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Strategies for rice production and research in Greece

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Introduction

The rice crop is a small crop in Greece but it is very important because its production covers the domestic needs and a surplus usually of Indica type is exported.

The number of rice growers is about 4,500. Rice crop is very competitive relatively to other crops i.e., maize, alfalfa, sugarbeet. Rice production cost represents about 90% of the prices obtained by producers.

I – Rice production strategy

The rice production was increased at an average of 7.6% annually for the period 1981-1998 (Table 1), while the consumption of milled rice increased at an average of 0.8% during the same period (Table 3). The rice market in Greece is highly influenced by E.U. trade policy and its regulations and restrictions. During the last decade, a remarkable increase in production indices has been noticed mainly caused by the Indica type production raise, while Japonica rice production has not altered considerably in the same period. This can be probably enrolled to E.U.'s agricultural policy, in an attempt to increase Indica rice production in order to satisfy the Community demands (Yap, 1997).

The rice area was fluctuating between 14,000 to 30,000 ha annually during the period 1981-1998 (Table 1). This area which is 0.06% of the Greek cultivable area (year 1998) is impossible to be increased more than 30,000 ha for the time being because there is the problem of irrigation water shortage.

The yield had an average annual increase of 2.1% for the period 1981-1998 (Table 1). There is a significant difference in yields among the various regions of rice cultivation due to incomplete information of rice growers of some regions (Table 2).

The rice yields will be increased very soon and can be stabilized at 8.5 t/ha. The expected increase of the yields will be a result of cultivation of new Greek varieties, which will substitute some of the cultivated ones. Also the increase of the yields will be achieved with the adoption of the new techniques in the rice cultivation by some rice growers.

Rice consumption in Greece has not undergone substantial changes, as it remains at the same level for the last ten years (6.3 kg per capita per year, Table 3). However, there is strong evidence that rice quality preferences went through major changes. More precisely, Japonica rice seems to be the most preferable type by Greek consumers; nevertheless, Indica rice consumption represents about thirty five percent of the total domestic consumption. From the Japonica type Greeks rather prefer to consume the long grain than the medium grain (Tsakiridou et al., 1998).

An overview in European rice consumption indicates that Greece is classified among the first countries in rice consumption, deviating significantly from the average E.U. patterns (Mattas and Tsakiridou, 1995). Moreover, rice consumption patterns seem to be oriented to quality direction. Strong consumer prefe-

rences for particular rice types are based primarily on cooking and taste characteristics. Moreover, quality preferences are typically correlated with income levels; higher quality rice commands a higher price and is strongly preferred by upper income consumers.

Greece has become self-sufficient with rice since 1984 with exception the years 1985, 1990 and 1992 at which the balance imports-exports showed a deficit (Table 4). The rice product was more exportable due to the significant improvement of its quality.

The deflated prices of paddy rice were increased on the average by 13% during the three years' period 1988-1990 in comparison to the prices of the year 1981. This period was characterized by dry weather conditions, shortage of irrigation water and decrease of the yields. The same prices were also increased on the average only by 1.5% the six years' period 1982-1987 and 4% the five years' period 1991-1995 in comparison to the prices of the year 1981. Finally, the prices decreased on the average by 27% during the three years' period 1996-1998 in comparison to the prices of the year 1981 (Table 5).

In 1998, the price of the Indica type rice was 12% lower than that of the Japonica type rice. The prices of the last type rice were differentiated proportionally with the rice grain category. So the prices of the medium grain category were 5-6% lower than those of the long grain category. Varieties with short grains are not cultivated in Greece (Table 6).

The regulations of E.U. have influence sharply on the rice market in Greece. The cultivated area must be decreased and standardized at an area of 25,000 ha. Simultaneously, producers' prices have been subjected to a gradual decrease which will be continued until the year 2000 (from 351 EURO/MT in 1997 to 298,35 EURO/MT in 2000). In order to cover the decrease of income EU subsidised 8,500 drach/ha, i.e. 1% of the price per kg in 1997 and 86,000 drach/ha, i.e. 11% of the price per kg in 1998. The Greek policy aim is to be conformed to these regulations in order to protect the crop and the producers' income as well (Hellenic Ministry of Agriculture, 1997).

The production of Indica type rice is more than double of the Greek consumption needs, while there is 5-10% deficit of Japonica type rice. Our objective is a production balance between the above rice types for achieving their sufficiency. Another objective is the stable improvement of rice quality so that it will be more competitive in the European market.

II – Rice research strategy

Breeding is an important activity allowing to solve some practical problems of intensive cultivation in order to meet market preferences and to improve rice growers' income.

1. Breeding for combined grain yield and quality

Breeding for combined grain yield and quality is the main priority for rice improvement. Actual programmes have the objective to improve the genetic material releasing new rice varieties combining satisfactory grain yield and high quality. Our direction is to improve both rice types Japonica and Indica. Especially for the type Japonica it is very important to release new varieties of long grain category for which Greek consumers show greater preference than the small and medium grain categories (Tsakiridou et al., 1998).

Until now artificial crosses were done between Japonica x Japonica and Indica x Indica but heterosis does not surpass 10% and 30%, respectively. It is known that Japonica x Indica crosses can give heterosis until 40%. It is obvious that we must orientate for realization of the last type of crosses for increasing the yield and transferring genes controlling qualitative characteristics but there is the problem of incompatibility and sterility in the following generations. Although the genetic barriers are a serious problem, the hybridization programme must be intensified and investigated because it is the most important step for creating high yielding and good quality genotypes.

A promising alternative approach for obtaining new varieties may be the biotechnology method based on the *in vitro* culture and especially in anther culture. It presents the advantage of succeeding homozygosity in very small time. Moreover, the recessive genes can be expressed at the haploid face and plants with such genes can disrupt at the fist stages.

Honeycomb pedigree selection method of genetic material for yield and quality will be the method in which we can base on selection the segregating genetic material because it is more effective method compared to others.

The cultivar Thaibonnet represents the most important Indica type variety grown in Greece. It covers 58% of the Greek cultivated rice area. It is necessary that new varieties of Indica type will be released and cultivated in order to avoid risks of pathogens' diffusion due to the cropping of a single genotype. Also the cultivation of new varieties is needed in order to reduce the red rice populations which resulted from the low competitiveness of this cultivar.

Rice milling industry plays a significant role to form the marketing because they direct the consumers for some types of product. Parboiling process will be increasing year to year because the millers have more profit obtaining higher milling yield by decreasing the grain breakage during the milling process and exploiting the rice bran converting it to a rice product. The parboiling process is usually applied in Indica type rice although it is continuously increased in Japonica type rice. The success of parboiling process requires also improvement of other market quality characteristics such as high milling yield, vitreosity, slenderness, homogeneity and healthiness of the grain. Breeding for rice quality imposes the close collaboration with the rice millers.

The export market requirements lead to new trends in our breeding programme so that strategies in rice quality are succesful. These are:

❏ Husks and pericarp colour normal;
❏ Greater grain size, shape, and uniformity;
❏ Higher grain vitreosity;
❏ Absence of chalkiness;
❏ Higher milling yield;
❏ Lower grain breakage;
❏ Uniformity of milled rice;
❏ Medium amylose content (24-25%) for the Indica type rice.

Aromatic rice is increasingly requested at present in Greece and other European countries. Attempts for growing foreign genetic material of aromatic rice have been made in Greece but this has shown poor adaptability to the local climatic conditions. The most serious problem in breeding of aromatic rice is the loss of aroma intensity in crosses between scented and local varieties. More research efforts must be done in order to get more satisfactory results.

2. Breeding for diseases and insects resistance

A. Diseases

The disease *Pyricularia oryzae* which affects the yield and quality significantly, is at present the main disease but it rarely causes damage to the crop depending on climatic conditions. Moreover, the cultivation of foreign varieties sensitive to this disease obligated us to develop a breeding programme for its control. Generally speaking, incorporating genetic factors contributing reasonable degree of horizontal resistance is a common aspect in breeding new varieties. Neckblast causes the most serious yield losses. Breeding lines should be screened at both the seedling and neck stages since resistance at the two stages may differ substantially.

B. Insects

The stem borer *Sesamia nonagrioides* is the most serious insect in Greece. This attacks the rice plants and causes damages more than 10% to the late maturity cultivars. The releasing of rice varieties resistant to this insect is necessary in order to avoid the insecticides application and to succeed in the yield stabilization.

3. Breeding for salinity tolerance

About 90% of the cultivated rice area is characterized by high salinity pathogenic soils. So there is great necessity for leaching of the soil salts especially at the first stages of the rice plants and also for application of acid fertilizers. Breeding for salinity tolerance is one of our priorities.

4. Water management

The shortage of irrigation water is the most restrictive factor for the expansion of the rice crop. Using the laser technique for land levelling we have succeeded great economy of irrigation water and have not only maintained the cultivated rice areas but have even increased them, too. There is a permanent system of irrigation and drainage in about 75% of the cultivated area. The method of rice irrigation is the flooding. The program of water distribution is: irrigation for four days and its intermission for four-five days.

The study of new irrigation methods is necessary in order to have economy in water. Also it is very interesting to improve the water use efficiency in rice production system by using appropriate water control and crop management techniques with emphasis on irrigation technologies combined with genetic improvement.

5. Fertilization

The study of the nutritional requirements (N, P, K and Zn) of the rice plants for the new modern varieties which exhaust soil fertility more rapidly than the older varieties, is one of our priority. Also, it is necessary to examine ways to reduce nitrogen losses, evaluate nitrogen response of new cultivars and study new fertilizer compounds and growth regulators and slow release fertilizers.

6. Rotation

An ideal system of rotation is very difficult to be applied because of the very high salinity. Moreover, there is a significant area (80%) where rotation of 3 years with rice and one year (corn, sugarbeet and cotton) is applied. It is necessary to study the effect of rice rotation and organic fertilization (crop residuals) on yield in order to reduce chemical inputs.

7. Weed control

The most serious weeds of the rice crop which effect the yield and the quality are barnyardgrass (*Echinochloa crus galli*) and red rice (*Oryza sativa*). The control of the first weed is achieved using the herbicides molinate, propanil, quinclorac and pretilachlor. The control of this weed is very difficult the last years because it developed resistant biotypes caused by the application of the first two herbicides for 35 years. Also the small competitiveness of the newer rice varieties to the above weed effects its control. The red rice is controlled in part using certified seed, mechanical means of working the ground, as ploughing and harrowing and also rotation. The expenses for controlling both weeds participate in the total production cost is about 10%. The study of competition of each rice cultivar with both weeds will have as a result more economy and effective control of the weeds with herbicides. Also the evaluation of new herbicides for controlling barnyardgrass and herbicides for red rice control are necessary. The effective control of both weeds can increase the yield about 10%.

Table 1. Rice area, production and yield with respective indexes, 1981-1998

	Area				Production		Yield	
	Japonica + Indica		Indica		Japonica + Indica		Japonica + Indica	
Year	1000 ha	Index	1000 ha	Index	1000 t	Index	kg/ha	Index
1981	15.9	100	2.0	100	87	100	5 450	100
1982	15.5	98	1.0	50	83	96	5 370	99
1983	13.9	87	0.3	15	82	95	5 900	108
1984	14.0	88	0.9	45	90	103	6 430	118
1985	16.4	103	1.3	65	106	122	6 470	119
1986	17.6	111	1.6	80	119	137	6 790	125
1987	19.0	120	1.9	95	130	149	6 830	125
1988	20.6	130	4.0	200	114	131	6 530	102
1989	16.2	102	3.1	155	100	115	6 180	113
1990	16.0	101	2.3	115	96	110	6 000	110
1991	14.7	92	3.9	195	89	102	6 060	111
1992	14.5	91	4.9	245	110	126	7 540	138
1993	19.2	121	7.2	360	142	163	7 380	135
1994	22.8	143	11.3	565	174	200	7 640	140
1995	25.5	160	17.5	875	207	238	8 110	149
1996	30.0	189	18.2	910	223	256	7 430	136
1997	30.3	191	18.3	915	222	255	7 330	134
1998	27.2	171	16.2	810	205	236	7 530	138

Source: Hellenic Ministry of Agriculture

Table 2. Rice area, yield and main cultivars in Greek regions, 1998

Region	Rice area 1000 ha	Percentage of total cultivated area %	Yield t/ha	Cultivars
Thessaloniki	14.50	53.2	8.40	Thaibonnet, Dion, Makedonia, Ariete, Olympiada
Serres	4.54	16.7	4.50	Axios, Makedonia, Roma, Europi
Imathia	3.30	12.1	9.82	Thaibonnet, Turbo
Fthiotida	1.35	5.0	7.00	Dion, Strymonas
Etoloakarnania	1.00	3.7	4.50	Thaibonnet, Strymonas
Kabala	0.74	2.7	5.82	Thaibonnet, Ariete
Pieria	0.73	2.7	7.40	Thaibonnet
Rest	1.08	3.9	6.00	Dion, Roxani
Total	27.24	100.0	Mean: 7.53	

Source: Hellenic Ministry of Agriculture, N.AG.RE.F. – Cereal Institute

Table 3. Total and capita rice consumption, 1981-1998

Year	Total Consumption milled rice 1000 t	Index	Per capita Consumption kg	Index
1981	54.96	100	5.33	100
1982	56.69	103	5.50	103
1983	55.64	101	5.40	101
1984	53.25	97	5.17	97
1985	65.84	120	6.39	120
1986	60.57	111	5.88	110
1987	64.40	117	6.25	117
1988	63.42	115	6.16	116
1989	48.34	88	4.69	88
1990	61.79	112	6.00	113
1991	47.43	86	4.65	87
1992	69.58	127	6.76	127
1993	73.12	133	7.10	133
1994	69.17	126	6.72	126
1995	70.62	128	6.72	126
1996	70.97	129	6.75	127
1997	70.25	128	6.69	126
1998	70.61	128	6.73	126

Source: N.AG.RE.F. - Cereal Institute

Table 4. Rice import and export

Year	Imports 1000 t*	Value million USA $	Exports 1000 t	Value million USA $
1981	2.5	1.96	5.0	1.37
1982	8.3	5.15	4.4	1.01
1983	7.8	5.35	4.4	0.83
1984	9.5	6.30	17.4	8.13
1985	7.4	5.58	12.5	3.92
1986	5.7	5.78	31.9	12.00
1987	5.2	5.74	36.2	15.38
1988	6.1	7.95	22.7	12.58
1989	4.5	7.05	29.9	14.20
1990	4.7	8.73	5.6	1.81
1991	6.3	8.93	22.3	9.35
1992	7.4	10.39	9.9	4.29
1993	7.0	9.16	36.4	23.03
1994	6.5	8.32	50.7	33.77
1995	5.7	6.98	90.6	45.81
1996	9.8	10.29	54.3	27.68
1997	6.6	7.73	66.6	28.64
1998	5.8	6.68	60.1	26.20

*(Rice=Paddy X 65%, brown, milled, broken, flour)
Source: EUROSTAT

Table 5. Price evolution for rice production

Year	Average prices of paddy rice Drachmas/kg	Deflated prices of paddy rice Drachmas/kg
1981	15.94	15.94
1982	19.44	16.76
1983	23.68	16.68
1984	28.44	16.73
1985	32.16	16.16
1986	36.66	15.53
1987	40.32	15.27
1988	50.10	17.16
1989	64.21	19.58
1990	67.86	17.44
1991	73.78	15.97
1992	87.63	16.76
1993	98.35	16.73
1994	109.50	16.95
1995	116.00	16.74
1996	108.00	14.49
1997	83.00	10.46
1998	84.00	10.16

Source: N.AG.RE.F. – Cereal Institute

Table 6. Yearly cultivation at different grain type varieties in Greece (% over total rice cultivated area)

Year	Short grain (%)	Medium grain (%)	Long grain A (%)	Long grain B (%)
1981	18.9	15.0	52.7	13.4
1982	13.9	22.7	61.2	2.2
1983	4.7	22.4	71.1	1.8
1984	1.8	25.2	66.7	6.3
1985	0.6	35.4	56.3	7.7
1986	1.0	28.1	62.0	8.9
1987	0.6	22.1	67.4	9.9
1988	-	21.4	62.0	16.6
1989	-	13.5	67.4	19.1
1990	-	22.4	63.2	14.4
1991	-	10.0	63.2	26.8
1992	-	14.7	51.5	33.8
1993	-	13.5	49.0	37.5
1994	-	7.2	43.4	49.4
1995	-	5.4	26.2	68.4
1996	-	9.2	30.1	60.7
1997	-	6.3	33.2	60.5
1998	-	6.4	33.9	59.7

Source: Hellenic Ministry of Agriculture

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