International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 6, No. 4, p. 8-13, 2015

RESEARCH PAPER OPEN ACCESS

Phytosociological attributes of weeds in lowland paddy at Talata Mafara, Sudan Savannah, Nigeria

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Article published on April 01, 2015

Key words: Phytosociology weeds species, Paddy, Importance Value Index (IVI).

Abstract

Study was conducted to assess the phytosociological studies of weed species in paddy at research farm of the irrigation research station, Institute for Agricultural Research (I.A.R), Ahmadu Bello University, Zaria located at Bakolori irrigation scheme Talata Mafara, (Zamfara) State, in the Sudan Savannah ecological zone of Nigeria during 2012 and 2013 wet seasons, A total of 19 and 26 weed species were identified during the 2012 and 2013 wet seasons respectively. The results obtained indicated that *Echinochloa colona, Cyperus difformis, Digitaria horizontallis,* were the most densely populated in 2012 while *Digitaria horizontallis, Echinochloa colona* and *Cyperus iria* were the most densely populated weeds in 2013. The most important weeds in the 2012 were *E. colona* followed by *D. horizontallis* and *C. difformis* while in 2013 the importance value index (IVI) revealed that the most important weeds within the community were *D. horizontallis, E. colona* and *C. iria*. The most important weeds that were associated with the rice crop in the study area are of grass and sedge family.

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Introduction

Paddy (*Oryza sativa* L.) is the most important staple food crops of the world and more than half of the human race depends on rice for their daily sustenance and It is the third-highest world-wide production, after maize and wheat (Chauhan *et al.*, 2011, Faostat, 2013,). Beside its use for human food, paddy is a source for number of industrial products like rice starch, rice bran oil, flaked rice, puffed rice and rice husk etc. Despite its importance, the average production yield of paddy in Nigeria is low (1.8 tonnes per hectare) compared to the global yield (4.4 tonnes per hectare). (Faostat, 2013). Weed, which is a plant considered by human to be not of use and undesirable at a place where it flourishes has been identified as the most important production constraint to paddy production (Chikoye *et al.* 2004).

Although competition from weeds reduces the yield of rice, mere presence of weeds determined though visual observation such as weed cover score on crop field may not determine the most important weed specie causing reduction in yield of the crop or at what level is it economical to control the weeds. Decision on weed control depends largely on the density of weeds. For example, Moon *et al.* (2014) investigated rice-weed competition and develop a model which was utilized on optimum herbicide dose for a given weed density in paddy yield. Threshold level for a few weed species was worked out by Singh and Angiras (2008) and Islam *et al.* (2003). Moreover, selective control of weeds in crop fields requires the knowledge of the most important weeds associated with a particular crop for effective targeted control. There is paucity of information on the most important weed species associated with rice and their phytosociological attributes in the study area which resulted to farmers investing extra time and resources in controlling less important weeds in the field.

Because of the variability in the growth habit of weeds, any single method of weed control cannot effectively provide a season long control in rice. Plants like humans form a society referred to as phyto-society, which is essentially an ecosystem of crops and weeds. Phyto-sociological study gives an appraisal of plants or weeds of importance in an area with fact and figures; provide overall information on the species-wise distribution in and around crops of a given area and; compare and classify weeds in a crop-weed ecosystem. (Zimdahl, 2007, Das, 2008). Understanding the sociological structure of weeds in crop fields is a pre-requisite for its effective management. Phytosociological studies of weeds are necessary for understanding the relationship between crops and their weed flora and may be useful, as a tool for developing a sustainable long-term weed management strategy. This study was under taken to determine the phytosociological characters of weeds in rice field with the view to identify the most important weeds associated with paddy and suggest an effective weed management strategy.

Materials and methods

Experimental Site

Experiment was conducted during the wet season of 2012 and 2013 at research farm of the irrigation research station, Institute for Agricultural Research (I.A.R), Ahmadu Bello University, Zaria located at Bakolori irrigation scheme Talata Mafara, (Zamfara) State, in the Sudan Savannah ecological zone of Nigeria.

Methodology

Weed phytosociological parameters were taken from 1.0 m x 1.0 m quadrat placed randomly in 108 rice planted plots at harvest. The weed samples within each quadrat was removed, washed with tap water and separated by species. The phytosociological attributes; abundance, density and frequency and their relative values and importance Value Index (IVI) were computed using the following principles as presented by Das (2008).

$$\text{Frequency (F)} = \frac{\text{Number of quadrat in which specie occurred}}{\text{Total number of quadrat studied}} \times 100$$

$$\text{Abundance (A)} = \frac{\text{Total number of individuals of a species in all the quadrats}}{\text{Number of quadrats in which the specie occrued}} \times 100$$

$$\text{Density (D)} = \frac{\text{Total number of individual species in all quadrats}}{\text{(Total number of quardrat studied)X (Area in m2 of a quadrat)}}$$

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of a specie}}{\text{Frequency of all species}} X\ 100$$

$$\text{Relative Abundance (RA)} = \frac{\text{Abundance of a specie}}{\text{Abundance of all species}} \text{X } 100$$

$$\text{Relative Density (RD)} = \frac{\text{Density of a specie}}{\text{Density of all species}} X\ 100$$

Importance Value Index (IVI) = Relative frequency (RF) + relative abundance (RA.) + relative density (RD)

Results and discussion

Phytosociological study of plant/weed, which provide knowledge of the dynamics and relative importance of a species in a particular phytosociety or across phytosocieties assume enough relevance in crop-weed ecosystem. It gives an appraisal of species through quantitative characters which allow effective weed management decision. Weed species identified in the rice experimental field of Talata Mafara during the 2012 wet season and their phytosociological characters are provided in Table 1. A total of 19 weed species were identified in the experimental field. Among the weeds 10 (52.6%) are broad leaf 6 (31.5%) grasses and 3 (15.9%) of which are sedges.

Table 1. Phytosociological attributes of paddy weeds at Talata Mafara in 2012 wet season.

		Attributes								
S/N	Name of the species	TNI	TOI	D	F	A	RD	RF	RA	IVI
	Broad Leaves									
1	*Alternanthera sessilis (L.)*	7	4	0.10	5.56	1.75	0.25	2.19	0.94	3.38
2	*Commelina erecta (L.)*	12	6	0.17	8.33	2.00	0.44	3.28	1.07	4.79
3	*Corchorus olitorius*	72	7	1	9.72	10.29	2.61	3.83	5.52	11.95
4	*Eclipta alba*	75	15	1.04	20.83	5.00	2.72	8.20	2.68	13.60
5	*Hypoestes cancellata*	14	5	0.19	6.94	2.80	0.51	2.73	1.50	4.74
6	*Ludwigia decurrens*	26	6	0.36	8.33	4.33	0.94	3.28	2.32	6.55
7	*Melochia corchoriforlia*	47	12	0.65	16.67	3.92	1.70	6.56	2.10	10.36
8	*Pentodon pentandrus (Schum. & Thonn)*	3	1	0.04	1.39	3.00	0.11	0.55	1.61	2.26
9	*Physalis angulata*	7	4	0.10	5.56	1.75	0.25	2.19	0.94	3.38
10	*Sphenoclea zeylanica (Gaertn)*	6	4	0.08	5.56	1.50	0.22	2.19	0.80	3.21
11	Grasses									
12	*Dactyloctenium egyptium*	50	8	0.69	11.11	6.25	1.81	4.37	3.35	9.54
13	*Digitaria horizontallis*	476	8	6.61	11.11	59.50	17.26	4.37	31.92	53.55
14	*Echinochloa colonum* (L.) Link	1247	43	17.32	59.72	29.00	45.21	23.50	15.56	84.27
15	*Panicum subalbidum*	3	1	0.04	1.39	3.00	0.11	0.55	1.61	2.26
16	*Paspalum schrobiculatum*	75	14	1.04	19.44	5.36	2.72	7.65	2.87	13.24
17	*Settaria pumilla*	37	7	0.51	9.72	5.29	1.34	3.83	2.84	8.00
	Sedges									
18	*Cyperus difformis* (L.)	477	27	6.63	37.50	17.67	17.30	14.75	9.48	41.53
19	*Cyperus iria* (L.)	24	6	0.33	8.33	4.00	0.87	3.28	2.15	6.29
20	*Cyperus rotundus* (L.)	100	5	1.39	6.94	20.00	3.63	2.73	10.73	17.09

Key: TNI- Total number of individual weeds; TOI- Total occurrence of individual weeds; D-Density; F-Frequency; A- Abundance; RD- Relative density; RF- Relative frequency; RA- Relative abundance; IVI-Importance value index.

The total number of individual weeds (TNI) vary among the different species where *Echinochloa colona* was found to have the highest number followed by *Cyperus difformis, Digitaria horizontallis, Cyperus rotundus, Paspalum scrobiculatum* and *Eclipta alba* in descending order. The occurrence of the individual weeds showed a different trend with that of the number of individual weeds although *E. colona* and *C. difformis* consistently occupied the first and the second positions respectively. These were followed by *E. alba, Paspalum schrobiculatum* and *Melochia. corcodiforlia* in that order. *Digitaria horizontallis* and *C. rotundus* that were ranked as the third and fourth in the total number of individual weeds could not be among the first five most occurring weeds in 2012 at Talata mafara. The results obtained indicated that *E. colona, C. difformis, D. horizontallis, C.*

rotundus followed each other in descending order in their density while *P. schrobiculatum* and *E. alba* had similar density and occupied the fifth position in the ranking. The most frequent weeds in 2012 at TalataMafara were *E. colona* and this was followed by *C. difformis, E. alba, P. schrobiculatum* and *Melochia corchorifolia* in descending order. The weeds exhibited a different trend in their abundance in which *D. horizontallis* was the most abundant followed by *E. colona*, *C. rotundus*, *C. difformis* and *C. olitorius* in that order. The most important weeds in the 2012 of TalataMafara experiment were *E. colona* followed by *D. horizontallis* both of which are grasses. These were followed by *C. difformis* and *C. rotundus* in order of importance. *E. alba* occupied the fifth position in the order importance among the weeds.

Table 2. Phytosociological attributes of paddy weeds at Talata Mafara in 2013 wet season.

	Species	TNI	TOI	D	F	A	RD	RF	RA	IVI
	Broad Leaves									
1	*Cochorus olitorius*	199	28.00	1.84	25.93	7.11	1.82	4.42	3.16	9.40
2	*Commelina benghalensis* Burm. F	8	4.00	0.07	3.70	2.00	0.07	0.63	0.89	1.59
3	*Commelina erecta* (L.)	291	21.00	2.69	19.44	13.86	2.67	3.31	6.15	12.14
4	*Eclipta alba*	95	25.00	0.88	23.15	3.80	0.87	3.94	1.69	6.50
5	*Euphobia heterophylla*	1	1	0.01	0.93	1.00	0.01	0.16	0.44	0.61
6	*Euphobia hirta*	4	2.00	0.04	1.85	2.00	0.04	0.32	0.89	1.24
7	*Hibiscus asper*	2	2.00	0.02	1.85	1.00	0.02	0.32	0.44	0.78
8	*Hydrolea glabra (Schum. &Thonn)*	4	1.00	0.04	0.93	4.00	0.04	0.16	1.78	1.97
9	*Ipomoea aquatic*	15	10.00	0.14	9.26	1.50	0.14	1.58	0.67	2.38
10	*Ludwigia decurrens*	108	30.00	1.00	27.78	3.60	0.99	4.73	1.60	7.32
11	*Melochia corcodiforlia*	330	41.00	3.06	37.96	8.05	3.03	6.47	3.57	13.07
12	*Mimosa invisa* (mart)	287	52.00	2.66	48.15	5.52	2.63	8.20	2.45	13.29
13	*Pentadon pentandrus*	175	10.00	1.62	9.26	17.50	1.60	1.58	7.77	10.95
14	*Phylanthus amurus*	1	1.00	0.01	0.93	1.00	0.01	0.16	0.44	0.61
15	*Physalis angulata*	20	8.00	0.19	7.41	2.50	0.18	1.26	1.11	2.56
	Grasses									
16	*Aeschynomene indica*	10	2	0.09	1.85	5.00	0.09	0.32	2.22	2.63
17	*Dactyloctenium egyptium*	75	10.00	0.69	9.26	7.50	0.69	1.58	3.33	5.60
18	*Digitaria horizontallis*	3652	86.00	33.81	79.63	42.47	33.49	13.56	18.86	65.91
19	*Echinochloa colonum*(L.) Link	2345	91.00	21.71	84.26	25.77	21.50	14.35	11.45	47.30
20	*Eleusine indica*	1	1.00	0.01	0.93	1.00	0.01	0.16	0.44	0.61
21	*Panicum subalbidum*	3	3.00	0.03	2.78	1.00	0.03	0.47	0.44	0.94
22	*Paspalum schrobiculatum*	186	36.00	1.72	33.33	5.17	1.71	5.68	2.29	9.68
23	*Settaria pumilla*	532	46.00	4.93	42.59	11.57	4.88	7.26	5.14	17.27
	Sedges									
24	*Cyperus difformis* (L.)	132	14.00	1.22	12.96	9.43	1.21	2.21	4.19	7.61
25	*Cyperus rotundus* (L.)	587	34.00	5.44	31.48	17.26	5.38	5.36	7.67	18.41
26	*Cyperus iria (L.)*	1842	75.00	17.06	69.44	24.56	16.89	11.83	10.91	39.63

Key: TNI- Total number of individual weeds; TOI- Total occurrence of individual weeds; D-Density; F-Frequency; A- Abundance; RD- Relative density; RF- Relative frequency; RA- Relative abundance; IVI-Importance value index.

Total Number of Individual weeds (TNI), Total Occurrence of Individual weeds (TOI), Density (D), Frequency (F), Abundance (A), Relative Density (RD), Relative Frequency (RF), Relative Abundance (RA), and the resultant Importance Value Index (IVI) of the individual weeds identified in rice during the wet season trial of 2013 at Talata Mafara is provided in Table 2. A total of 26 weed species were identified during the experiment among the which, 61.5% were broad leaf, 26.9% grasses and 11.5% sedges. *Digitaria horizontallis* and *Echinochloa colona* which are of grass family were found to outnumber other weeds during 2013 wet season trial at Talata Mafara. These were closely followed by *Cyperus iria*, *C. rotundus*

and *Settaria pumila* in that order. In terms of the density of the weeds, *D. horizontallis* was found to be more densely populated compared to all weeds during the wet season trial of 2013 at TalataMafara. This was followed by *E. colonum, C. iria, C. rotundus* and *Settaria pumila* in descending order of density. But the most frequent weed in the 2013 wet season trial was *E. colonum* then followed by *D. horizontallis*, *C. iria*, *Mimosa invisa* and *Settaria pumila* in that order.

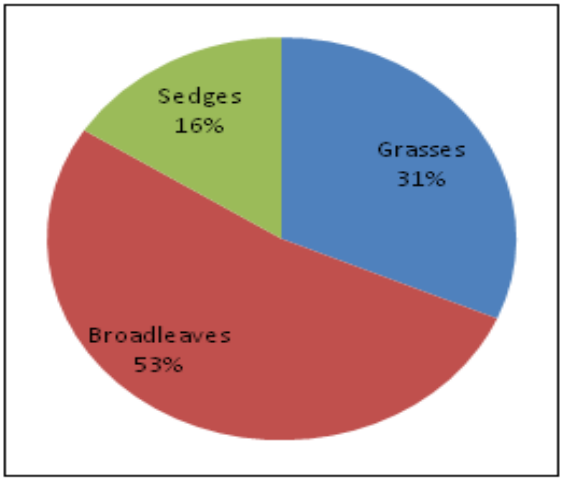

Fig. 1. Percentage distribution of weed family at Talata Mafara in 2012.

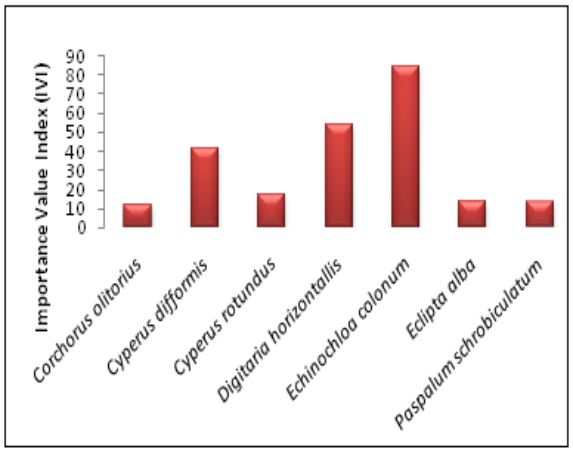

Fig. 2. IVI of most important weeds in paddy fields at Talata Mafara in 2012.

The most abundant weeds were *D. horizontallis*, *E. colona*, *C. iria*, *Pentadon pentandrus* and *C. rotundus* following each other in descending order. The relative density relative frequency and relative abundance of the individual weeds to one another followed the same trend with their individual density frequency and abundance respectively. The resultant strength of the individual weeds through the importance value index revealed that the most important weeds within the community were *D. horizontallis, E. colona* and *C. iria*. These were followed by *C. rotundus* and *Settaria pumila* in order of importance. The high number of weeds identified in this study could be attributed to the presence of a large weed seed bank in the soil that must have been deposited from previous years. Weeds have higher seed production that is easily dispersed through different ways with variable dormancy resulting in germination by flushes over a long period (Akobundu, 1987).

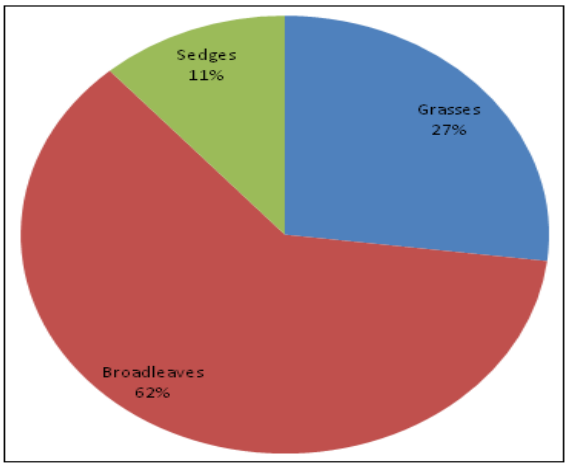

Fig. 3. Percentage distribution of weed family at Talata Mafara in 2013.

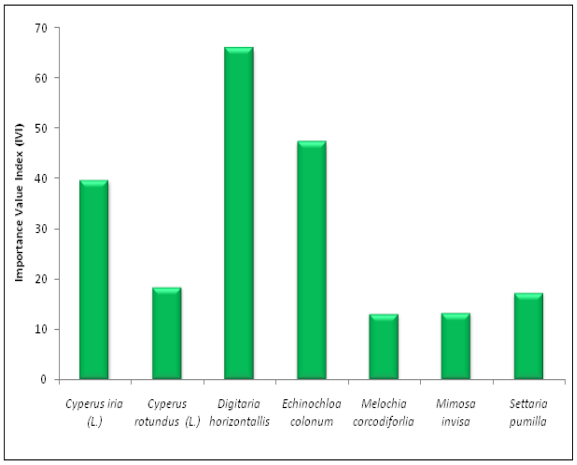

Fig. 4. IVI of most important weeds in paddy fields at Talata Mafara in 2013.

The exhibition of a high level of persistence of the most important species of weeds as fore-runners in all

their phytosociological attributes could not be unconnected to their similarity in their families, morphorgy and development attributes. Most of the weed species with the highest density, frequency and abundance were of the grass family and sedges. These weeds have high fecundity producing hundreds of thousands of seeds during single growing season, reproduce through vegetative propagules and seeds and have vegetative mimicry with crops in addition to long-time seed dormancy. (Akobundu, 1987; Zimdahl, 2007).

Conclusion

This study was able to establish that the most important weeds that were associated with the paddy crop in the study area are of grass and sedge family. Effective weed management methods in the study area should strategize on the control of growth and reproduction of the grass and sedge family.

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