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WEED INFESTATION AND ITS INFLUENCES ON EARLY GROWTH OF RICE (ORYZA SATIVA) IN FLOODED PLAINS OF SAVANNA IN NORTHERN GHANA

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ABSTRACT

This paper reports collaborative research on the development of low input and sustainable rice production technology in flooded plains of lowland savanna in northern Ghana. The research aims are to identify suitable weed management methods. Weed infestation and its influence on rice plants (Oryza sativa c.v. Sikamo) at early growth stage were investigated in rainfed and broad-casted rice fields in Yipielgu (Y) and Zaw (Z) villages where submergence conditions were different. At March before plowing, Paspalum scrobiculatum, surviving the dry season, were dominant, accounting for 50 to 97 percent of dry matter weight (DMW) of weeds. At 45 days after removing weeds and broad-casting, DMW per m^2 was 96.1g in Z under insufficient submergence and 139.5g in Y flooded with around 5 cm depth, respectively. Dominant species were P. scrobiculatum and Digitaria sangunalis. in Z, and Cyperus spp., Fimbristylis spp. and Acroceras zizanoides in Y. DMW of rice plants decreased as total DMW of weed increased above 150g/m^2 approximately in Y, while it was not clear when total DMW was below 150g/m^2 in Z. Glyphosate applied before plowing or after broad-casted could not suppress weeds both in Z and Y. It is needed to determine appropriate application time and rate of non-selective herbicides for effective management of weed in rice fields in northern Ghana.

Key words: Flooded plain, Ghana, *Paspalum scrobiculatum*, rainfed rice field, weed infestation.

INTRODUCTION

Increase in rice production is an urgent subject in Sub-saharan Africa where food shortage has become serious by increase in population. A collaborative research project on development of low input and sustainable rice production technology in flooded plains of lowland savanna in northern Ghana has been promoted to increase rice production through expanding acreage for rice, by Japan International Research Center for Agricultural Sciences (JIRCAS) and

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Savanna Agricultural Research Institute of Ghana SARI). Weeds are a most troublesome factor affecting stable yield of rice in flooded plains, submerged seasonally. Having knowledge of weed flora and density is important to establish effective and cost reducing weed management procedures in rice fields in the above environment. In this paper, the situation of weed infestation and its influence on rice plants (*Oryza sativa*) at early growth stage were investigated in rainfed and broad-casted rice fields under different submergence conditions, in northern Ghana.

MATERIALS AND METHODS

Locations and season of investigation

Experimental plots were established on farmers' rice fields, Z(N9.6.18, W1.9.21) (Zaw) and Y(N9.22.32, W:0.5.9) (Yipielgu) villages, in flooded plain along the White Volta river in northern Ghana. Weed removal and plowing, and sowing rice (*Oryza sativa* cv. Sikamo) at the seed rate of 1.75 g/m^2 took place on the 10th June and 1st July 2010, respectively. Weed species and density were measured with a quadrat of 1 m^2 before plowing on 30th and 31st of March (end of dry season), and at the early growth stage of rice on 16th and 17th of August 2010 (initial stage of rainy season). Number and dry matter weight of rice plants established in 1 m^2 were measured on 16th and 17th of August.

Identification of weed species

Weed species collected were identified based on Johnson (1997) and a Data-Base "Plants in lowland savanna of West Africa: (http://www.jircas.affrc.go.jp/project/Ghana/ home.html) compiled for the JIRCAS Project.

RESULTS

Weed infestation before plowing, at the end of the dry season

At the end of the dry season, seedlings from seeds and sprouts from vegetative organs of weeds were observed both in Z and Y. Five and 15 species per m^2 were found in Z and Y, respectively. Dry matter weight (DMW) was approximately 120 g per m^2, in which *Paspalum scrobiculatum* survived during the dry season accounted for 97 and 50 percent of total DMW in Z and Y, respectively. Besides *P. scrobiculatum*, weed species observed during the rice growing season in 2009 including *Acroceras zizanioides*, *Borreria filifolia*, *Fuirena umbellata* and *Melochia corchorifolia* (Morita *et al.,* 2011) also emerged in the fields (Table-1).

Weed infestation at early growth stage of rice plant, at the initial stage of rainy season

Glyphosate was applied to the experimental plots of 4 m^2 at the end of the dry season or immediately after sowing rice with two application rates, to evaluate the herbicidal efficacy on weeds. However, suppression to weeds could not be observed both in Z and Y by the glyphosate application. Number of species occurring was 13 and 16, number of plants was 261 and 1007 in total and DMW was 96.1 g and 139.5 g per m^2 for Z and Y, respectively. Dominant species in Z were poaceous weeds such as *P. scrobiculatum* and *Digitaria* spp. Dominant species in Y were sedges such as *Cyperus pulstulatus*, *C. halpan*, *Pycerus flavescens*. *Fimbristylis ferruginea* and *Lipocarpha sphacelata* as well as *P. scrobiculatum* and *A. zizanioides*. In addition the parasitic weed, *Rhamphicarpa fitulosa* was found in Y. Difference in the degree of submergence (Z was not flooded, Y flooded with approximately 5 cm of water) was considered a major factor affecting species composition, number of plants and biomass of weeds between the two villages.

Table-1. Weed occurrence in 1 m^2 in Z and Y fields at the end of the dry season.

Category and species of weed			Zaw field (Z)		Yipielgu field (Y)	
Life form	**Family or group**	**Botanical name**	**No. of plants (/m^2)**	**DMW (g/m^2)**	**No. of plants (/m^2)**	**DMW (g/m^2)**
Perennial	Gramineae	*Eragrostis* spp. (survived adult)	-	-	9.7±1.9	20.7±0.3
		Eragrostis spp. (seedling)	-	-	9.7±1.91.0	9.7±1.9
		Paspalum scrobiculatum (survived adult)	36.0±10.3	124.3±10.7	22.3±6.1	57.1±22.5
		Paspalum scrobiculatum (seedling)	19.0±8.1	0.8±0.2	15.0±7.1	0.7±0.4
	Cyperaceae	*Fuirena umbellate*	-	-	2.3	5.4
	Broad leaves	*Calopogonium mucunoides*	-	-	7.0	11.5
		Calopogonium mucunoides (seedling)	-	-	1.7	2.2
		Ludwigia sp.	0.3	2.8	-	-
Annual	Gramineae	*Acroceras zizanioides*	-	-	144.7±108	5.6±2.4
		Brachiaria sp.	0.3	0.04	46.3±33.3	3.5±2.5

		Digitaria sp.	5.0	0.3	81.3	1.8
		Oryza sativa	2.3±1.9	0.1±0.1	33.0±16.4	1.9±1.0
	Broad leaves	*Borreria filifolia*	-	-	2.7	0.2
		Coldenia procumbens	-	-	1.0	0.6
		Leguminosae			3.7	0.2
		Melochia corchorifolia			1.3	0.1
		Nelsonia canescens	-	-	2.0±0.5	2.6±1.7
		Phyllanthus sp.	-	-	3.0	0.2
		Un-identified	0.3	0.3	-	
Total			63.3±9.8	128.4±8.2	378.0±145.1	14.1±33.4

Collected on 30,31 March 2010, figure shows average and SE of three replications except for species occurred in one replication.

Table 2. Weed occurrence in 1 m^2 in Z and Y fields at the early stage of the rainy season.

Crop and weeds	Botanical name	Zaw field (Z)		Yipielgu field (Y)	
		No. of plants (/m^2)	DMW (g/m^2)	No. of plants (/m^2)	DMW (g/m^2)
Crop	*Oryza sativa*	67.0±27.1	26.4±10.7	61.7±12.4	26.4±10.7
Gramineae	*Acroceras zizanioides*	-	-	32.7±18.7	18.8±6.2
	Digitaria sanguinalis	108.0±63.2	24.7±12.1	-	-
	Eragrostis spp.	4.0±2.5	0.9±0.8	3.0±2.1	1.9±1.2
	Leersia hexandra	-	-	1.0±1.0	0.0±0.0
	Paspalum scrobiculatum	121.7±39.6	62.2±18.7	4.7±2.6	5.9±3.8
Total of Gramineae		233.7±45.3	87.4±7.0	41.3±17.7	26.6±3.6
Cyperaceae	*Cyperus pustulatus* *	-	-	473.7±63.8	57.4±8.9
	Cyperus halpan	-	-	140.3±44.0	21.7±4.2
	Cyperus sp.	1.3±0.3	0.6±0.3	-	-
	Eleocharis complanata	-	-	5.0±5.0	0.2±0.2
	Fimbristylis ferruginea + *Lipocarpha* spp.	11.7±6.9	0.5±0.4	132.0±92.5	31.0±14.6

	Fuirena umbellata	-	-	0.7±0.7	0.0±0.0
	Scirpus sp.	-	-	0.3±0.3	0.0±0.0
Total of Cyperaceae		13.0±6.7	1.2±0.7	752.0±187.0	110.3±33.3
Broad leaves, Monocot.	*Aneilema* sp.	6.3±1.9	3.4±2.1	2.0±1.0	0.2±0.1
	Burnatia enneandra	-	-	5.7±2.0	3.3±0.8
Total of Monocot. broad leaves		6.3±1.9	3.4±2.1	7.7±3.0	3.5±1.2
Broad leaves, Dicot.	*Borreria scaber*	0.3±0.3	0.0±0.0	-	-
	Cleome viscosa	1.0±1.0	3.3±3.3	-	-
	Citrullus sp.	0.7±0.3	0.2±0.2	-	-
	Euphorbia hirta	0.3±0.3	0.0±0.0	-	-
	Leguminosae	-	-	0.3±0.3	0.0±0.0
	Ludwigia hyssopifolia	1.0±0.6	0.0±0.0	23.7±10.9	0.4±0.3
	Limnophila sp.	-	-	94.0±25.4	10.9±7.1
	Mollugo nudicaulis	0.7±0.7	0.0±0.0	-	-
	Phyllanthus sp.	4.3±0.7	0.5±0.1	-	-
	Rhamphicarpa fistulosa	-	-	88.3±82.4	5.4±4.8
Total of Dicot. broad leaves		8.3±1.5	4.2±3.4	206.3±72.1	16.7±7.5
Grand total		261.3±38.0	96.1±10.2	1007.3±157.4	139.5±40.9

Collected on 16,17 August 2010, figure shows average and SE of three replications, *: includes *Pycerus flavescence* and *Cyperus podocarpus*.

Relationship between weed biomass and early growth of rice plant

Number of individual weed species and biomass of weeds and rice plants differed between experimental plots including those applied with glyphosate, which might be caused by position in the farmers' rice fields both in Zaw and Yipielgu villages. Average value of DMW of rice plants decreased as total DMW of weeds increased (Figure 1). In Y DMW generally exceeded approximately 150 g/m^2, while at Z total DMW was below 150 g m^{-2}, making it unclear what impact weed density had no rice DMW.

DISCUSSION

Results showed that weeds began to emerge at the end of the dry season, that degree of submergence affected the differences in

weed infestation such as species composition, number and biomass at the early stage of rainy season, and that early growth of rice was suppressed when DMW of weeds exceeded 150 g/m^2. Further investigations on changes in growth habits and in responses to management procedures including herbicides with different soil moisture and submergence conditions are necessary for the development of weed management procedures for fields of lowland savanna in northern Ghana.

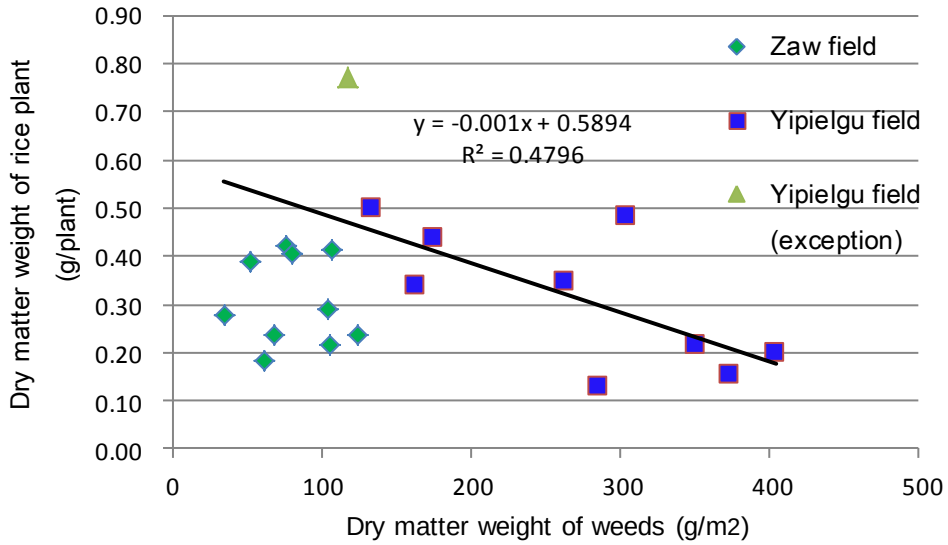

Figure 1. Relationship between total DMW of weeds and average DMW of rice plant in Z and Y fields at the early stage of the rainy season (▲: excepted from calculation for Y field).

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