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EC AGRICULTURE
Research Article

Major Weeds of Ecuador. I. Rice

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Received: August 20, 2020; **Published:** January 29, 2021

Abstract

Rice is one of the main components of the diet in Ecuador, a country in South America. The population that lives on the coast is the one that consumes the most this cereal, so its production is important for the country's food sustainability. Weeds are among major constraints to rice production there. The present study aimed to evaluate weed presence in rice crops in Ecuador. A survey was carried out in 140 ha of the main rice growing areas of the country. To this end, total weed and prevailing species cover were visually assessed using a scale from 0 to 4, where 1- 1 - 5% of weed cover and 4- more than 50%. With these values, Absolute and Relative Frequencies, ΣI-sum of cover values, Im- average cover value, and finally SI- index of infestation severity (F by Im) were determined. Results show that the most important species in transplanted rice were Weedy Rice (*Oryza sativa* L.), *Echinochloa colona, Cyperus iria and Eclipta prostrata*, while in direct-seeded rice *E. colona,* Weedy Rice, *Leptochloa fusca* var. *uninervia and Sesbania herbacea* prevail. *Limnocharis flava* was frequent in spots permanently flooded. The abundance of weedy rice presence in both rice crops suggests a high seed bank in soil as well as the presence of weed seeds in rice seeds, and also of water management problems in uneven fields of transplanted rice. High SI of *L. fusca* var. *uninervia* in direct-seeded rice may be due to repeated applications of ACCase inhibitors, such as cyhalofop butyl and profoxydim, which suggest possible presence of herbicide-resistant biotypes. Results roughly indicate that improved weed management may bring substantial rice yield increases in Ecuador.

Keywords: *Ecuador; Rice; Weed; Weedy Rice; Echinochloa colona*

Introduction

Ecuador is a South American country with a total area of 283,561 km^2 and a population of 17,643,054 inhabitants according to worldometers.com (2020). Geographically the country has three continental regions: La Costa (Coast), La Sierra (the Andean mountains) and El Oriente (Eastern part), plus one insular region, the famous Galapagos Islands.

Among the major crops, rice is a main staple in the people´s diet. Sixty three % of its area, of more than 340,000 ha, is mainly grown in the so-called wintertime and on the on the flood plains of the Guayas River Basin in Guayas, Manabí and Los Ríos provinces in La Costa region. According to Alves [1], the production amounted to 840,000 tons in 2018, which represents 152,000 tons less than the production in 2015.

[1]Research carried out as part of the National Prometeo Project "Malezas principales en la agricultura de Ecuador", Aug. 2014-Aug. 2015ç.

Forty five % of the rice-producers in Ecuador grow 4 - 5 ha, with an average yield of 3,7 ton/ha. Among major constraints to rice production, dense weed infestations hamper rice high yields. Methods used for weed control do not consider species prevalence.

Weeds are the cause of serious yield reduction problems in rice production worldwide. Losses caused by weeds vary from one country to another, depending on the predominant weed flora and on the control methods practised by farmers [2]. The rice grain yield losses vary with the type of rice cultivation, country or region where rice is grown [3].

Factors such as weed species composition, weed density, duration of weed-rice competition, rice cultivar, seeding density, water management, and fertility level influence the degree of rice yield loss from weed competition [4]. Weed species composition is normally a product of the adopted cropping system. Rice can be direct-seeded, transplanted using different irrigation systems according to water or rain availability. The diversity of weed communities are determined by environmental and management factors, as well as by interspecific competition between weeds and crop plants, and among the same weed species Poggio., *et al* [5].

The information on the up-to-date presence, composition, abundance, importance and ranking of weed species is needed to formulate appropriate weed management strategies to produce optimum yields of rice [6].

Taking into account the losses caused by weeds in rice, it was decided to include a study in order to identify major species in rice differentiating weed prevalence in transplanted and direct-seeded rice. Such an information is useful to determine feasible control methods in each case.

The lack of information of major weeds in rice of Ecuador does not enable farmers to implement right strategies for weed management. To fill this information gap, a study was conducted to determine the main weed species in rice cultivation in Ecuador.

Materials and Methods

A weed survey was carried out in 140 ha distributed in main four rice-growing areas (Table 1) of the country during the period of September 2014 and May 2015.

Area	Ha
Babahoyo-Baba	46
Balzar, Guayas	24,5
Daule, Guayas	34
Charapoto	35
Total	139,5

Table 1: *Evaluated rice area in different zones (ha).*

Weeds were evaluated visually (see score system used below), going around each field and entering in areas evidently with large weedy spots. In each site, evaluation consisted of the cover of each species present and the total weed cover. Sites chosen for evaluation were around 10 - 12 depending on the total area of each field.

Scale-Cover

0- 0 weeds

1- 1-5%

2- 6-25%

3- 26-50%

4- More than 50%.

Those values were processed, where:

- FA- Absolute frequency was determined, i.e. the number of times each species was found in each site.
- F- Relative frequency in %, number of infested sites by one species divided by the total of sites evaluated.
- ΣI- Sum of the cover values
- Im- Average of cover values, i.e. ΣI/number of evaluated sites in each field.
- SI- Severity infestation obtained as product of F by Im.

A matrix was prepared to determine the above values and to determine SI of each species.

Results and Discussion

In the evaluated areas, the unevenness of the land, which makes difficult to apply any measure, including direct seeding or planting and correct irrigation, was a constant anomaly. That is why the distribution of some species depends on their ability to grow in places with higher or lower moisture. In transplanted areas, weedy rice and *Echinochloa colona* (L.) Link were the prevailing species, while sedges found, *Cyperus iria* L. and *Cyperus difformis* L., were medium abundant (Figure 1). Another important species in transplanted rice was *Eclipta prostrata* (L.) L. In highly permanent flooded spots aquatic *Limnocharis flava* (L.) Buchenau was the most abundant species.

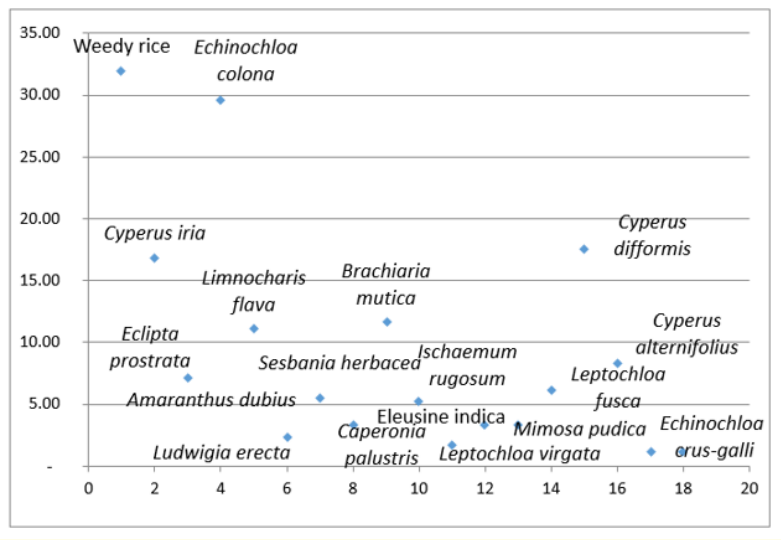

Figure 1: *Major weeds (SI) in transplanted rice.*

This predominance pattern repeated in the direct-seeded areas (Figure 2), although sedges were less abundant. In this modality, *Leptochloa fusca* (L.) Kunth var. uninervia had values very similar to those shown by weedy rice. It was impossible to differentiate weed cover according to the herbicides use due to farmers' lack of knowledge of what they actually apply in the field. However, in direct-seeded areas repeated post-emergence use of ACCase inhibitors, such as cyhalofop butyl and profoxydim, might have brought about resistant biotypes of *Leptochloa* spp., something that is still to be confirmed experimentally. Before entering those fields, dense *Leptochloa fusca* white spots are easily seen. The most unfortunate thing is farmers continue to apply those same ineffective herbicides.

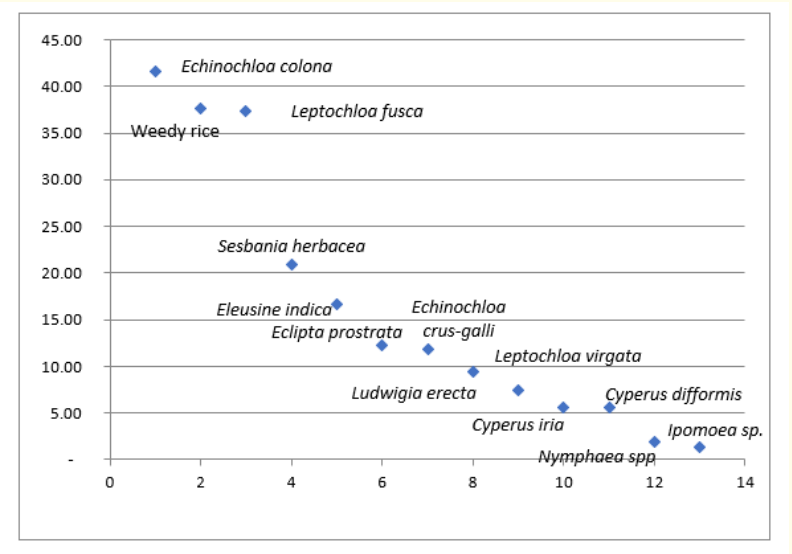

Figure 2: *Major weeds (SI) in direct-seeded rice.*

Except Charapoto, Manabí province, weedy rice was in general the major weed (Table 2), which suggests that its seed bank in soil is high in any form of rice plantation. As indicated already, *E. colona* is the second most important species, while *L. fusca* is a problem in direct-seeded areas.

Balzar (Guayas)	SI	Daule (Guayas)	SI	Babahoyo (Los Ríos)	SI	Charapoto (Manabí)	SI
Weedy rice	42,37	Weedy rice	37,77	Weedy rice	55,56	*Echinochloa colona*	67,86
Leptochloa fusca	41,28	*Echinochloa colona*	26,85	*Cyperus iria*	41,67	*Eleusine indica*	52,38
Echinochloa colona	22,69	*Leptochloa fusca*	24,36	*Sesbania herbacea*	14,58	Weedy rice	19,05
Eclipta prostrata	21,92	*Echinochloa crus-galli*	22,56	*Eclipta prostrata*	14,31	*Amaranthus dubius*	14,29
Ludwigia erecta	18,40	*Leptochloa virgata*	15,38	*Limnocharis flava*	11,67	*Cyperus difformis*	14,29
Sesbania herbacea	13,46	*Eclipta prostrata*	14,19	*Caperonia palustris*	8,75	*Cyperus iria*	10,71
Echinochloa crus-galli	10,77	*Cynodon dactylon*	7,69	*Ischaemum rugosum*	7,92	*Eclipta prostrata*	10,71
Mimosa pudica	3,85	*Cyperus iria*	7,26	*Brachiaria mutica*	7,50	*Leptochloa fusca*	7,14
Limnocharis flava	1,92	*Limnocharis flava*	5,77	*Echinochloa colona*	7,22	*Limnocharis flava*	7,14
Cyperus iria	1,92	*Saggitaria latifolia*	3,85	*Leptochloa virgata*	6,25	-	-

Table 2: *Major weeds in rice of Ecuador.*
SI: Severity of Infestation.

Based on the results, the major weeds in rice of Ecuador are nine grasses: Weedy rice, *Echinochloa colona*, *E. crus-galli* (L) P. Beauv., *Eleusine indica* (L) Gaertn., *Leptochloa fusca*, *L. virgata* (L.) P. Beauv., *Ischaemum rugosum* Salisb., *Brachiaria mutica* Forsk. Stapf, and *Cynodon dactylon* (L.) Pers.; three sedges: *Cyperus iria, C. difformis*, and *C. alternifolius* L.; six broadleaved species were: *Eclipta prostrata*, *Caperonia palustris* (L.) A.St.-Hil., *Sesbania herbacea* (P. Mill.) McVaugh, *Amaranthus dubius* Mart., *Ipomoea* spp. *Ludwigia erecta* (L.) H. Hara, plus three aquatics: *L. flava*, *Saggitaria latifolia* Willd., and rare *Nymphaea* spp. It is also evident that annual species prevail over perennials.

Comparing these results with those reported in other tropical countries, there is no much difference. Hakim., *et al.* [7] reported *Echinochloa* spp. *Leptochloa* spp and sedges as major weeds in rice of Sebarang Perak in West Malaysia. Nearly the same weed composition was found by Ramírez., *et al.* [8] in Tolima Dept., Colombia. However, in some areas depending on soil preparation and climate, the results can be much different [9].

The results obtained indicate that there is a potential to increase rice yields improving crop and weed management. Improved agronomic practices, including use of clean seeds, ground levelling, alongside sowing or planting and irrigation will significantly reduce actual weed infestations in paddy of Ecuador. Chemical control should be only implemented under the advice to farmers by qualified personnel and thus avoid the wrong or repeated use of already ineffective herbicides, as it is the case of the control of *L. fusca*. Exhausting weedy rice infestation before planting through removing early weed flushes, i.e. the so-called stale seed bed, which consists of keeping the field wet or flushing it with water one or more times in order to stimulate germination and/or rotting of the seeds, removing mechanically or using a safe chemical emerged seedlings, may reduce significantly the weedy rice seed bank in soil. This is more effective if combined with the use of clean rice seeds [10].

Conclusion

Results roughly indicate that improved weed management may bring substantial rice yield increases in Ecuador.

Bibliography

1. Alves Bruna. Production of milled rice in Ecuador from 2010 to 2018. Statista.com (2020).
2. Labrada R. "The need for improved weed management in rice". In Sustainable rice production for food security, Proceedings 20th Session International Rice Commission. Bangkok, Thailand (2002).
3. Yaduraju N., *et al*. "Weeds in Indian agriculture: Problems and prospects to become self-sufficient". *Indian Farming* 65 (2015): 2-6.
4. Odero D and VanWeelden M. "Weed Management in Rice". EDIS, No. 2 (2019).
5. Poggio SL., *et al*. "Structure of weed communities occurring in Pea and Wheat crops in the rolling pampa (Argentina)". *Agriculture Ecosystem and Environmental* 103.1 (2004): 225-235.
6. Begum M., *et al*. "Weed diversity of rice fields in four districts of muda rice granary area, north-west Peninsular Malaysia". *Malaysian Applied Biology* 34 (2005): 31-41.
7. Hakim MA., *et al*. "A survey on weed diversity in coastal rice fields of Sebarang Perak in Peninsular Malaysia". *The Journal of Animal and Plant Sciences* 23.2 (2013): 534-542.
8. Ramírez J., *et al*. "Weed population dynamics in rice crops resulting from post-emergent herbicide applications". *Revista Facultad Nacional de Agronomía* 70.1 (2017): 8035-8043.

9. Golmohammadi MJ., *et al*. "Rice weed community composition and richness in northern Iran: a temperate rainy area". *Applied Ecology and Environmental Research* 16.4 (2018): 4605-4617.

10. Ferrero A and Vidotto F. "Red rice control in rice pre-and post-planting". In FAO. Global workshop on red rice control. Report of Workshop, Varadero, Cuba. Plant Production and Protection Division. Rome (1999): 155.

Volume 7 Issue 2 February 2021