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WEED CONTROL AND RICE PRODUCTION IN BRAZIL

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The rice lands of Brazil are classified according to water regime. The major rice production problems are described by cultivar, disease, pest, and soil. Results of experiments on weed control systems in wetland and dryland rice are reported. Because of the severe labor shortages during critical weeding periods, a weed control system based on chemical control is recommended for wetland and dryland rice culture.

Rice is a major agricultural product in Brazil, with 92% of the total production in Rio Grande do Sul, Mato Grosso, Maranhão, Paraná, Minas Gerais, Goiás, Saõ Paulo, and Santa Catarina States. The area under rice totals about 7 million hectares and 1979-80 production was an estimated 9 million tons.

Rice production in Brazil basically is characterized by four systems, classified according to water supply (Empresa Brasileira de Pesquisa Agropecuaria [EMBRAPA] 1981):

System I — wetland (flooded) with permanently controlled water level.
System II — wetland (naturally flooded) without controlled water level.
System III — wetland (not flooded) in naturally humid lowlands.
System IV — dryland totally dependent on rainfall.

System I is traditional in the south (Rio Grande do Sul and Santa Catarina). Its

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increasing importance in new areas of Central Brazil presents a large potential. These regions are being opened to cultivation through such government projects as Rio Formoso and settlement programs under the Program of Rational Utilization of Lowland Areas (PROVARZEAS).

Systems II and III predominate in the north and northeast where low areas near the rivers flood periodically, offering conditions suitable for cultivating rice. Currently both systems are less important because their proportion of national production is insignificant so far. The systems are less utilized by farmers, mainly because of the lack of adequate technology for local conditions. However, interest is high at government and technical levels in incorporating these areas into the total production scheme because of their high potential. The two systems potentially could add about 30 million hectares of land to total rice cultivation.

System IV is the most significant cultivation system. It represents more than 70% of the total rice cultivation area and covers more than 4 million hectares. Dryland rice is cultivated both in favored and in unfavored regions. In favored regions, climatic conditions, especially rainfall, are less variable and offer less risk. Farmers in those regions are encouraged to use the high technology that can lead to higher productivity.

In unfavored regions, risks are higher. Adverse environmental conditions such as extended dry periods (veranicos) during crop growth discourage the use of high technology and yields are low. In the unfavored regions of Central and part of Southeast Brazil, rice is typically a transitional crop. Rice cultivation as the first utilization of deep, highly permeable soils with low fertility and high levels of toxic aluminum is used as a means of decreasing land preparation costs for subsequent crops, such as soybean and pastures. Under these conditions, rice is planted for 1 to 3 years.

MAJOR PROBLEMS OF RICE PRODUCTION

Each region and cultivation system has particular rice production problems in suitable cultivars, diseases, insects, nematodes, and soil types (CNPAF 1975, EMBRAPA 1981).

System I — wetland flooded rice

Cultivars. Low productivity, susceptibility to lodging, diseases, and insects; poor grain quality.

Diseases. Rice blast, brown spot, narrow brown leaf spot, leaf scald, and seedling blight.

Insects. Rice water weevil, rice stem borer, and rice stink bugs.

Nematodes. White-tip nematodes.

Soils. Deficiencies of nitrogen, phosphorus, potassium, zinc, and sulfur; iron and manganese toxicity; salinity (EMBRAPA/CPAC 1976).

Wetland rice without permanent water level and systems II and III wetland saturated

Cultivars. Lack of cultivars adapted to these conditions.

Soils. Manganese and iron toxicity.

Harvest. Lack of adequate mechanization for these cultivation systems.

Seeds. Lack of good quality seeds.

System IV — dryland rice

Cultivars. Low productivity; susceptibility to lodging, diseases and insects, grain shattering.

Diseases. Rice blast, leaf scald, brown spot, narrow brown leaf spot, glume blight, and basal node rot (Pradhu 1981).

Nematodes. Root-knot nematode and white-tip nematode.

Insects. Lesser corn stalk borer, grass spittle bugs, rice stink bugs, and rice stem borer.

Drought. Extended dry periods during crop growth.

Soils. Deficiencies of nitrogen, phosphorus, potassium, calcium, magnesium, and zinc; aluminum toxicity.

MAJOR WEED PROBLEMS IN WETLAND AND DRYLAND RICE

Wetland rice

The major weed species occurring in wetland rice areas are:

Grasses. Red rice, *Echinochloa crus-galli, Echinochloa crus-pavonis, Echinochloa colona,* and *Paspalum* sp.

Sedges. Cyperus odoratus L., *Cyperus difformis, Fimbristylis littoralis,* and *Cyperus* sp.

Broadleaf weeds. Aeschynomene sensitiva var. *hispidula,* and *Monochoria vaginalis.*

Dryland rice

The most important weed species occurring in dryland rice areas are:

Grasses. Digitaria sanguinalis, Setaria geniculata, Cenchrus echinatus, Eleusine indica, Cynodon dactylon, Brachiaria plantaginea, and *Imperata brasiliensis.*

Sedges. Cyperus rotundus and *Cyperus* sp.

Broadleaf weeds. Sida rhombifolia, Cassia obtusifolia, Cassia occidentalis, and *Bidens pilosa; Amaranthus spinosus, Ipomoea* sp., *Portulaca oleracea, Ageratum conyzoides, Commelina* sp., *Galinsoga parviflora,* and *Solanum paniculatum.*

WEED CONTROL AT CNPAF/EMBRAPA

Wetland rice

With the dependence on labor availability in the rice production regions, weed control during critical weeding periods often is too late to prevent substantial yield losses. Delay in weed control can cause a considerable loss of production. Herbicides are an important weed control measure in wetland rice, where weeds are the primary restraint to high productivity.

Herbicide trials so far show that herbicides bentazone, oxadiazon, butachlor, and propanil + 2,4-D promise effective weed control in wetland rice. They controlled grasses and sedges (Table 1). These trials will be extended to regions where rice is cultivated under controlled and uncontrolled irrigation.

Table 1. Effect of herbicides on grain yield of wetland rice cultivar IAC899 (CNPAF 1980, unpubl. data).

Treatment[a]	Herbicide rate (kg a.i./ha)[b]	Time of application[c]	Grain yield[d] (t/ha)
Bentazone	1.4	15 DE	6.3
Weeded twice	–	15 and 30 DE	5.6
Butachlor	3.5	PE	4.9
Propanil + 2,4-D	3.6 + 0.3	25 DE	4.9
Oxadiazon	1.0	PE	4.7
Oxadiazon	0.75	PE	4.7
Bentazon	1.0	15 DE	4.6
Butachlor	2.4	PE	4.4
Unweeded	–	–	4.4
Pyridate	2.0	15 DE	4.4
Propanil + oxadiazon	0.8 + 0.6	10 DE	4.4
Pyridate	1.4	15 DE	4.4
Pendimethalin	1.75	PE	4.0
Propanil + 2,4-D	4.3 + 0.5	25 DE	3.7
Pendimethalin	1.25	PE	3.7
Propanil	3.6	25 DE	3.3
Propanil + oxadiazon	1.5 + 0.5	10 DE	3.2
Propanil	4.3	25 DE	3.0

[a]A plus sign (+) between 2 herbicide names means they were tank-mixed prior to application. [b]a.i. = active ingredient. [c]DE = days after emergence, PE = preemergence. [d]Data are means of 3 replications.

Table 2. Effect of herbicides on grain yield of dryland rice cultivar IAC47 (CNPAF 1980, unpubl. data).

Treatment[a]	Herbicide rate (kg a.i./ha)[b]	Time of application[c]	Grain yield[d] (t/ha)
Propanil + 2,4-D	4.3 + 0.5	25 DE	2.8
Propanil + 2,4-D	3.6 + 0.3	25 DE	2.5
Weeded twice	–	15 and 30 DE	2.3
Pendimethalin	1.75	PE	2.3
Oxadiazon	1.0	PE	2.3
Butachlor	2.3	PE	2.3
Butachlor	3.5	PE	2.2
Oxadiazon	1.25	PE	2.2
Propanil	4.3	25 DE	2.1
Propanil + oxadiazon	1.8 + 0.6	10 DE	2.0
Propanil	3.6	25 DE	1.9
Pendimethalin	1.25	PE	1.9
Propanil + oxadiazon	1.5 + 0.5	10 DE	1.8
Unweeded	–	–	1.7

[a]A plus sign (+) between 2 herbicide names means they were tank-mixed prior to application. [b]a.i. = active ingredient. [c]DE = days after emergence, PE = preemergence. [d]Data are means of 3 replications.

Dryland rice

In the first year an area is planted to rice, weed populations are low and weed control does not constitute a problem. Beginning the second year of rice cultivation, weeds can reduce yields by 50% in years with good rainfall distribution and by 70% during extended dry periods. This is one reason farmers shift to crops such as soybean or pasture, which offer less production risk and safer profits.

Weed control should be done manually where labor is available.

The first weeding should be done during the first 20-25 days of the rice crop and the second at 40 to 45 days.

In areas of dryland rice cultivation where there is labor shortage, chemical weed control is recommended.

Herbicides pendimethalin, 2,4-D + propanil, and oxadiazon effectively controlled the predominant weed species in the area (Table 2). Dryland rice herbicide trials also will be extended to other rice production regions.

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DISCUSSION

EASTIN: You listed red rice as a major weed in wetland rice but did not list it in dryland rice. Is it a problem in dryland rice?

SILVEIRA: No. This is a serious problem only in wetland rice in southern Brazil.

BAKER: What is the reason red rice is not a problem in dryland rice?

SILVEIRA: I think because rice has not been cultivated for a long time in the same area.

MUKHOPADHYAY: It is a shifting cultivation area.

MOODY: You mentioned that in the first year in your dryland rice area you had very few weed problems, but in the second and subsequent years an increase in weed problems was observed. What was the composition of the weed flora during those periods? Are you getting an increase in grasses with time?

SILVEIRA: Most are broadleaf weeds.

MOODY: So you have a very low broadleaf population in the first year that increases with time.

SILVEIRA: Yes.

ISLAM: How much yield do you get under dryland conditions with a moderate level of weed control?

SILVEIRA: The yield is very low — 1.3 t/ha.

YEH: You said that in wetland rice, bentazone is the best herbicide. Do you have a problem with *Echinochloa?*

SILVEIRA: Yes. Bentazone performed best in the trial conducted in central Brazil, where *Echinochloa* is not a major problem. *Echinochloa* is a major problem in the south.

MUKHOPADHYAY: You mentioned you had *Sida* and *Commelina* in the same field. Normally, in dryland rice you don't get *Sida* and *Commelina* together because *Sida* occurs in the dry areas on the bunds and the roads, whereas some moisture is needed for the growth of *Commelina.* I don't understand how you get these weeds together in the same field.

MOODY: In Nigeria, *Commelina* and *Sida* grow together in the same field in dryland rice. They grow quite well in the same environment.

MUKHOPADHYAY: What was the species —*benghalensis* or *nudiflora?*

MOODY: It was *Commelina benghalensis.* The *Sida* species include *S. acuta* and *S. rhombifolia.*

MATTHEWS: Is *Richardia scabra* ever a problem in rice in Brazil?

SILVEIRA: No.