A QUANTITATIVE ESTIMATE OF WEEDS OF SUGARCANE (*Saccharum officinarum* L.) CROP IN ILORIN, SOUTHERN GUINEA SAVANNA OF NIGERIA

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Abstract

A survey was conducted in the sugarcane fields of Unilorin Sugar Research Institute, Ilorin in the southern Guinea savanna agro-ecological zone of Nigeria during 2011 and 2012 cropping seasons with an objective to identify the current status of prevalent weeds in rainfed and irrigated sugarcane fields. A quantitative method was employed for the enumeration of weeds. Quadrats were laid along transects and individual weed species in each quadrat was identified and counted. Simpson's diversity index, Sorensen similarity index and relative abundance were used to determine the weed community structure. A total of 51 weed species belonging to 40 genera within 16 families were identified across the sugarcane fields. Rainfed sugarcane field was higher in weed species (41) than irrigated fields (35 weed species). Rainfed fields also had the diversity index of 28.84 % compared to 21.66% species diversity computed for irrigated fields. The result generally shows that the similarities index of weed species between rainfed and irrigated fields is about 50 %. Among the 10 abundant weed species, two grasses viz. Panicum repens L. and Imperata cylindrica (L.) Raeschel were the most abundant weeds in sugarcane fields followed by Rottboellia cochinchinensis Lour and two sedge weeds Cyperus rotundus L. and Mariscus longibracteatus Cherm. Results obtained from this study would be useful in creating a weed management programme and making informed decision on choice of herbicides. Regular weed survey to identify possible problematic weeds and weed population shifts and direct research toward new or improved weed control measures is thereby recommended.

Key words: *Sugarcane fields, rainfed, irrigation, survey, weed species*

Introduction

A major part of Africa lies in the tropics and sub-humid tropics which are characterized by high temperatures and humid ecosystems, a situation which makes the region conducive to weed growth. Hence, weeds constitute a significant component of the pest complex in African farms, consequently, an important constraint in agricultural production system.

Weeds are genetically diverse and can readily take advantage of the variety of conditions created by any given crop production system. Many common weed species also have the ability to establish themselves rapidly in the field (Mikulka and Chodová 2000). This is primarily due to their ability to produce a large quantity of viable seeds (if it is an annual) or vegetative tissues such as rhizomes (if it is a perennial) in a single growing season.

In recent times, a considerable increase in infestation of arable land with perennial weeds has been reported (Winkler 2000). This trend was attributed to failure of the farmers to carry out cultural practices as well as poor weed control during this process (Mikulka and Chodová 2000).

The most important features of Nigerian sugarcane industry are the practice of monoculture, on the same piece of land for a long period of time resulting in low productive capacity of the sugarcane varieties and similar weed management practices which lead to a build-up of weed communities that might be resistant to the weed control option adopted. In addition, sugarcane differs from other crops in

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that it takes twelve months from planting to harvesting and four to five harvests can be made from a single planting. The soil on the row top where the sugarcane grows is not appreciably disturbed during the multi-year cropping, weeds can become well established and difficult to control.

Therefore, documenting the weed species present in sugarcane fields and cultural practices used to control them allows comparisons with past and future surveys. These comparisons can help elucidate the effect of new weed control technologies on farming practices, weed species shifts in response to new weed control technologies and development of herbicide resistant weeds (Kamal-Uddin *et al*., 2009). Documenting the relative importance of weed species also facilitates the establishment of priorities for research and extension activities (McClosky *et al*., 1998). Therefore, knowledge on the nature and extent of infestation of weed flora in sugarcane fields through weed surveys is essential in formulating relevant weed control strategies. Thus, the objective of this study was to identify the current status of persistent weeds; including occurrence, composition and distribution of weed communities prevailing in rainfed and irrigated sugarcane fields in Ilorin.

Materials and Methods

In Nigeria, sugarcane is planted either at the onset of rain in April/May or at the end of raining season in October/November. This survey was conducted in two distinct research fields (rainfed and irrigated) of Unilorin Sugar Research Institute ($9^{o}29^{'}$ N, $4^{o}35^{'}$ E) of Nigeria and is 307 m above sea level during 2012 - 2013 growing season.

The field survey was carried out according to the quantitative survey method described by Thomas (1985) and Kamal-Uddin *et al.* (2009). Transect lines were set to cover the research fields and quadrats of size 1m x 0.25m were arranged 10 m apart in a grid pattern across each transect line. Each transect line was surveyed and observations were recorded from the quadrats.

The weeds were identified using the hand book of West African Weeds (Akobundu and Agyakwa, 1998). Data on weed density was collected at monthly intervals for five month (May to September in rainfed fields and October to February in irrigated fields).

The composition of the weed flora was analysed by calculating the relative abundance (RA) of each species within each experimental field as follows: RA = (RD + RF) / 2, where RD (relative density) = number of a weed species per unit area (within a quadrat) in the plot divided by the total number of weed species within the same unit area (quadrat); and RF (relative frequency) = proportion of quadrat in which the species was present per experimental unit divided by the total frequency of all species in the experimental unit (Takim and Fadayomi, 2009).

For the measurement of diversity, Sorensen similarities (Wolda, 1981) and Simpson diversity (Anon, 2008) indices were used to determine and compare the weed species diversity of each field and the indices were computed as follows:

Simpson's diversity index= $\sum_{t-1} [n_i (n_i -1)] / [N (N-1)]$

Where n =total number of each species, N = total frequency of all species

Sorensen similarity index = $a/ a+ b+ c * 100$

Where a = number of weed species common to both fields, b= number of weed species in rainfed fields not in irrigated fields, c= number of weed species in irrigated fields not rainfed fields.

Results

A total of 51 weed species belonging to 40 genera within 16 families were identified across the sugarcane fields in Ilorin (Table 1). Forty-one of the total weed species encountered were identified in the rainfed fields while thirty-five weed species were found in irrigated fields. Member of the family Poaceae had 13 (25.5%) weed species belonging to 10 genera, followed by Amarantheceae with 6 weed species while Asteraceae, Cyperanceae, Euphorbiaceae and Fabaceae had four weed species each. Thirty-four

broadleaves, 13 grasses (rainfed fields had 12 species while irrigated fields had 7 grass weed species) and 4 sedges made up the weed spectrum which was dominated with 28 species of annual weeds while perennials encountered were twenty-two species where 19 were identified in rainfed ecology and 14 of the perennial weed species were enumerated in the irrigated fields.

Twenty-five weed species that belong to 12 families, comprising of 11 perennials and 14 annuals were made of 17 broadleaves, 6 grasses and 2 sedges were common in both fields (Table 2). *Cyperus rotundus* L had the highest population of 237 seedlings/m^2 followed by *Panicum repens* L (217 seedlings/m^2) , *Cyperus esculentus* L (195 seedlings/ m^2) , *Imperata cylindrica* L Raeuschel (188 seedlings/ m^2) under the rainfed fields and the listed weed species made up of about 25% of total weeds relative abundance. Similarly, 33 % of the estimated weed species in the irrigated fields were made up of four weed species which include: *Panicum repens* L with the highest seedling population (688 seedlings/ m^2) , *Celosia iserti* (C.C. Townsend) (588 seedlings/ m^2), *Imperata cylindrica* L Raeuschel (532 seedlings/ m^2) , *and Rottboellia cochinchinensis* Lour (476 seedlings / m^2).

Ten most populated weed species encountered in both fields comprised of 4 grasses, 4 broadleaves and 2 sedges that made up of 7 perennials and 3 annuals. Top five weed species on the list are *Panicum repens Imperata cylindrica, Cyperus rotundus, Rottboellia cochinchinensis* and *Mariscus longibracteatus* (Table 3).

Table 4 shows the species richness (diversity of weed species in the fields). Rainfed fields had the highest weed diversity index of 28.84 % and irrigated fields had 21.66%. The result generally shows that the similarities indices of weed species between rainfed and irrigated fields is about 50 %.

Discussion

The results from this study showed that broadleaves had higher diversity in species on the Unilorin sugarcane fields but members of the Poaceae family dominated the sugarcane weed community. There is a gradual shift from the natural vegetation with predominant annual broadleaves to an induced vegetation of perennial grasses. The low Simpson's diversity indices obtained in this study showed that the sugarcane weed community was dominated by certain weed species which are more important than other species in the sugarcane ecology. Studies have shown that the more diverse the land use system, the more diverse the weed community, with less dominant and troublesome species (Cardina *et al.,* 1998). Cereal crops grown continuously for several years, select for grass weeds (Blackshaw, 1994) and broadleaf weeds tend to increase in continuous broadleaf crops such as legumes (Lemerle and Murphy, 2000). The adaptation of weed populations to continuous cropping is due to a consistently hospitable environment for weeds that have phenological and physiological similarities to the crop (Owen, 1998). The continuous cropping sequences in the mid-western U.S.A. for instance, select for these annual weeds as the length of the growing season of these crops allows such weeds to avoid control measures and complete their life cycle (Murphy and Lemerle, 2006). The perennial weed species on the other hand, prosper well on less-disturbed and more stable environments. They are therefore more common under no-till cropping system (Clements *et.al.,* 1996).

The results from this study agreed with the report of Quershi (2004) in Sukkur district of Pakistan, who reported that 50 weed species belonging to 21 angiospermic families dominated sugarcane field and *Desmostachya bipinnata, Cynodon dactylon, Cyperus rotundus, Trianthema portuacastrum* among others were the most dominant and frequent weed species of sugarcane crop while Murugan and Kathiresan (2010) reported that sugarcane fields of Cuddalore district of Tamil nadu in India is

dominated with *Cyperus rotundus*. In Nigeria, Ndarubu *et al.* (1998) earlier reported the scourge of *Paspalum* spp *on* the Nigerian Sugar Company Bacita fields. However, Ndarubu and Fadayomi (2006) observed that broadleaves had higher diversity while density of grasses was higher across the sugarcane fields of Nigerian Sugar Company.

It follows that rainfed field is higher in species richness than irrigated fields. This difference in weed species emergence and magnitude could be subjected to environmental conditions, namely moisture regime (Marginet *et al.,* 2000) while similarity index between the two sugarcane fields was about 50%. This high similarity value could be attributed to the irregular amount and distribution of rainfall throughout the year in this region which is similar to the pattern of irrigation rendering moisture as a factor controlling weed seedling emergence (Zimdahl *et al*., 1988) relatively insignificant. Other reasons could be similar soil properties, tillage operations and weed management practices adopted (Cardina *et al* 1998).

Conclusion

This survey provides the first quantitative comparison of the common weed species in sugarcane fields in the savanna ecology of Nigeria. Among the 10 abundant species, two grasses viz: *Panicum repens* and *Imperata cylindrica* were the most abundant weeds in sugarcane fields followed by *Rottboellia cochinchinensis* and two sedge weeds *Cyperus rotundus,* and *Mariscus longibracteatus*. Weed management on sugarcane fields in Nigeria is shifting from manual to chemical weed control, results obtained from this study would be useful in creating a weed management programme and making informed decision on choice of herbicides. Overall, more survey work is needed on a regular basis to identify possible problematic weed and weed population shifts and direct research toward new or improved control measures.

References

Akobundu I.O. and Agyakwa C.W. (1998), *A Hand book of West African Weeds.* IITA, Ibadan- Nigeria. 521pp.

Anonymous (2008), Ecology and Simpson's Diversity Index : advanced applied science: GCE A2 UNITS: 1- 9.

Blackshaw, R.E. (1994), Rotation affects downy brome (*Bromus tectorum*) in winter wheat (*Triticum aestivum*).*Weed Technology* 8,728–732.

Cardina, J., Webster, T. M. and Herms, C.P. (1998), Long-term tillage and rotation effects on soil seedbank characteristics. *Applied Biology* 51, 213–220.

Clements, D.R., Benoit, D.L. Murphy, S.D. and Swanton, C.J. (1996), Tillage effects on weed seed return and seed-bank composition. *Weed Science,* 44, 314-322.

Kamal-Uddin, M.D., Juraimi, A.S., Begum, M., Ismail, M.R., Abdul Rahim, A. and Othman, R. (2009). Floristic Composition of Weed Community in Turf Grass Area of West Peninsular Malaysia. *International Journal of Agriculture & Biology,* 11(1), 13-20.

Lemerle, D. and Murphy, C.E. (2000), Cultural management methods. In: B.M. Sindel (Ed.), *Australian Weed Management Systems*, pp.123–138.

McClosky, W.B., Baker. P.B. and Sherman, W. (1998), *Survey of Cotton Weeds and Weed Control Practices in Arizona Upland Cotton Fields*. Publication AZ1006"cotton: College of Agriculture, University of Arizona.

Marginet A., Van Acker, R., Derksen, D.A.. Entz, M.H. and Andrews, T. (2000), Wild oat (*Avena fatua*) emergence as averted by tillage and ecodistrict. *In: Proceedings of the 2000 national meeting:expert committee on weeds,* Alberta, Canada, pp 31–39

Mikulka, J. and Chodová, D. (2000), Changes in weed societies in the Czech Republic. In: XVth Czech and Slovak Plant Protection Conference, September 12–14, 2000, Brno, No. 15, 287–288.

Murphy, C.E and Lemerle, D. (2006), Continuous cropping systems and weed selection *Euphytica* 148, 61–73.

Murugan, G. and Kathiresan, R.M. (2010), Ecological studies on weeds of sugarcane fields. *Plant Archives* 10(2), 667-669.

Ndarubu, A.A., Bulus, S., Gimba, N., Busari, L.D. and Misari, S.M. (1998), Weed flora of sugarcane and their management strategies. *Abstract:* Annual Conference of Weed Science Society of Nigeria held at Federal University of Technology, Akure, between 9th-12th November, 1998.

Ndarubu, A.A. and Fadayomi, O. (2006), Relationship between soil, weed-seed bank and floristic survey estimations of weed density and species' diversity on the sugarcane estate of the Nigerian Sugar Company (NISUCO) Ltd, Bacita, Nigeria. *Nigerian Journal of Weed Science* 19, 23-31.

Takim, F.O. and Fadayomi, O. (2010), Influence of Tillage and Cropping Systems on Field Emergence and Growth of Weeds and Yield of Maize (*Zea mays* L.) and Cowpea (*Vigna unguiculata* L.). *Australian Journal of Agricultural Engineering* 1(4), 141-148.

Owen, M.D.K. (1998), Producer attitudes and weed management. In: J.L Hatfield, D.D Buhler & B.A. Stewart (Eds.) *Integrated weed and soil management,* pp. 43–60. Ann Arbor Press, USA.

Thomas, A.G. (1985), Weed survey system used in Saskatchewan for cereal and oilseed crops. *Weed Science,* 33, 34-43.

Winkler, J. (2000), The changes of species structure of weed communities influence by flood. In: XVth Czech and Slovak Plant Protection Conference, September 12–14, 2000, Brno, No. 15, 315–316.

Wolda, H (1981), Similarity Indices, Sample Size and Diversity. *OecoIogia (Berl)*, 50,296-302.

Zimdahl, R.L., Moody, K., Lubigan, R.T. and Castin, E.M. (1988), Pattern of weed emergence in tropical soils. *Weed Science,* 36, 603-608.

Table 1 Weed species encountered on sugarcane fields during the 2011-2012 growing season

FAMILY	WEED SPECIES	LC	MG	Weed density(no/m^2)		Rel. Abundance (%)	
				Rainfed	Irrigated	Rainfed	Irrigated
Acanthaceae	*Blepharis maderaspatensis* L	P	B	-	12	-	0.17
	Hypoestes cancellata (Nees)	A	B	-	20	-	0.29
	Monechma ciliatum (Jacq) Milne R	A	B	-	20	-	0.29
Aizoaceae	*Trianthema portulacastrum* L.	A	B	27	232	0.79	3.37
Amaranthaceae	*Achyranthes aspera* L.	A	B	14	-	0.40	-
	Celosia iserti (C.C. Townsend)	A	B	-	588	-	8.53
	Celosia leptostachya Benth	A	B	104	148	3.05	3.59
	Cyathula prostrate L. Blume.	A	B	-	04	-	0.06
	Gomphrena celosioides (Mart)	A/P	B	-	72	-	1.04
	Pupalia lappaceae (L) Juss	A	B	-	80	-	1.16
Asteraceae	*Ageratum conyzoides* L	A	B	74	100	2.17	1.45
	Aspilia africana pers C.D. Adams	P	B	72	140	2.11	2.03
	Chromolaena odorata L (RM) Kings	P	B	89	148	2.61	2.15
	Tridax procumbens L	A	B	72	172	2.11	2.50
Cleomaceae	*Cleome rutidosperma* D.C.	A	B	24	-	0.70	-
	Cleome viscosa L.	A	B	81	360	2.38	5.22
Commelinaceae	*Commelina diffusa* Burm.	P	B	37	-	1.09	-
Cyperaceae	*Cyperus esculentus* L	P	S	195	-	5.72	
	Cyperus rotundus L	P	S	237	292	6.96	4.42
	Mariscus alternifolius Vahl	P	S	151	-	4.43	-
	Mariscus longibracteatus Cherm	P	S	149	224	4.37	3.52
Euphorbiaceae	*Acalypha fimbriata* Schum & Thonn	A	B	-	148		2.15
	Croton lobatus L.	A	B	32	-	0.94	-
	Euphorbia heterophylla L	A	B	75	96	2.20	1.39
	Phyllanthus amarus Schum & Thonn	A	S	98	48	2.85	0.70
Lamiaceae	*Solenostemon monostachyus* P. Beauv	A	B	38	228	1.12	3.31
Leguminoseae/ Fabaceae	*Desmodium salicifolium* (Poir) DC	A	B	52	156	1.53	2.26
	Mimosa pudica L	P	B	-	64		0.93
	Tephrosia bracteolata Guill & Perr	A	B	103	164	3.02	2.38
	Tephrosia linearis Willd Pers	A	B	116	96	3.41	1.39
Malvaceae	*Sida acuta* Burm.	P	B	59	104	1.73	1.51
	Sida garckeana Polak	P	B	135	132	3.96	1.92
	Sida rhombifolia L	P	B	55	-	1.61	-
Nyctaginaceae	*Boerhavia coccinea* Mill	P	B	34	-	0.99	-
	Boerhavia diffusa L	P	B	92	320	2.70	4.64
Poaceae	*Andropogon gayanus* Kunth	P	G	70	128	2.06	1.86

	Axonopus compressus Sw. P. Beauv	P	G	144	184	4.23	2.67
	Bracharia lata Schumach C.E	A	G	76	196	2.23	2.84
	Cynodon dactylon (L) Pers	P	G	41	-	1.20	-
	Eleusine indica Gaertn	A	G	28	-	0.82	-
	Imperata cylindrica L Raeuschel	P	G	188	532	5.52	7.72
	Panicum maximum Jacq	P	G	52	-	1.53	-
	Panicum repens L	P	G	217	688	6.37	9.92
	Paspalum conjugatum Berg.	P	G	-	284	-	4.12
	Paspalum scrobiculatum L	P	G	97	-	2.85	-
	Pennisetum polystachion L Schult	A	G	29	-	0.85	-
	Pennisetum violaceum Lam L.	A	G	24	-	0.70	-
	Rottboellia cochinchinensis Lour	A	G	79	476	2.32	6.91
Portulacaceae	*Portulaca oleraceae* L	A	B	31	-	0.91	-
Rubiaceae	*Mitracarpus villosus* Sw. DC	A	B	81	116	2.38	1.86
Solanaceae	*Physalis angulata* L	A	B	42	-	1.23	-

LC = life cycle, MG = morphological group, P = perennial, A= annual, G = grass, B= broadleaf, S= sedge, Rel.= relative

Table 2 Common weed species encountered on rainfed and irrigated sugarcane field in Ilorin

FAMILY	WEED SPECIES	LC	MG	Weed density (no/m^2)		Rel. Abundance (%)	
				Rainfed	Irrigated	Rainfed	Irrigated
Aizoaceae	*Trianthema portulacastrum .*	A	B	27	232	0.79	3.37
Amaranthaceae	*Celosia leptostachya*	A	B	104	148	3.05	3.59
Asteraceae	*Ageratum conyzoides*	A	B	74	100	2.17	1.45
	Aspilia africana	P	B	72	140	2.11	2.03
	Chromolaena odorata	P	B	89	148	2.61	2.15
	Tridax procumbens	A	B	72	172	2.11	2.50
Cleomaceae	*Cleome viscosa*	A	B	81	360	2.38	5.22
Cyperaceae	*Cyperus rotundus*	P	S	237	292	6.96	4.42
	Mariscus longibracteatus	P	S	149	224	4.37	3.52
Euphorbiaceae	*Euphorbia heterophylla*	A	B	75	96	2.20	1.39
	Phyllanthus amarus	A	B	98	48	2.85	0.70
Lamiaceae	*Solenostemon monostachyus*	A	B	38	228	1.12	3.31
Leguminoseae	*Desmodium salicifolium*	A	B	52	156	1.53	2.26
	Tephrosia bracteolata	A	B	103	164	3.02	2.38
	Tephrosia linearis	A	B	116	96	3.41	1.39
Malvaceae	*Sida acuta*	P	B	59	104	1.73	1.51
	Sida garckeana	P	B	135	132	3.96	1.92
Nyctaginaceae	*Boerhavia diffusa*	P	B	92	320	2.70	4.64
Poaceae	*Andropogon gayanus*	P	G	70	128	2.06	1.86
	Axonopus compressus	P	G	144	184	4.23	2.67
	Bracharia lata	A	G	76	196	2.23	2.84
	Imperata cylindrica	P	G	188	532	5.52	7.72
	Panicum repens	P	G	217	688	6.37	9.92
	Rottboellia cochinchinensis	A	G	79	476	2.32	6.91
Rubiaceae	*Mitracarpus villosus*	A	B	81	116	2.38	1.86

LC = life cycle, MG = morphological group, P = perennial, A= annual, G = grass, B= broadleaf, S= sedge, Rel.= relative

Table 3 The ten most populated weed species encountered on sugarcane fields in Ilorin

FAMILY	WEED SPECIES	LC	MG	Weed density (no/m^2)		Rel. Abundance (%)		
				Rainfed	Irrigated	Rainfed	Irrigated	Mean Rel. Abundance (%)
Poaceae	*Panicum repens*	P	G	217	688	6.37	9.92	8.15
Poaceae	*Imperata cylindrica*	P	G	188	532	5.52	7.72	6.62
Cyperaceae	*Cyperus rotundus*	P	S	237	292	6.96	4.42	5.69
Poaceae	*Rottboellia cochinchinensis*	A	G	79	476	2.32	6.91	4.62
Poaceae	*Mariscus longibracteatus*	P	S	149	224	4.37	3.52	3.95
Cleomaceae	*Cleome viscosa*	A	B	81	360	2.38	5.22	3.80
Nyctaginaceae	*Boerhavia diffusa*	P	B	92	320	2.70	4.64	3.67
Poaceae	*Axonopus compressus*	P	G	144	184	4.23	2.67	3.45
Amaranthaceae	*Celosia leptostachya*	A	B	104	148	3.05	3.59	3.32
Malvaceae	*Sida garckeana*	P	B	135	132	3.96	1.92	2.94

LC = life cycle, MG = morphological group, P = perennial, A= annual, G = grass, B= broadleaf, S= sedge, Rel.= relative

Table 4 Details of diversity and similarity of weeds in sugarcane fields of Ilorin

Indices	Rainfed field	Irrigated field	Whole fields
Species Richness	41	35	51
Simpson diversity index	28.84 %	21.66 %	-
Sorensen similarity index	-	-	49.02%