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Alionte G., Mihalache M., Alionte E.

in

Chataigner J. (ed.).
Future of water management for rice in Mediterranean climate areas: Proceedings of the Workshops

Montpellier : CIHEAM
Cahiers Options Méditerranéennes; n. 40

1999
pages 101-108

Results obtained in rice breeding for salinity tolerance in Romania

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Abstract. The present paper is a survey of the main achievements in rice breeding concerning the salinity tolerance suitable for Romania rice salt-soil area.

From a total of 64,000 ha for rice arrangements existing today, about 30,000 ha situated along Danube river are salty soils with different degrees of salinity.

Breeding for rice salinity tolerance is performing at RICTP Fundulea, Rice Laboratory Chirnogi (Calarasi county) and at Central Station of Research for salt-soils Braila, Experimental Center Polizesti (Braila county).

The main purpose of the rice breeding for salinity tolerance is to create new high yielding varieties with salt tolerance. These new varieties must have good characteristics such as: disease and pest resistance, early maturity (110-120 days), short stature and high resistance to lodging and acceptable grain quality.

The most tolerant rice variety obtained and cultivated until 1989 year, have been Polizesti 28 and Braila beeing spread on 70-75% of the total rice cultivated area, but very susceptible to diseases and now very restricted in farming.

Starting with control fields, in three centers of rice culture of the country (Banloc Wst part, Chirnogi S part and Polizesti S-E part of Romania), the most promising breeding lines has been tested and selected in salinity soils condition in the Experimental Center Polizesti-Giurgeni for salinity tolerance.

The results of this study have revealed that a lot of lines and cultivars have a remarkable value for salinity tolerance with an exceptional value for Polizesti 28 cultivar. We may notice exceptionally the cultivars Oltenta, Chirnogi, Cristal,Spranta and also the lines F.31, F.32, F.33, F.34, F.35, M.255, M.350,Partos 15/80, etc.

Key Words. Rice *(Oryza sativa L.)* – Salinity.

Introduction

About the rice tolerance to salinity inclusive the action of different environment factors many researchers from the most important crop rice producers countries has been working on.

There are well known the researches of Kiricenko and Tuliakona (Rusia), Pearson, Ayers, Bernstein (SUA), Narale, Balasutramanian, Walehab (India), Balal (Egypt) etc, performed in natural conditions and very different farming system: They concluded that the salinity is a major difficulty in rice increasing production in all countries. That for, the cultivar remain the only basis factor to obtain high and stable production.

Taking into consideration that in Romania from a total of 64,000 ha potentialy cultivated with rice, the most part situated along the Danube river, 30,000 ha are on salt-soils or included in an improving system, one of the most important objective in rice breeding is that to obtain high yielding cultivars, with tolerance to salinity to evaluate these soils of salt or alcalic nature, and also of some salt waters for irrigation.

In Romania, has started a programme of plant breeding in order to create tolerant cultivars to salinity after the year 1970, programme which has been displayed especially to Polizesti Experimental Center,

because of its soil- salted location, place on which has been obtained the first bigh salt-salinity cultivars such as Polizesti 28 and Braila. In this center and in S.C. Giurgeni, Ialomita county environements, the promising lines obtained from the network of Agricultural and Forestey Science Akademy has been and still there are tested directly in the field determination for an answer to a high pH of the soil, above 8.0.

That for the main purpose in rice breeding for tolerance to salinity, in rommanian cultivation conditions is that to obtain cultivars with high production potential with moderate high tolerance to salinity, resistance to low temperatures in different vegetation periods, to diseases and pests, to loadging and suitability for mechanical harvesting and a very good grain quality.

I – Material and method

The experiences has been conducted at Experimental Center Polizesti in special vegetation table vessels and in experimental cement small lots divided through small cement dams with soil drain in natural position with different textures, artificial salted realised by salt applications in the roots layer (0-40cm deep).

Comparative cultivation with lines and cultivars has been tested on experimental plots (0.5 ha) with different soil as a texture and a salinity content.

The soil used was of two types: loam-potter's earth (LL) and loam-argil (LA).

In the rice beeding laboratory of Chirnogi the lines and cultivars were sown directly in the field, in a normal soil with a Ph of 7.4-7.8.

The interpretation regarding salinity tolerance correlated with different environment factors has been generally made on the duration base of sprouting percentage and seed production, because on that is acting more powerful the negative action of salts.

Experimental material used 25 lines and rice cultivars created in the network ASAS (ICCPT Fundulea, rice breeding laboratory of Chirnogi, SCCCSS Braila, CE Polizesti and Timisoara University- SC Banloc).

Seed sowing has been done in water by spreading and in soil by incorporation of the seed at the depth of 1-3 cm, the quantity of the seed used for both variants beeing 270- 300 kg/ha.

The chek cultivars used has been Polizesti 28.

Fertilization has been made at levels of N_{120}, P_{100}, K_{100} s.a./ha.

II – Results and discussions

In soil-salted cases (CE Polizesti) in optimum and homogenons cultural conditions for all lines and cultivars tested (Polizesti 28, Oltenita, M 250 and M 350), has been revealed first of all differences of the tested material at a medium salinity of soil (0.600% salts) and an estimation at a high level of salinity (0.800 % salts) high production (with aprox 30% at a salinity content of 0.400% soluble salts and with aprox 20% at a salinity content of 0.400 % soluble salts) and concave aspect of the tolerance curves has been obtained at Polizesti 28 and Oltenita cultivars faced with the productions and convex curves obtained at M 250 and M 350 lines (Fig. 1), this thing certifiying a higher tolerance at soluble salts.

The same thing results also from the analyze of the relative agronomic tolerance (50 % production obtained on normal fields), this is realized at the value of 0,600 % soluble salts in M 250 and M 350 lines; as for the cultivars Oltenita and Polizesti 28 at 0,750 % soluble salts.

The researches revealed that usually the lines and cultivars more tolerants as Oltenita, Polizesti 28, etc, are cultivars of intensive type, small stature erect plant, dark green leaves and a very rich root system and also near the soil surface, the active roots beeing placed usually near the soil surface in the first five centimeters, contrary of M 250 and M 350 lines which the root system is also very developed is placed more profoundly, with the active roots are situated in a big quantity more deeply (under the 5 cm level).

Regarding the main physical and chemical capacities of Polizesti and Giurgeni soil given in Table 1, we can observe that this type of soil is of aluvional-alcalized one (typical salted soil type) when the level of phreatic water is situated and 100-120 cm depth and the mineralized degree is betwen 1.0 and 2.2 g per liter, the pH is 8.3- 8.8, the mineral rezidiu more than 120 mg/100 g soil and an aprox. 11.0-12.0% Na from the total.

According to the tests performed in the three centers mentioned above during many years, 22 lines and cultivars which have been tested in field directly have been selected (Table 2.1).

So, after three years of testing 1998-1990 we can conclude: analysing the results only on the Polizesti-Giurgeni soil type, the best cultivar is Oltenita (obtained by induced mutation), cultivar with a constant significative yielding increase by comparison with the cultivar Polizesti 28 and also with the lines F 35 and Partos 215/80.

We must notice that the cultivars Oltenita and Chirnogi and also the lines F 31, F 35, F33, F 34 and Partos 215/80 realize more high production on the type of salted (salin) soil from Polizesti-Giurgeni, much more than on a normal type of soil as of that from CE Chirnogi with a pH value under 8.0 value.

We must underline an another positive aspect: generally the cultivars with a seed of long shape react negatively at the concentration of salts by comparison with the seeds of round shape (experiences has been made in many country rice producers as Rusia, Hungary, Japan, etc.), although Cristal cultivar and the line F 31 beeing grouped in the seed long shape realized in soil condition of CE Polizesti-Giurgeni a production over 7.0 t/ ha.

Conclusions

- ❏ The last and present researches testify that the salted soil from Romania situated along the Danube river can be easily used by rice cultivation.
- ❏ In order to fructify these soils an important factor to obtain high production is the cultivar, in this way the rice breeding from Romania has sufficient material to realise this purpose.
- ❏ The researches revealed a lot of perspective lines and cultivars recently registered as the lines F 31, F 32, F 33, F 43, F 35, and Partos 215/80 and especialy the Oltenita cultivar.
- ❏ From the vegetation period point of view, on these types of soils are suitable especially the lines and cultivars with a period of vegetation between 110 and 120 days.
- ❏ According to the climate conditions from Romania, the indicated sowing method in generally and especially on salin-soils is in water conditions, by broadcasting.

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Table 1. The main physics and chemistrry characteristics of the alluvial soil situated in Polizesti-Giurgini zone (S-E -ist. part of Romania) (Depth of phreatic water -120 c m and mineralization level 2.2 g/l)

Soil depth (cm)	**Apparent density** (g/cm3)	**Total porosity** (%)	**Hydraulic conductivity** (K sat.mm/h)	**Humus** (%)	**P Mobil ppm**	**K Mobil ppm**	**pH**	**Mineral residual** (mg/100 g)	**% Na from total**
0-20	1.44	46.4	0.30	2.47	31	257	8.74	124	11.8
20-40	1.46	45.5	114	2.47	20	173	8.85	149	11.5
40-60	1.44	46.1	120	1.87	13	120	9.10	144	10.3
60-80	1.42	47.0	134	–	–	–	9.30	140	12.3
80-100	–	–	–	–	–	–	9.50	127	18.8
100-120	–	–	–	–	–	–	9.40	129	15.9

Figure 1.

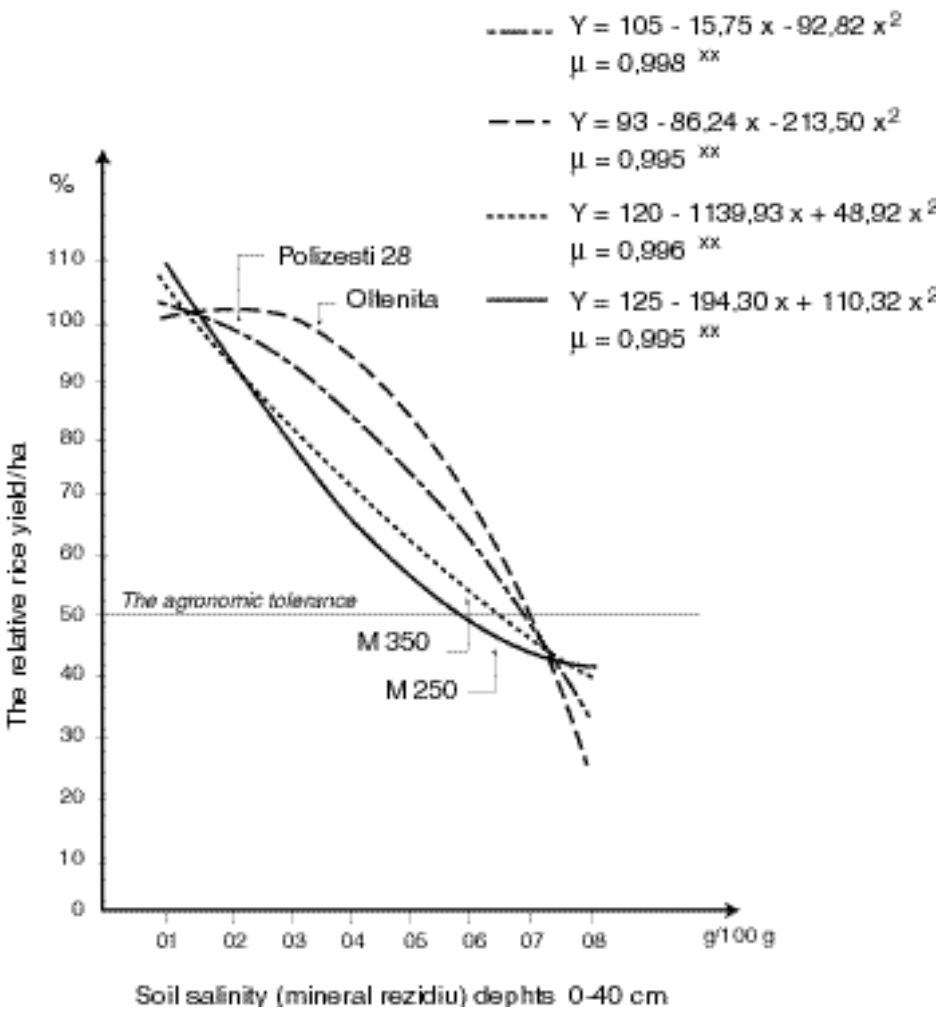
Y = 105 - 15,75 x - 92,82 x2
µ = 0,998 xx
Y = 93 - 86,24 x - 213,50 x2
µ = 0,995 xx
Y = 120 - 1139,93 x + 48,92 x2
µ = 0,996 xx
Y = 125 - 194,30 x + 110,32 x2
µ = 0,995 xx
Polizesti 28
Ollenita
The agronomic tolerance
M 350
M 250
The relative rice yield/ha
%
110
100
90
80
70
60
50
40
30
20
10
0
01
02
03
04
05
06
07
08
g/100 g
Soil salinity (mineral rezidiu) dephts 0-40 cm

Table 2.1. Performance of some promising lines and varieties under different salinity soil condition (1989 -1992)

		Chirnogi Oltenita (pH 7.6-8.0)		Banloc Timisoara (pH 8.2-8.4)		Polizesti Braila (pH 8.0-9.0)		Mean	
	Lines/Varieties	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha	%
1	Oltenita	7890	118.2	7200	101.6	9100	113.8	8060	110.0
2	Chirnogi	7400	110.9	6570	98.5	8120	101.6	7360	100 4
3	Cristal	7160	107.3	6470	97.0	6300	78.8	6640	90.6
4	F31	7000	104.9	7330	103.5	8220	102.8	7510	
5	F32	6300	94.4	7050	99.6	6650	83.2	6670	90.9
6	F33	6100	91.4	4900	69.2	7280	91.1	6090	83.1
7	F34	6400	95.9	6220	87.8	7080	88.6	6560	89.5
8	F35	6860	102.8	7280	102.8	8890	111.2	7670	104.6
9	M250	5990	89.8	7500	105.9	7800	97.6	7090	96.7
10	M350	6590	98.8	7340	103.6	7920	99.1	7280	99.3
11	Partos 215/80	6720	100.7	7550	106.6	8520	106.6	7590	103.5
12	Partos 222/80	6220	93.2	7340	103.6	7920	99.1	6800	92.8
13	Braila 50	6220	93.2	–	–	7380	97.4	6800	92.8
14	Braila 51	5740	86.0	–	–	7530	94.2	6640	90.6
15	F36	6720	100.7	–	0.0	7500	93.8	7180	97.9
16	F37	7230	103.5	7460	105.3	7360	92.1	7350	103.0
17	M351	7140	107.0	7430	104.9	7720	96.6	7430	101.4
18	F38	6100	91.4	5460	77.1	7800	97.6	6450	87.8
19	Spalcik	6740	101.0	6550	92.5	7600	95.1	6960	94.9
20	Baraila	5960	89.3	–	–	7680	96.1	6310	92.9
21	Polizesti	6607	100.0	–	–	7990	100.0	7330	100.0
22	Krasnodar 424	7960	119.3	7080	100.0	7900	99.1	7640	104.3
LD = 5%		742kg/ha		760kglha		810kg/ha		771 kg/ha	

Table 2.2. The main agronomic characters

Nr. crt.	Varieties /lines	Vegetation period (days)	Nr. of plants/sq.m	Plant height (cm)	Filled spikelets (%)	Spikelets nr./panicle	Panicul lenght	Panicul gr.	Lodging (*)	1000 grain wt (gr)
1	Oltenita	116	368	80	92.0	122	16.9	3.3	2-3	29.2
2	Chirnogi	118	424	67	83.4	121	13.9	3.4	1	29.6
3	Cristal	120	334	86	87.7	110	18.4	3.9	1	40.1
4	F.31	121	390	73	81.4	98	18.1	2.8	1	30.4
5	F.32	116	321	82	86.0	136	17.7	4.3	2	34.8
6	F.33	110	473	80	90.4	97	16.6	2.8	2-3	30.0
7	F.34	118	424	81	89.4	145	16.8	4.0	1	30.4
8	F.35	121	372	88	89.6	182	17.4	5.4	2	30.8
9	M.250	124	386	73	82.3	110	17.2	3.4	1	30.6
10	M.350	118	460	92	84.5	131	17.4	3.5	2	29.6
11	Partos 215/80	116	410	85	81.2	125	16.1	3.4	2	31.2
12	Partos 222/80	112	482	78	82.1	86	14.5	3.1	2	34.0
13	Braila 50	115	486	85	81.3	97	14.3	2.7	1	32.0
14	Braila 51	110	510	76	78.9	85	14.9	2.4	1	33.0
15	F.36	120	371	84	84.4	127	16.1	4.0	1	32.4
16	F.37	120	340	82	87.1	147.3	16.6	4.4	1	30.4
17	M.351`	122	302	95	88.7	120	15.4	3.6	1	28.4
18	F.38	120	356	87	83.9	130	15.8	3.5	1	32.0
19	Spalcik	112	352	72	75.8	174	14.2	3.2	5-6	26.0
20	Braila	116	421	80	76.9	89	14.8	2.9	1	34.0
21	Polizesti 28	121	336	82	81.2	106	16.4	3.0	1	30.1
22	Krasnodar 424	122	350	106	85.2	114	20.2	3.8	7	32.0

(*) 1 -very resistent
7-very susceptible

Table 2.3. Results obtained in comparative crops on hard alkalinized soil (Giurgeni 1988-1990)

Nr. crt.	Varieties/lines	Yield kg/ha	Yield %	Differences kg/ha	Differences %
1	Oltenita	4330	118	680	18
2	M.100	4310	118	660	18
3	Braila	3950	109	300	9
4	Cigalon	3790	103	140	3
5	Polizesti 28 (chek)	3650	100	0	0
6	Spalcik	3450	94	-200	-6
7	Lido	3410	93	--240	-7
8	Cristal	3190	87	-460	-13
9	F.19	3130	85	-520	- 15
10	S.Andrea	3000	82	--650	- 18
11	Chirnogi	2950	80	-700	-20
12	F.18	2920	79	-730	-21
13	Ballila	2270	62	-1370	-28
	L.D.	260 kg/ha			

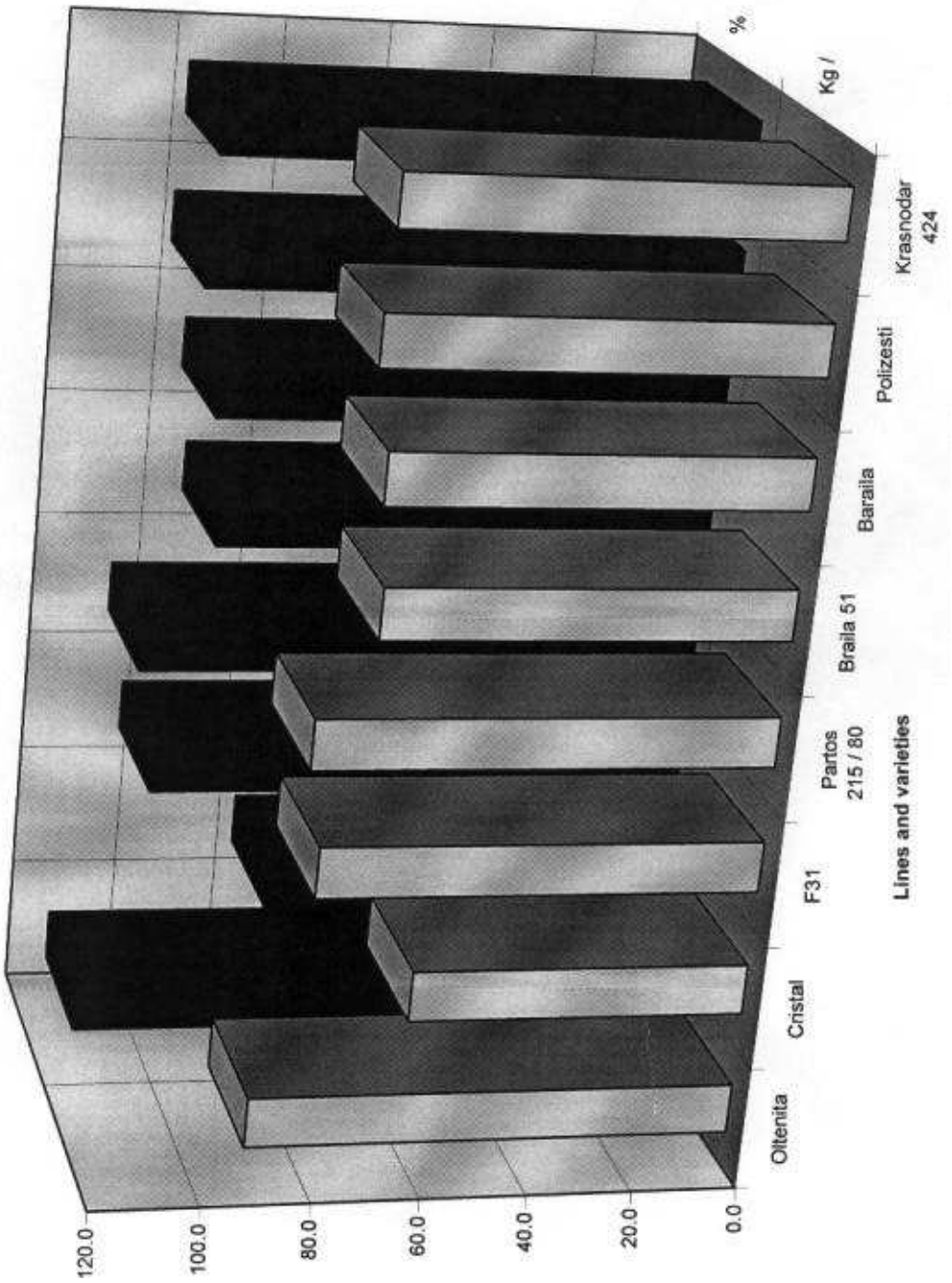

Figure 2. Comparison between lines/varietes and check (Polizesti 28)