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Research Paper

Weeds Density Study in Lowland Rice Production System in Northern Guinea Savanna Ecology, Nigeria

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A field trial was conducted at research farm of the irrigation research station, Institute for Agricultural Research (I.A.R), Ahmadu Bello University, Zaria located at Kadawa irrigation scheme in the Northern Guinea Savanna ecological zone of Nigeria during 2012 and 2013 wet seasons to study the density attributes of weeds in paddy rice ecology. A total of 20 and 22 weed species were identified during the 2012 and 2013 wet seasons respectively. Results obtained indicated that *Cyperus Iria* had the highest density, relative to other weeds, followed by *Cyperusdifformis, Dactelocteniumaegyptium, Ludwigiaabyscinica and Kylingiasquamulata* in 2012 while in 2013; *C. iria* was found to consistently be the most densely populated weed among the identified weed species during the trial. This was followed in decreasing order by *Digitaria horizontalis, Echinochloacolona, C. rotundus and D. Aegyptus.* The most important weed in the 2012 wet season was *C.iria* which was followed by *C.difformis, D.aegyptium*, *L.abyscinica and K.squamulata* while in 2013 the importance value index (IVI) revealed that the most important weed within the community was *C. difformis.* This was closely followed by *D. horizontalis, E. colona, C. rotundus,* and *D. aegyptium.*The most important weeds associated with the paddy crop in the study area were grasses and sedges.

Keywords: Phytosociology, weeds attributes, paddy rice, Importance Value Index (IVI)

INTRODUCTION

Weeds infestation is the most serious constraint limiting the productivity of rice especially direct seeded rice (Khaliq *et al*., 2012). Weeds produce an abundance of seeds and other regenerating propagules that are difficult to remove, and produces an abundance of weeds of diverse nature in crop fields that makes weed the single most consistent season threat to grain yields, and as such are controlled by a variety of methods (Johnson *et al*., 1997; Singh *et al*., 2008). An appropriate weed management strategy that improves yield, quality and minimises production costs has always been a major focus and key element to making direct seeded rice a success (Phuong *et al*., 2005). Manual weeding is a very an effective but inefficient weed control method due to the fact that it requires a lot of energy and resources and consumes time. Although appropriately selected herbicide may perform an important role in weed infestation reduction, increasing weeds resistant to herbicides moves the agro-ecosystem to low species diversity and especially negative effect of herbicides on human and environment such as ground and surface water pollution are of greater concern (Abdin *et al*., 2000; Ghanizadeh *et al*., 2011).Knowledge concerning the phytosociological characters of weeds identifying the most common or important weeds in a given cropping system is important in that, such information can then be

used to develop effective and efficient weed management strategies appropriate to that system. It is an attempt to compile information on the common and most important weed species within the study ecology which may be used to develop an appropriate weed management strategy in paddy this study was under taken.

MATERIALS AND METHODS

The experiment was conducted during the wet seasons 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 Kadawa, Northern Guinea Savanna ecological zone of Nigeria. Weed phytosociological parameters were taken from 1.0 m x 1.0 m quadrate placed randomly in 108 rice planted plots at harvest. The weed samples within each quadrat were removed, washed with tap water and separated by species. The attributes of individual weeds identified within the area such as abundance, density, frequency, their relative values and importance Value Index (IVI) were computed using the following principles as presented by Das (2008).

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{(Total number of quardrat studied) X (Area in m}^2\text{ of a quadrat)}}$$

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

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

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

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

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

Importance Value Index (IVI) = Relative Frequency (RF) + Relative Abundance (RA.) + Relative Density (RD)

RESULTS

Table 1 show some of the attributes of individual weeds identified associated with rice at Kadawa during the 2012 wet season. A total of twenty (20) weed species were identified to be associated with the rice crop during the season. Of these, 11(55%) were broad leaf weeds while 6 (30%) were grasses and 3 (15%) were sedges (Figure 1). The general picture of the weed density attributes shows that the most dominant weeds in the community were sedges. In all the phytosociological characters measured, *C. iria* was found to be superior to all other weeds identified in the study area and hence the most important species. This was closely followed by *C. difformis* which are also sedge. The density of the individual weeds relative to each other indicated that *C. iria* had the highest density, relative to other weeds and this was followed by *C. difformis, D. aegyptium, L. abyscinica and K. squamulata.* But the relative frequency of the individual weeds during the season showed a different trend from that of the relative density of the weeds. In the relative frequency, following *C. iria and C. difformis,* the most frequent weeds relative to other weeds in the community during the study period were *L. abyscinica, D. aegyptium and E. obtusiflora*in that order. *C. iria* was found to maintain its status as the most abundant weed relative to other weeds and this was followed in descending order by *C. difformis, K. squamulata, D. horizontalis and L. abyscinica.* Among the weeds identified to be associated with the rice crop during the wet season at Kadawa in 2012, the most important weed was *C. iria* which was followed by *C. difformis, D. aegyptium*, *L. abyscinica and K. squamulata* in that order (Figure 2).

Weed species identified to be associated with rice at Kadawa during the 2013 wet season and their phytosociological attributes were presented in (Table 2). A total of twenty-two (22) weed species were identified of which 54.5% were broad leaf, 31.8% grasses and 13.6% sedges (Figure 3). *C. iria* was found to consistently be the most densely populated weed among the identified weeds during the season. This was followed in decreasing order by *D. horizontalis, E. colona, C. rotundus and C. difformis*. However, the frequency of the individual weeds and their abundance followed a similar trend and this was also repeated in the relative frequency of individual weeds to each other. But the abundance of the individual weeds in 2013 wet season at Kadawa presented a different trend despite that, *C. iria* stillremainedthe most abundant weed; it was contrastingly followed by *D. horizontalis, C. rotundus E. colona*and *C. difformis* in decreasing order. The density of the individual weeds relative to each other showed that *C. iria* had the highest density relative to other weeds and this was followed by *D. horizontalis, E.colona, C. rotundus and C. difformis.* But the relative frequency of the individual weeds during the trial showed that the most frequent weeds relative to other weeds in the community during the study period were *C. iria, E. colona, D. horizontalis, C. difformis and C. rotundus* in descending order. *C. iria* was found to be the most abundant weed relative to other weeds and this was followed in descending order by *D. horizontalis, C. rotundus, E. colona and C. difformis.*

The worthiness and strength of an individual weed in the community measured through the importance value index (IVI) exhibited that *C. iria* was the most important weed specie during the trial. This was closely followed by *D. horizontalis, E. colona, C. rotundus, D. aegyptium and C. difformis* in that order (Figure 4).

Table 1. Density attributes of weeds in rice field at Kadawa in 2012 wet season.

SPECIES	D	F	A	RD	RF	RA	IVI
Broad Leaf							
Ageratum conyzoides (L.)	0.03	1.39	2.00	0.05	0.36	1.66	2.07
Celosia tsertii (L.)	0.11	8.33	1.33	0.20	2.14	1.11	3.44
Eclipta alba (L.)	0.35	11.11	3.13	0.62	2.85	2.60	6.07
Euphorbia heterophylla (L.)	0.13	6.94	1.80	0.22	1.78	1.50	3.50
Euphorbia hirta (L.)	0.06	1.39	4.00	0.10	0.36	3.32	3.78
Ipomoea aquatica (L.) Forsk	0.03	2.78	1.00	0.05	0.71	0.83	1.59
Ludwigiaabyscinica (L.)	2.33	45.83	5.09	4.18	11.74	4.23	20.16
Ludwigiadecurrens (Walt.)	0.31	12.50	2.44	0.55	3.20	2.03	5.78
Phylanthusamurus (L.)	0.15	12.50	1.22	0.27	3.20	1.02	4.49
Physalisangulata (L.)	0.24	12.50	1.89	0.42	3.20	1.57	5.20
Portulacaoleracea (L.)	0.24	12.50	1.89	0.42	3.20	1.57	5.20
Grasses							
Dactylocteniumaegyptium (L.)	3.51	38.89	9.04	6.30	9.96	7.51	23.77
Digitaria horizontalis (Willd)	0.58	11.11	5.25	1.05	2.85	4.36	8.26
Echinochloaobtusiflora (L.)	0.96	19.44	4.93	1.72	4.98	4.10	10.80
Echinochloacolona (L.) Link	0.58	16.67	3.50	1.05	4.27	2.91	8.23
Eragrostistremula (L.)	0.32	8.33	3.83	0.57	2.14	3.19	5.89
Oryzabarthii (L.)	0.06	5.56	1.00	0.10	1.42	0.83	2.35
Sedges							
Cyperus iria (L.)	33.46	93.06	35.96	59.99	23.84	29.89	113.71
Cyperus difformis (L.)	10.40	51.39	20.24	18.65	13.17	16.83	48.64
Kyllingasquamulata (L.)	1.94	18.06	10.77	3.49	4.63	8.95	17.06

Key: D-Density(m^{-2}); F- Frequency (%); A- Abundance; RD- Relative density (%); RF- Relative frequency (%); RA- Relative abundance (%); IVI- Importance value index.

Table 2. Density attributes of weeds in rice field at Kadawa in 2013 wet season.

Species	D	F	A	RD	RF	RA	IVI
Broad Leaves							
Basilicumpolystachyon (L.)	0.05	0.93	5.00	0.05	0.17	2.70	2.91
Commelinaerecta(L.)	0.38	8.33	4.56	0.40	1.52	2.46	4.37
Eclipta alba (L.)	2.16	34.26	6.30	2.26	6.25	3.40	11.91
Euphorbia heterophylla (L.)	0.24	12.96	1.86	0.25	2.36	1.00	3.62
Euphorbia hirta (L.)	0.03	1.85	1.50	0.03	0.34	0.81	1.18
Hydroleaglabra(Schum. andThonn)	0.01	0.93	1.00	0.01	0.17	0.54	0.72
Ipomoea aquatic (L.)	0.15	9.26	1.60	0.16	1.69	0.86	2.71
Ludwigiadecurrens (Walt.)	0.59	25.00	2.37	0.62	4.56	1.28	6.46
Mimosa invisa(Mart)	0.31	9.26	3.30	0.32	1.69	1.78	3.79
Phylanthusamurus (Schum. andThonn)	1.03	22.22	4.63	1.08	4.05	2.49	7.63
Physalisangulata (L.)	0.02	1.85	1.00	0.02	0.34	0.54	0.90
Portulacaoleracea (L.)	0.06	1.85	3.50	0.07	0.34	1.89	2.29
Grasses							
Dactylocteniumaegyptium (L.)	9.34	54.63	17.10	9.80	9.97	9.22	28.99
Digitaria horizontalis (Willd.)	21.60	74.07	29.16	22.66	13.51	15.72	51.89
Echinochloacolona(L.) Link	14.64	80.56	18.17	15.35	14.70	9.80	39.85
Eragrostistremula (L.)	0.01	0.93	1.00	0.01	0.17	0.54	0.72
Panicum subalbidum (Jacq.)	0.19	6.48	3.00	0.20	1.18	1.62	3.00
Paspalumschrobiculatum (L.)	0.45	10.19	4.45	0.48	1.86	2.40	4.74
Setariapumila (Poir.)	1.05	12.96	8.07	1.10	2.36	4.35	7.81
Sedges							
Cyperus iria (L.)	24.69	84.26	29.31	25.90	15.37	15.80	57.07
Cyperus difformis (L.)	8.93	50.00	17.85	9.36	9.12	9.62	28.11
Cyperus rotundus (L.)	9.42	45.37	20.76	9.88	8.28	11.19	29.34

Key: D-Density(m); F- Frequency(%); A- Abundance; RD- Relative density (%); RF- Relative frequency (%); RA- Relative abundance (%); IVI- Importance value index.

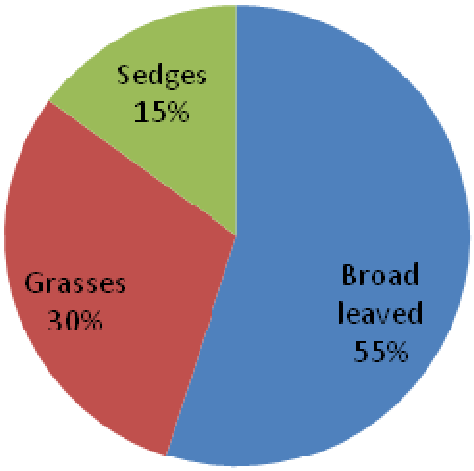

Figure1. Percentage distribution of weed family at Kadawa in 2012.

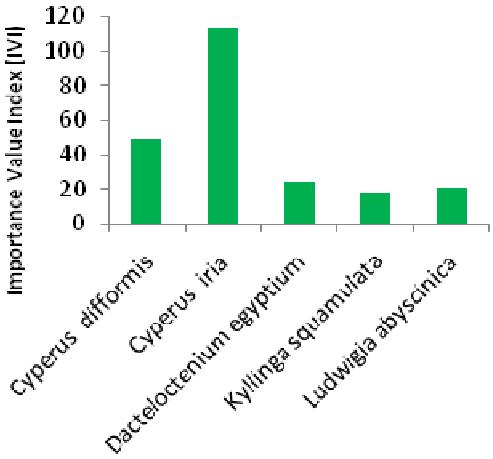

Figure 2. IVI of most important weeds in paddy fields at Kadawa in 2012.

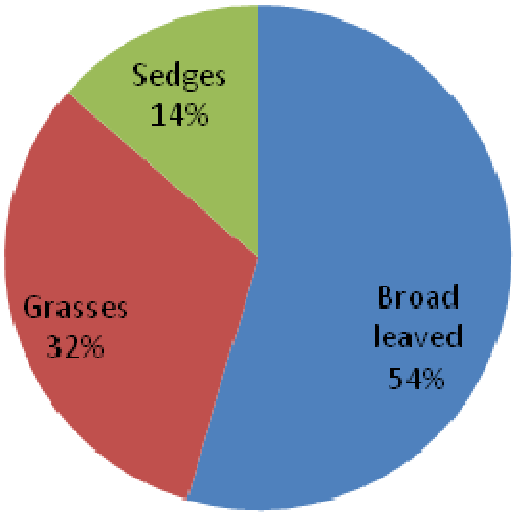

Figure 3. Percentage distribution of weed family at Kadawa in 2013.

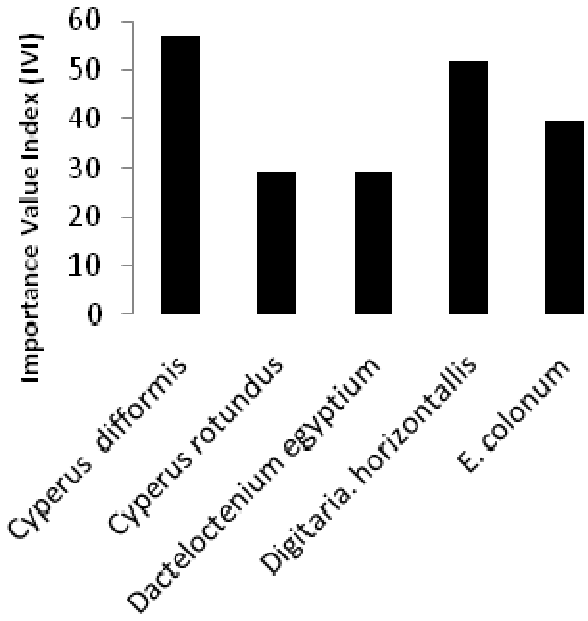

Figure 4. IVI of most important weeds in paddy fields at Kadawa in 2013.

DISCUSSION

The most important weed species identified during the study in all the years at this location have exhibited a more or less consistent trend generally in their relay positions among themselves as per their phytosociological attributes. Quantitative analysis showed that grasses and sedges were the most important weeds in the rice fields. Most of these weeds appear more important in the community because of their ability to multiply rapidly within different rice production systems. Weeds are able to produce seeds within the duration of a rice crop growth, and can often continue to produce seed after the rice had been harvested. For instance, *Cyperus rotundus* is perennial sedge which produces tubers that a long period of dormancy and multiply rapidly in areas under intensive cultivation such as Kadawa. The species also produces viable seeds which remain dormant for a long period (Akobundu, 1987; Johnson, 1997). Likewise, grasses such as *Digitaria horizontalis* is able to flower within 40 days of emergence, expand population rapidly and produce seeds before harvest.

Conclusion

The most important weeds associated with the rice crop in the Northern Guinea Savanna of Nigeria were grasses and sedges. For appropriate and efficient weed management technology and for better crop yield in the study area, weed management strategy should focus more on the prevention and control of grasses and sedges, and weeds should be controlled before they flower and produce seeds.

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