Mean field value of species K, D_i = Density (expressed as number per square meter) value of species in the field i.

***Relative frequency for species K (RF_k)*:**

$$\frac{Frequencyvalueofspecies\ 'k'}{Sumoffrequencyvalueforspecies} \times 100$$

***Relative field uniformity for species K (RFU_k)*:**

$$\frac{Fielduniformityofspecies\ 'k'}{Sumoffrequencyuniformityforspecies} \times 100$$

***Relative mean field density for species K ($RFMD_k$)*:**

$$\frac{Meanfielddensityvalueofspecies\ 'k'}{Sumofmeanfielddensityvalueforallspecies} \times 100$$

Relative Abundance (RA)

In order to summarize the abundance of a species, three of the above relative measures were combined into a single value, which is known as Relative Abundance (RA).

Therefore, Relative abundance for species K, $RA_k = RF_k + RFU_k + RMFD_k$. The relative abundance measure has a value of 300.This calculation assumed that the frequency, field uniformity and mean field density were of equal importance in estimating the abundance of a species. If only one species occurred in a community, the relative abundance will be 300. If more than one species occur in the community the total value of 300 is shared by them. The greater the share of a species is recorded the greater the importance it marks. Thus the relative abundance of the infesting species would show their relative ecological importance in the community.

3. Results and Discussion

3.1. Weed vegetation in T. *aman* rice

Twenty-two weed species belonging to 11 families were found in T. *aman* fields comprising five kinds of grass, five sedges and 12 broadleaf weeds (Table 1). Poaceae and Cyperaceae were the families with the highest number of weed species. Commelinaceae and Amaranthaceae contributed three and two weed species, respectively. Compositae, Convolvulaceae, Marsileaceae, Onagraceae, Pontederiaceae, Polygonaceae, and Rubiaceae were represented by only one weed species each. In terms of frequencies, the most frequent weed species were two broadleaf weeds i.e. *Ludwigia hyssopifolia* and *Alternanthera sessilis* that occupied all five fields. The weed species that occurred in frequencies ≥ 60% were *Echinochloa crusgalli* among the grasses, *Fimbristylis miliacea* and *Cyperus difformis* among the sedges and *Polygonum orientale, Alternanthera philoxeroides, Hedyotis corymbosa, Marsilea crenata,* and *Monochoria vaginalis* among the rest of the broadleaf weeds (Table1). Uniformity is a quantitative measure of the spread of a weed species within a field. *Ludwigia hyssopifolia* was the most uniformly distributed weed species followed by *Alternanthera sessilis, Polygonum orientale, Fimbristylis miliacea* and *Echinochloa crusgalli* (Table1). Similarly, *Ludwigia hyssopifolia* was the most abundant

weed species with a density of 17.6 plants m^{-2}. Here it was observed that the mean field density of *Fimbristylis miliacea* were higher but the frequency and uniformity were lower than *Alternanthera sessilis.* Among the infesting weed species, the five most dominant weed species in terms of relative abundance value in descending order were *Ludwigia hyssopifolia* (35.1%), *Alternanthera sessili* (24.5%), *Polygonum orientale* (23.1%), *Fimbristylis miliacea* (22.3%) and *Hedyotis corymbosa* (19.1%) while the remaining species had 175.9% (Figure 1). The relative abundance value of broadleaf weeds (195.3), sedges (66.9) and grasses (37.7) clearly represented the dominance of broadleaf weeds over sedges and grasses (Figure 2). Mamun et al. (1995) surveyed weed species of transplant *aman* rice in two Agro-ecological Zones (AEZ) of Bangladesh i.e. Old Brahmaputra Floodplain (OBFP) and Young Brahmaputra and Jamuna Floodplain (YBJFP) and observed that although the total number of weed species in both the AEZs was same, the composition of weed flora was different.

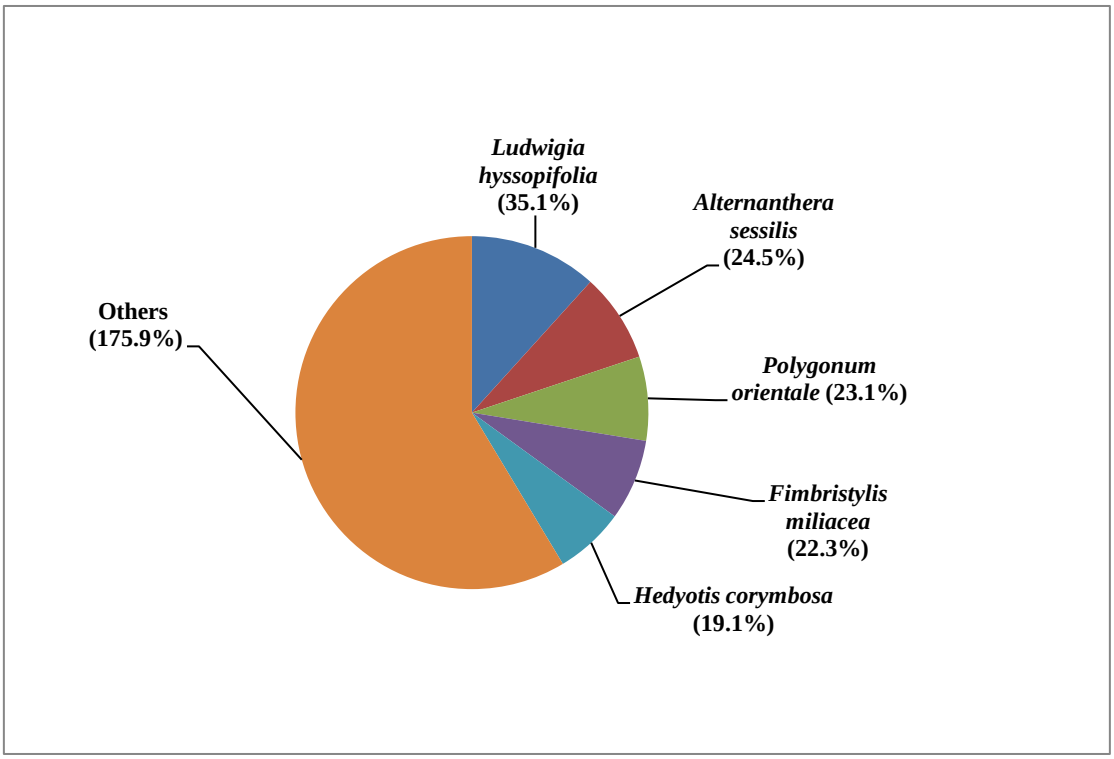

Figure 1- Five most dominant weeds based on relative abundance value in T. *aman* rice.

Table 1- Frequency, field uniformity, mean field density and relative abundance value of weeds in T. *aman* rice fields

Name of the weed species	Family	Frequency (%)	Field uniformity (%)	Mean field density (m^{-2})	Relative abundance value (%)
Grasses					
Echinochloa crusgalli	Poaceae	60	50	5.2	16.3
Echinochloa colonum	Poaceae	40	15	0.8	6.3
Leersia hexandra	Poaceae	20	20	2.2	6.2
Cynodon dactylon	Poaceae	20	20	1.2	5.4
Paspalum commersonii	Poaceae	20	10	0.6	3.6
Sedges					
Fimbristylis miliacea	Cyperaceae	60	55	11.4	22.3
Cyperus difformis	Cyperaceae	60	45	4.2	14.8
Eleocharis atroperpurea	Cyperaceae	40	40	6.4	14.2
Cyperus iria	Cyperaceae	40	40	4.8	12.8
Scirpus juncoides	Cyperaceae	20	5	0.4	2.8
Broadleaf weeds					
Ludwigia hyssopifolia	Onagraceae	100	85	17.6	35.1
Alternanthera sessilis	Amaranthaceae	100	75	6.8	24.5
Polygonum orientale	Polygonaceae	80	65	8.8	23.1
Alternanthera philoxeroides	Amaranthaceae	80	40	3.2	15.2
Hedyotis corymbosa	Rubiaceae	60	55	7.8	19.1
Marsilea crenata	Marsileaceae	60	45	6.2	16.5
Monochoria vaginalis	Pontederiaceae	60	55	3.8	15.6
Murdannia nudiflora	Commelinaceae	40	25	7.4	13.3
Eclipta alba	Compositae	40	35	5.0	12.4
Ipomoea aquatica	Convolvulaceae	20	20	7.8	11.2
Cyanotis axillaris	Commelinaceae	20	15	1.4	4.9
Commelina diffusa	Commelinaceae	20	15	0.8	4.4

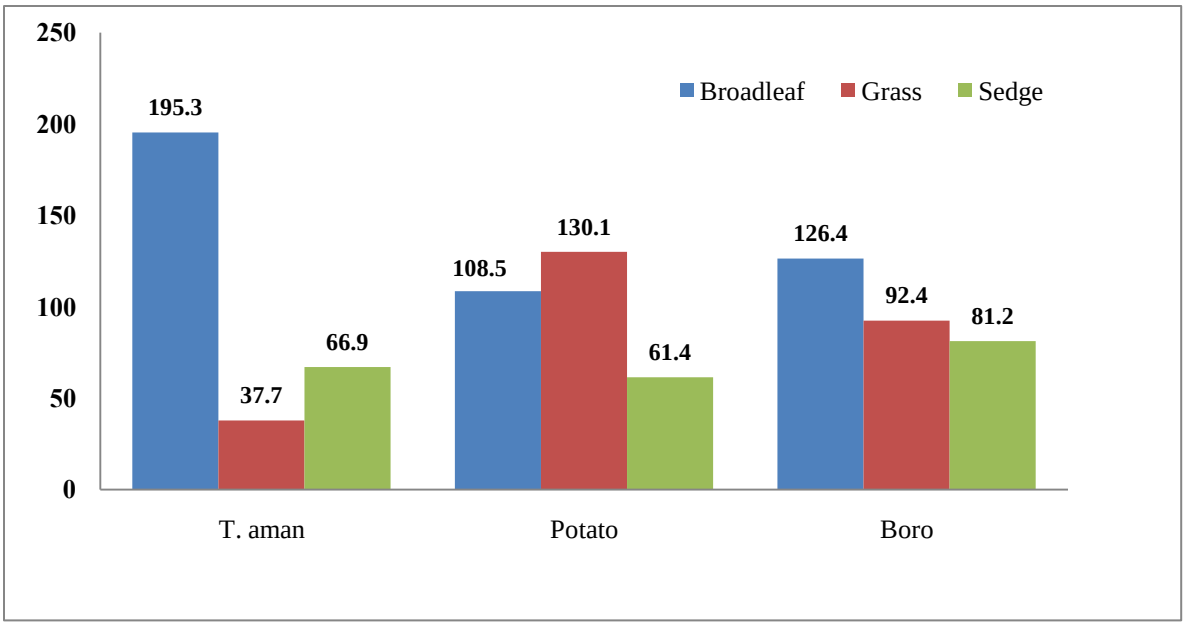

Figure 2- Relative abundance value of weed types in T. *aman* - potato– *boro* cropping pattern.

3.2. Weed vegetation in potato

In potato, the number of infesting weed species was 15 belonging to seven families of which five were grasses, three were sedges and seven were broadleaf weeds (Table 2). Poaceae was the most dominant family having the highest number of weed species followed by Amaranthaceae and Cyperaceae. Poaceae represented five weed species while Amaranthaceae and Cyperaceae both represented three weed species. Compositae, Marsileaceae, Polygonaceae, and Rubiaceae contributed only one species each. The most common and frequent weed species were *Echinochloa crusgalli*, *Panicum distichum* and *Cyperus rotundus* which were observed in all five fields (Table 2). *Cynodon dactylon*, *Eleusine indica*, *Polygonum hydropiper*, and *Alternanthera philoxeroides* occupied ≥60% of total potato fields. A similar trend was observed in case of uniformity and mean field density both of which were highest in *Echinochloa crusgalli* followed by *Cyperus rotundus* and *Panicum distichum* (Table 2). But *Polygonum hydropiper* had high mean field density having less abundance value. In descending order, the topmost five species that had the higher relative abundance value were *Echinochola crusgalli* (41.5%), *Cyperusrotundus* (36.4%), *Panicum distichum* (32.4%), *Polygonum hydropiper* (27.1%) and *Cynodon dactylon* (26.4%) respectively while rest of the species represented 136.2% (Figure 3). Here, the relative abundance value of grasses was 130.1% which was much higher than broadleaves (108.5%) and sedges (61.4%) (Figure 2). So, in potato, grasses were dominant over broadleaves and sedges. Islam et al. (2017) also observed a dominant list of weed

species in potato having *Cyperus rotundus* (44.89%), *Alternaria sessilis* (31.06%), *Echinochloa crusgalli* (26.48%), *Polygonum orientale* (23.94%), *Cynodon dactylon* (23.66%) as the most abundant weed species in descending order.

Table 2- Frequency, field uniformity, mean field density and relative abundance value of weeds in potato fields

Name of the weed species	Family	Frequency (%)	Field uniformity (%)	Mean field density (m^{-2})	Relative abundance value (%)
Grasses					
Echinochloa crusgalli	Poaceae	100	100	13.0	41.5
Panicum distichum	Poaceae	100	100	6.3	32.4
Cynodon dactylon	Poaceae	75	75	6.3	26.4
Eleusine indica	Poaceae	75	75	4.8	24.4
Echinochloa colonum	Poaceae	25	12.5	0.8	5.4
Sedges					
Cyperus rotundus	Cyperaceae	100	100	9.3	36.4
Eleocharis atroperpurea	Cyperaceae	50	37.5	2.5	13.8
Fimbristylis miliacea	Cyperaceae	50	25	1.8	11.2
Broadleaf weeds					
Polygonum hydropiper	Polygonaceae	75	56.25	8.5	27.1
Alternanthera philoxeroides	Amaranthaceae	75	68.75	6.8	26.3
Hedyotis corymbosa	Rubiaceae	50	37.5	4.3	16.2
Eclipta alba	Compositae	25	50	4.0	14.5
Amaranthus viridis	Amaranthaceae	25	25	2.5	9.4
Alternanthera sessilis	Amaranthaceae	25	18.75	2.3	8.2
Marsilea crenata	Marsileaceae	25	18.75	1.3	6.9

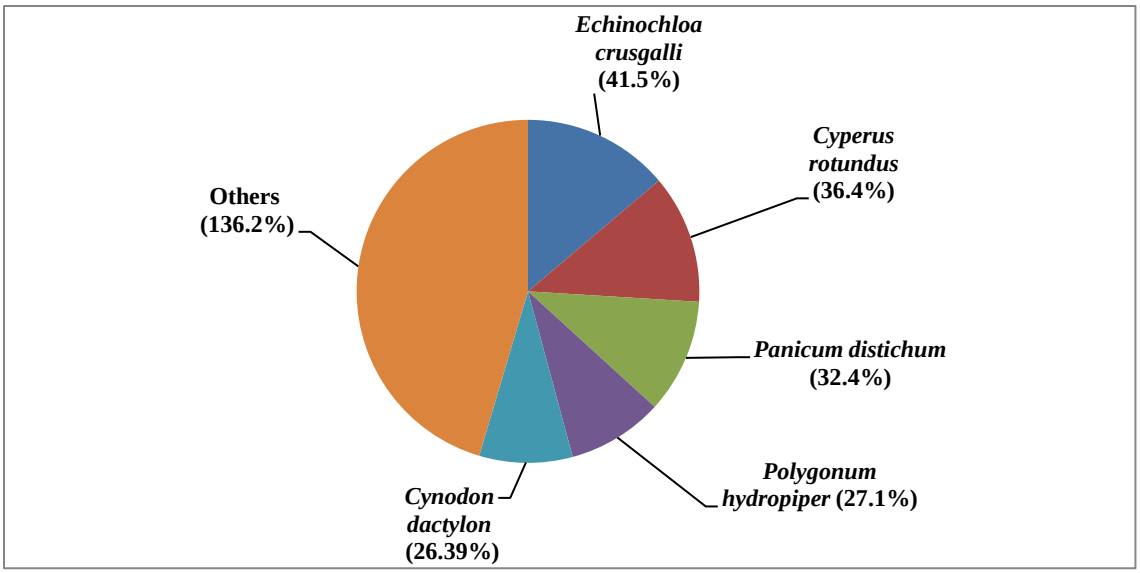

Figure 3- Five most dominant weeds based on relative abundance value in potato.

3.3. Weed vegetation in *boro* rice

A total of 20 weed species belonging to nine families were observed infesting *boro* rice fields where seven kinds of grass, four sedges, and nine broadleaf weeds were present (Table 3). The most important family was Poaceae with the highest number of weed species followed by Cyperaceae. Here, Poaceae family contributed seven weed species while Cyperaceae contributed four. Amaranthaceae and Polygonaceae both represented two weed species. Compositae, Marsileaceae, Onagraceae, Pontederiaceae and Rubiaceae, each family contributed only one weed species. The most common and frequent weed species according to frequency were *Echinochloa crusgalli* and *Cyperus difformis,* occupying all five fields of *boro* rice (Table 3). The rest of the weed species that occurred in frequencies ≥60% were *Echinochloa colonum* and *Cynodon dactylon* among grasses, *Eleocharis atroperpurea* and *Fimbristylis miliacea* among sedges and *Eclipta alba*, *Polygonum hydropiper*, *Marsilea crenata*, *Monochoria vaginalis*, *Alternanthera philoxeroides* and *Alternanthera sessilis* among broadleaf weeds. *Echinochloa crusgalli* was the most uniformly distributed weed species with highest mean field density followed by *Cyperus difformis*, *Eclipta alba* and *Polygonum hydropiper*. But in terms of mean field density, despite having higher field uniformity, the density of *Cyperus difformis* was lower than *Eclipta alba* and *Polygonum hydropiper* (Table 3). Again, *Eleocharisatroperpurea*had higher mean field density but lower abundance value. *Echinochloa crusgalli* (39.6%), *Eclipta alba* (26.8%), *Cyperus difformis* (24.2%), *Polygonum hydropiper* (24.1%), *Eleocharis atroperpurea* (23.6%) were the five most dominant and abundant weed species where rest of the species shared 161.5% (Figure 4). Broadleaf weeds had much higher relative abundance value (126.3%) comparing grasses (92.4%) and sedges (81.2%) showing the dominance of broadleaf weeds over the grasses and sedges (Figure 2). Almost

similar weeds were observed by Huda et al. (2017) in *boro* rice fields of Sutiakhali Natunchar village where the five most important weeds were in descending order *Cyperus difformis* (39.5%) > *Alternanthera philoxeroides* (36.4%) > *Echinochloa crus-galli* (33.4%) > *Eleocharis atropurpurea*(27.5%) >*Leersia hexandra*(25.7%) and rest of the 137.6% were represented by the other 16 species according to relative abundance value.

Table 3- Frequency, field uniformity, mean field density and relative abundance value of weeds in *boro* rice fields.

Name of the weed species	Family	Frequency (%)	Field uniformity (%)	Mean field density (m^{-2})	Relative abundance value (%)
Grasses					
Echinochloa crusgalli	Poaceae	100	100	20.4	39.8
Echinochloa colonum	Poaceae	80	60	2.8	15.9
Cynodon dactylon	Poaceae	60	35	2.8	11.6
Paspalum commersonii	Poaceae	40	35	1.6	8.7
Panicum distichum	Poaceae	40	20	1.8	7.3
Leersia hexandra	Poaceae	20	20	0.8	4.6
Eleusine indica	Poaceae	20	20	0.8	4.6
Sedges					
Cyperus difformis	Cyperaceae	100	90	6.2	24.2
Eleocharis atroperpurea	Cyperaceae	80	50	11.4	23.6
Fimbristylis miliacea	Cyperaceae	80	50	4.4	16.5
Cyperus iria	Cyperaceae	60	55	6.0	16.9
Broadleaf weeds					
Eclipta alba	Compositae	80	80	11.4	26.8
Polygonum hydropiper	Polygonaceae	80	80	8.8	24.1
Marsilea crenata	Marsileaceae	80	70	6.2	20.4
Monochoria vaginalis	Pontederiaceae	80	55	3.4	16.0
Alternanthera philoxeroides	Amaranthaceae	60	55	3.8	14.7
Alternanthera sessilis	Amaranthaceae	60	25	3.2	10.9
Hedyotis corymbosa	Rubiaceae	40	25	1.6	7.6
Ludwigia hyssopifolia	Onagraceae	20	10	0.4	3.1
Polygonum orientale	Polygonaceae	20	5	0.4	2.6

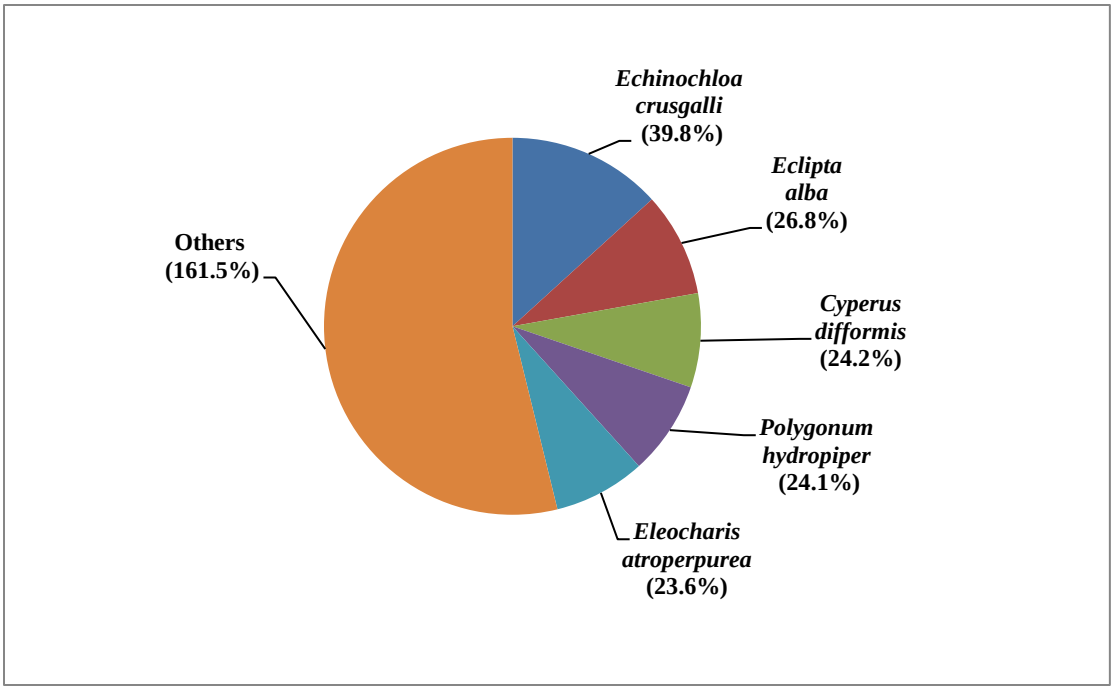

Figure 4- Five most dominant weeds based on relative abundance value in *boro* rice.

3.4. Comparison of weed species composition among T. *aman*, potato and *boro* rice

A total of 27 species of weeds belonging to 11 families were found infested in three crops under *T. aman*- potato – *boro* cropping pattern (Table 4). Among the three crops, T. *aman* rice was occupied with weed species from all 11 families which indicated severe weed infestation. The 10 most frequent and common species in all three crops were *Alternanthera sessilis, Alternanthera philoxeroides, Fimbristylis miliacea, Echinochloa crusgalli, Cynodon dactylon, Eclipta alba, Eleocharis atroperpurea, Echinochloa colonum, Hedyotis corymbosa* and *Marsilea crennta* (Table 4). Five weed species namely *Commelina diffusa, Cyanotis axillaris, Murdannia nudiflora, Scirpus juncoides* and *Ipomoea aquatica* were only present in T. *aman* rice whereas, in potato fields, two weed species *Cyperus rotundus* and *Amaranthus viridis* were only observed. In both T. *aman* and *boro* rice, seven weeds were commonly found viz. *Cyperus difformis, Cyperusiria, Ludwigia hyssopifolia, Paspalum commersonii, Leersia hexandra, Monochoria vaginalis* and *Polygonum orientale*. On the other hand, three weed species such as *Panicum distichum, Eleusine indica,* and *Polygonum hydropiper* were commonly found both in potato and *boro* rice. *Echinochloa crusgalli* was the most dominant and abundant weed having highest frequency, uniformity and mean field density in both potato and *boro* rice while in T. *aman*, *Ludwigia hyssopifolia* dominated over others (Table 1, 2 and 3). Here, the higher relative abundance value reflected its respective higher values of frequency, uniformity and mean field density. These results also agree with Kamal-Uddin et al. (2009) who also found in Turf grass area that weeds with higher frequencies also showed higher field uniformities,

mean field densities and relative abundance. But in T. *aman, Fimbristylis miliacea,* in potato, *Polygonum hydropiper* and in *boro, Eleocharis atroperpurea* showed exception i.e. their abundance value was low but mean field densitywas high which indicated that they can pose the potential threat (Table 1, 2 and 3).From the list of five most dominant weed species, *Echinochloa crusgalli* and *Polygonum hydropiper* were common in both potato and *boro* rice having same rank and order. The other three dominant weed species *Cyperus rotundus*, *Cynodon dactylon*, *Panicum distichum* in potato and *Eclipta alba*, *Cyperus difformis, Eleocharis atroperpurea* in *boro* were completely different. On the other hand, in T. *aman* rice, a completely different list of five dominant weed species having *Ludwigia hyssopifolia*, *Alternanthera sessilis*, *Poloygonum orientale*, *Fimbristylis miliacea* and *Hedyotis corymbosa*were observed. Similarly, differences were also found in the dominance of weed species in terms of morphology such as in T. *aman,* broadleaf weeds dominated over sedges and grasses but in potato, grasses dominated over broadleaves and sedges. In *boro* rice, broadleaves were dominant like T. *aman* but here, grasses were more dominant than sedges (Figure 2). Thomas (1985) observed that the relative abundance of a weed survey clearly indicated dominated weed species. The weeds with the highest abundance value also had the highest frequencies, field uniformities and mean field densities indicating that these weeds were the most difficult to control and these species should be carefully monitored. On the other hand, all those weed species having lower frequencies, uniformities and mean field densities may either less competitive or may be effectively controlled by the current weed management practices.

Table 4- Distribution and occurrence of weed species based on morphological type, scientific name and family emerged under T. *aman*-potato-*boro* cropping pattern.

Morphological type	Scientific name	Family name	Weed occurrence		
			T. *aman*	Potato	*Boro*
Grass	*Paspalum commersonii*	Poaceae	+	-	+
	Cynodon dactylon	Poaceae	+	+	+
	Echinochloa crusgalli	Poaceae	+	+	+
	Leersia hexandra	Poaceae	+	-	+
	Echinochloa colonum	Poaceae	+	+	+
	Panicum distichum	Poaceae	-	+	+
	Eleusine indica	Poaceae	-	+	+
Sedge	*Fimbristylis miliaceae*	Cyperaceae	+	+	+
	Cyperus difformis	Cyperaceae	+	-	+
	Eleocharis atroperpurea	Cyperaceae	+	+	+
	Cyperus iria	Cyperaceae	+	-	+
	Cyperus rotundus	Cyperaceae	-	+	-
	Scirpus juncoides	Cyperaceae	+	-	-
Broadleaf	*Alternanthera sessilis*	Amaranthaceae	+	+	+
	Alternanthera philoxeroides	Amaranthaceae	+	+	+
	Amaranthus viridis	Amaranthaceae	-	+	-
	Commelina diffusa	Commelinaceae	+	-	-
	Cyanotis axillaris	Commelinaceae	+	-	-
	Murdannia nudiflora	Commelinaceae	+	-	-
	Eclipta alba	Compositae	+	+	+
	Ipomoea aquatica	Convolvulaceae	+	-	-
	Marsilea crenata	Marsileaceae	+	+	+
	Ludwigia hyssopifolia	Onagraceae	+	-	+
	Polygonum hydropiper	Polygonaceae	-	+	+
	Polygonum orientale	Polygonaceae	+	-	+
	Monochoria vaginalis	Pontederiaceae	+	-	+
	Hedyotis corymbosa	Rubiaceae	+	+	+

+ = Present, - = Absent

Conclusion

Ranking weed species based on relative abundance value is a useful feature of the survey system which provides the quantitative comparison of the common and harmful weed species. The results of the study revealed that there was the divergence in the floristic composition and dominant weed species in three different crops. In both potato and *boro* rice, *Echinochloa crusgalli* was the most dominant weed species in terms of frequency, uniformity, mean field density and relative abundance value whereas, in T. *aman, Ludwigia*

hyssopifolia dominated over others. The rank and order of the five most abundant species were also quite different from each other. Variation of weed composition in the same field under different crops indicated that weed control measure should be adopted on a crop basis in a specific area considering dominant weed species for successful weed management.

Conflict of interest

Authors declare no conflicts of interest for this study.

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