EVALUATION OF RICE (*Oryza sativa* L.) HYBRIDS AND VARIETIES

Elizabeth Cristo✉, R. Morejón, María C. González, Regla M. Cárdenas and F. Cuevas

ABSTRACT. In "Los Palacios" Rice Research Station, belonging to the National Institute of Agricultural Sciences, some morphoagronomic characters of rice hybrids and varieties which are used in breeding programs for salinity tolerance were studied, with the objective of valuing the degree of existing diversity in the genetic materials. Results revealed a great phenotypic diversity in which all characters contributed to a full variation, the highest correlations being between the final height and panicle length as well as full grains per panicle and yield. There were associations between rice hybrids and their parents; also, the resistance of all rice hybrids and varieties to lodging, threshing and *Pyricularia grisea* was evaluated.

Key words: rice, breeding, phenotypes, varieties

RESUMEN. En la Estación Experimental del Arroz, ubicada en el municipio Los Palacios, perteneciente al Instituto Nacional de Ciencias Agrícolas, se estudiaron algunos caracteres morfoagronómicos de un grupo de híbridos y variedades de arroz, empleados en los programas de mejoramiento genético para la tolerancia a la salinidad, con el objetivo de valorar el grado de diversidad existente. Los resultados revelaron la gran diversidad fenotípica existente en el material, donde todos los caracteres contribuyeron a la variación total, siendo las correlaciones más altas entre la altura final con la longitud de la panícula y los granos llenos por panícula con el rendimiento. Existieron asociaciones de los híbridos con sus progenitores y se evaluó la resistencia al acame, desgrane y *Pyricularia grisea*.

Palabras clave: arroz, mejoramiento genético, fenotipos, variedades

INTRODUCTION

In the world, only seven countries have more than 100 million habitants and in five of them (China, India, Indonesia, Japan and Bangladesh), rice is an essential crop because it provides 70-80 % calories they need (1).

It is considered that in the year 2025, the human population will be 8.3 thousand millions, 50 % of which will consume rice, it indicating that its global production should increase in 70 % to satisfy this demand (2).

In Cuba, rice is the basic food in the people´s daily diet; that is why there are 144 000 ha devoted to this. However, the national production (510 000 t) does not satisfy each person consumption; that forces the country to import 210 000 t annually with high expenditures in foreign currencies (3).

There are some factors that are limiting rice production, which are associated to nutritional and phytotechnical aspects; thus, to obtain rice varieties with better attributes than the existing ones, indispensable conditions are needed, such as a wide genetic diversity and an appropriate breeding strategy to assure yield stability and behavior in front of pest and disease attack (4).

This work studied the behavior of some morphoagronomic hybrid characters from 19 rice varieties, with the objective to evaluate the degree of existing diversity, which variables positively correlate with yield as an element to be considered at the selection process in early generations, as well as the resistance to lodging, threshing and *Pyricularia grisea*.

MATERIALS AND METHODS

In "Los Palacios" Rice Research Station, located at the 22° 20' 50" north latitude and 83° 10' west longitude, the behavior of some morphoagronomic characters of a group of rice hybrids and varieties was studied (Table I).

Sowing was carried out in the dry period (November-May, 1998) under field conditions, on a Hydromorphic Ferruginous Nodular Gley soil (5) in 5-m long rows by drilling without repetitions. Cultural labor followed Rice Technical Pattern (6). Ten plants were selected at random per row to record the following evaluations:

X1 = plant height (A) (cm).
X2 = panicle length (LP)(cm)
X3 = full grains per panicle (G/P)
X4 = weight of 1000 grains (P 1000)
X5 = yield (R) (in a lineal meter)
RA = lodging resistance
RD = threshing resistance
RPG = resistance to *Piricularia grisea*

Elizabeth Cristo and R. Morejón, Junior Research Assistants; Dr. María C. González, Senior Researcher; M.Sc. Regla M. Cárdenas and F. Cuevas, Junior Researchers from "Los Palacios" Rice Research Station, Instituto Nacional de Ciencias Agrícolas, Gaveta Postal 1, San José de las Lajas, Havana, Cuba, CP 32 700.
✉ Corresponding author: e-mail: palacios@inca.edu.cu

Table I. Varieties, hybrids and their origin

N^O	Variety or Hybrid	Origin
1	Amistad-82	Cuba
2	A-82 / IR 20	Cuba
3	A-82 / IR 36	Cuba
4	C$_4$ 153 / A-82	Cuba
5	C$_4$173 / A-82	Cuba
6	C$_4$173	Corea
7	C$_4$ 153	Corea
8	IR 36	Philippines
9	J-104 / IR 20	Cuba
10	J-104	Perú
11	8073/IR-20	Cuba
12	8073	Cuba
13	8317 / IR 20	Cuba
14	8317	Cuba
15	IR 20/ A-82	Cuba
16	IR 20	Philippines
17	IR 20 / 8317	Cuba
18	IR 42 / J-104	Cuba
19	IR 42	Philippines

The mean values obtained per each character examined were statistically processed by means of the Main Components and Cluster Analyses (7), starting from a phenotypic correlation matrix among the analyzed variables.

RESULTS AND DISCUSSION

From now on, according to the Main Components Analysis, inferences of the data can be made using just the first two components, which accounts for 74.8 % the total variation, that is in this case 100 % for the five components (Table II).

Table II. Contribution of the axes to total variation (explained percentage)

	Main components				
	C1	C2	C3	C4	C5
Own value	2.4231	1.3173	0.7834	02701	0.2060
Total contribution %	0.485	0.263	0.157	0.054	0.041
Accumulated	0.485	0.748	0.905	0.959	1.00

When analyzing the association of all characters evaluated (Table III), significant correlations were appreciated, starting from the coefficient of correlation r^2= 0.6226 with a probability of 0.01(8), between the final height and panicle length as well as full grains per panicle and yield (9,10), it coinciding with other authors' results, when they studied a group of regenerated rice somaclones by *in vitro* culture under different saline conditions (11); they evaluated these same characters to a group of lines coming from a crossing. Other authors tested the behavior of these characters in a group of lines coming from higher studies of yield (12).

Table III. Correlations between variables

|	X1	X2	X3	X4	X5
X1	1.000	-	-	-	-
X2	0.779	1.000	-	-	-
X3	0.293	0.294	1.000	-	-
X4	-0.141	-0.058	0.149	1.000	-
X5	0.388	0.351	0.732	0.184	1.000

Looking for the biological sense of the phenomenon in the new components, starting from the initial variables, it was found that yield, full grains per panicle, panicle length and final height, contributed to explain the component one in an inverse way and that 1000-grain weight was the most contributing variable to the second component, also in a reverse manner (Table IV).

Table IV. Contribution of variables to main axes

	Main components	
Varieties	Axe 1	Axe 2
X1	-0.507	0.412
X2	-0.501	0.376
X3	-0.476	-0.391
X4	-0.045	-0.641
X5	-0.513	-0.354

When analyzing individual distribution in the first two components, a wide dispersion is observed (Figures 1); it could be due to a high variability generated in this material or genetic changes or their physiological answer to cultivation conditions (9). Thus, the formation of groups was impossible.

It is also appreciated in Figure 1 that the individuals 18, 19, 6, 4, 5, 3, 2 and 1 present the highest values of yields, plant height, panicle length and full grains per panicle, the remaining individuals being those that present smaller values in these characters. Individuals 1, 9 and 10 that presented another 1000-grain weight appear at the negative part of the axis 2.
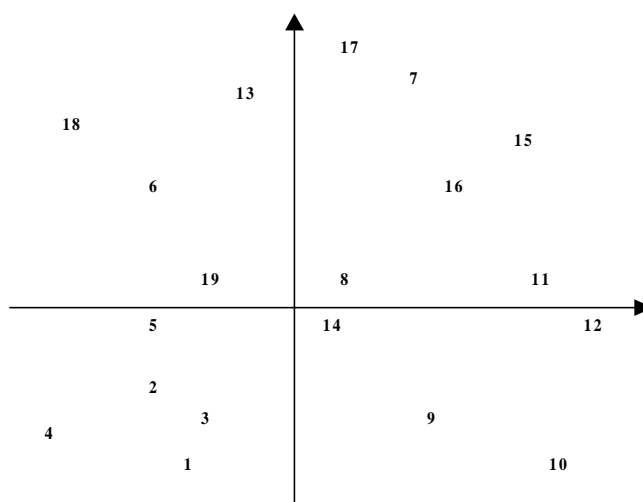
Figure 1. Individual distribution on the axes 1 and 2

To know the proximity between hybrid combinations and their parents, Frechet's distances were looked for, according to the difference of scales among variables, and it was observed that hybrid combinations in some cases were close to the female parent and to the male parent in others (Table V). The variety "Amistad 82" was always near its hybrids, showing its excellent agronomic characteristics; thus its use is recommended for future breeding programs. The best individuals were in groups I and III, since they presented the highest yields and their components.

Table V. Individual distribution in groups according to Euclidian's distance

Groups	Individuals	Yield (t.ha^{-1})
1	1	5.5
2	7, 9, 10, 11, 14	4.5
3	2, 3, 4, 5, 6, 18, 19	5.1
4	8,12,13, 15	2.9
5	16, 17	3.0

Keeping in mind the results, a marked influence of the technique employed was proved on the phenotypes of all varieties and hybrids used.

Resistance to lodging, threshing and Piriculariosis is shown in Table VI.

Table VI. Resistance of rice lines and varieties to lodging, threshing and piriculariosis

No.	Resistance		
	RA	RD	RPg
1	R	R	I
2	R	R	I
3	R	R	R
4	R	R	I
5	R	R	I
6	R	R	I
7	R	R	I
8	R	R	I
9	R	R	S
10	R	R	S
11	I	R	I
12	I	R	R
13	R	R	R
14	I	R	I
15	S	R	I
16	R	R	I
17	R	S	R
18	R	R	R
19	I	R	S

R: Resistance   I: Intermediate S: Susceptible

Referring to lodging, it can be said that most lines and varieties showed good resistance to lodging, except the line 8073/C4 153 and the varieties 8073 and the IR-42; concerning threshing, all varieties and lines but IR-20/8317 showed a better behavior. The table also presents damages for Piriculariosis, a better resistance being evident in the lines A-82/IR-36, IR-20/8317 and IR-42/J-104 and susceptibility in the line J-104/IR-20 and the varieties J-104 and IR-42 (13), to use a new methodology for the selection of rice resistant varieties to Piriculariosis in the "Caribe" farm from "Los Palacios" Rice Agroindustrial Complex.

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