

CULTIVAR RELEASE

IAC 203 and IAC 204: new upland rice varieties for the State of São Paulo

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Abstract – *The release of good yielding cultivars, which present low height, short cycle and responsiveness to new technologies, supports modern agriculture. The cultivars IAC 203 and IAC 204 are new options for upland rice cultivation for the State of São Paulo.*

Key words: *Oryza sativa, rice breeding, cultivar development.*

INTRODUCTION

Rice (*Oryza sativa*), together with common bean, is a very important cereal crop in Brazil due to our daily consumption habit, representing the nutrition basis of the Brazilian population. Although it is traditionally cultivated in flooded region, rice can be grown in upland areas, and this possibility represents an opportunity to get away from the usual cultivation system. Rice cultivation in uplands, with or without supplemental irrigation, allows farmers to produce good quality rice far from the traditional productive region. The Instituto Agronomico de Campinas (IAC) has concerned about rice production since 1937, and the first successful hybridization in Brazil was done in February, 1938 (Germek and Banzatto 1972). Since then, a large number of important cultivars has been released by the Rice Breeding Program. IAC 201 and IAC 202 upland rice varieties are currently maintained and commercialized by IAC, and were registered in 1992 and 1998, respectively. Moreover, IAC 201 presents the best upland rice characteristics in grain quality for cooking.

Breeding work in upland rice has never been interrupted and a great number of crosses has been done through selection since then, resulting in the development of two interesting and potentially productive upland rice cultivars.

GENETIC ORIGIN AND DEVELOPMENT

The new cultivars originated by crossing the commer-

cial varieties IAC 201 and IAC 202, which present good yielding, and the low height plants of the cultivar Carajas, which had been selected in the environmental conditions of Jaciara, MT, by Empaer-MT. The crosses were performed during the rainy season of 1998 at IAC, in Campinas, SP, being designated as H98203 and H98210, respectively. F₁ generations of the crosses were sowed in 2000. Preliminary evaluations with mild selection for desirable agronomic traits were performed using the Pedigree Method, in order to manage the segregating generations, and genealogy, for improving selection efficiency. The procedure identified the most promising lines, as the superior F₆ lines H98203-26-1-1 and H98210-20-1-1, named IAC 2005 and IAC 2009, respectively. In 2006 these lines were included in trials of Value for Cultivation and Use (VCU), and further evaluations were carried out. According to their agricultural behavior, yield potential, disease resistance and stability, IAC 2005 and IAC 2009 lines were selected and their corresponding cultivar names were designated as IAC 203 and IAC 204, respectively.

PERFORMANCE TRIALS

Field evaluations took place in Mococa-SP (21°28' S; 47°01' W, 665m asl) and Capao Bonito-SP (lat 23° 50' S, long 48° 36' W, alt 702 m asl), during the growing season of the years of 2006/07, 2007/08, 2008/09 and 2009/10. Sowing date was determined by availability of water, and was carried out between the beginning of November and the

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end of December. At both locations, the presence of weeds and necessary chemical control were more significant than the development of diseases, or more specifically, blast infection. Herbicide was applied using the formulation available at the market when necessary. Sowing and top dressing fertilization were provided based on soil analysis (Cantarella et al. 1997). Supplementary irrigation were used in Mococa-SP, when the rainfall regime failed to supply enough water, and varied within years.

Plots were harvested, and yield and other traits related to agronomic performance and milling properties were assessed. Table 1 presents characteristics taken from the VCU (Value of Cultivation and Use) tests.

Grain quality was analyzed at IAC laboratories; amylose content was determined for the new cultivars, and concentrations of 24.2 and 22.0% for IAC 203 and IAC 204,

respectively, were found. Both cultivars presented intermediate gelatinization temperature, and IAC 203 showed better cooking quality, compared to the control IAC 202. Size and shape analyses determined long and thin conformation of the milled grains, which characterizes the most demanded class of rice in Brazil.

Industrial processing presented milling yield superior to 72%, with more than 56% of whole grains for both new varieties. Grain humidity at harvest is an important issue for milling yield in rice production, and it must be within the range of 20-23% to assure good results for these new cultivars.

IAC 203 and IAC 204 plants presented very good resistance to lodging, due mainly to their reduced height. The release of these varieties was intended to provide an alternative that presents good yield potential for those farm-

Table 1. Characteristics of IAC 203 and IAC 204 cultivars in the VCU trials at two locations during the years of 2006/07, 2007/08, 2008/09 and 2009/10

Characteristics	IAC 203	IAC 204
Angle of the flag leaf	erect	erect
Leaf color	green	green
Pubescence	glabrous	glabrous
Tillering	intermediate	intermediate
Flowering 50%	69 days	72 days
Complete Maturity	112 days	120 days
Plant height	96 cm	85 cm
Lodging	resistant	resistant
Leaf Blast	moderately susceptible	moderately susceptible
Neck blast	moderately susceptible	moderately susceptible
Brown spot	moderately resistant	moderately resistant
Gray spot	moderately resistant	moderately resistant
Leaf scald	moderately resistant	moderately resistant
Glume color	straw/yellow colored	straw/yellow colored
Apex color at maturity	yellow	yellow
Presence of beard	absent	absent
Grain drop	Intermediate	Intermediate
Mean panicle length	21.5 cm	22.5 cm
Length of milled grain	7.54 mm	7.78 mm
Width of milled grain	2.03 mm	2.02 mm
Thickness of milled grain	1.78 mm	1.80 mm
Length/width ratio	3.71	3.85
Weight of 1000 unmilled grains	25.4 g	27.3 g
Class	long-fine	long-fine
Whole grains (%)	58.75	56.04
Broken grains (%)	13.91	17.29
Milling yield (%)	72.66	73.33

ers who delayed too much the sowing date. At late sowing, cultivars tend to have earlier cycle, and they are suit to the shorter period of time for late rice crop.

Yield was investigated in all trials, and potential for good grain production was shown by the selected lines when compared to the controls, included in the trials for reference. Table 2 shows the average yield by location and year.

IAC 203 and IAC 204 yield performance were consistently high and superior to the check means, excepted for IAC 203 in Capao Bonito, during 2008/09 and 2009/10, when check means were superior to treatment means. Experiments were conducted with accuracy; estimated coefficients of variation ranged from 11.4 to 25.4% in individual ANOVAs, and joint analysis was 18.7% (Table 2).

Based on the overall results, IAC 203 and IAC 204 cultivars, which produced 4381 and 4689 t ha⁻¹ of grain yield (Table 2), respectively, demonstrated very good performance in regard to blast, rice's main disease, especially for upland rice. Nurseries for disease evaluations have been carried out over the years in Pindamonhangaba, SP, in the traditional flooded rice planting region of Vale do Paraiba, with high disease pressure, and released varieties presented blast resistance in all trials, while other leaf infections were not important.

The VCU trials comprised 13 upland rice lines and three registered cultivars used as checks. For all experiments and joint analysis, genotype means were analyzed using Tukey test and no statistically significant differences among pairwise comparisons were detected at 5% of probability (Table 2).

Adaptability and stability of these genotypes were evaluated in VCU experiments by the methods of Eberhart and Russell (1966), Lin and Binns (1988) and Mixed Models (REML/BLUP) (*Restricted Maximum Likelihood/Best Linear Unbiased Prediction*) methodologies (Resende 2004). By the method of harmonic mean of the relative performance of genotypic values (MHPRVG) IAC 203 and IAC 204 were selected presenting yield superiority of 6% and 11%, respectively, compared to the overall experiments mean, which was consistent with the results obtained by the other methods (Regitano Neto et al. 2013).

During 2010-11 sowing season, in field conditions, and with central pivot irrigation, IAC 203 and IAC 204 presented, in demonstrative plots, 8761 and 8380 kg ha⁻¹, respectively, in Paranapanema-SP. Under these conditions and with high input of nitrogen fertilization, plant height was 80 and 60 cm, respectively, and was controlled by growth regulators. In the same conditions, check cultivars, IAC 201 and IAC 202, yielded 7746 and 7238 kg ha⁻¹, with 95 and 90 cm of plant height, in this order.

The good performance of the new upland rice cultivars, IAC 203 and IAC 204, and their responsiveness to new and more demanding technologies demonstrate their utility and modernity. IAC 203 and IAC 204 cultivars are registered in Brazil at the RNC (National Registry of Cultivars - *Registro Nacional de Cultivares*) of MAPA (Ministry of Agriculture, Livestock and Supply - *Ministério da Agricultura, Pecuária e Abastecimento*) under the numbers 28366 and 28367, respectively, since January of 2012, and IAC is responsible for seed production of the released cultivars.

Table 2. Mean yield^a (kg ha⁻¹), coefficient of experimental variation (CV%) in VCU field trials of upland rice in Mococa-SP (LI) and Capao Bonito-SP (LII) in four years

	2006/07		2007/08		2008/09		2009/10		Means		
	LI	LII	LI	LII	LI	LII	LI	LII	LI	LII	M
IAC 203	4358 a	6408 a	6033 a	4581 a	3807 a	3098 a	3445 a	3313 a	4411 a	4350 a	4381 a
IAC 204	4871 a	5286 a	6350 a	4244 a	4133 a	3661 a	4232 a	4738 a	4896 a	4482 a	4689 a
IAC 201	3613 a	4231 a	4963 a	2990 a	3058 a	3428 a	3045 a	3761 a	3670 a	3602 a	3636 a
IAC 202	4296 a	2900 a	6356 a	4167 a	3598 a	3305 a	3995 a	4336 a	4561 a	3677 a	4119 a
Curinga	3092 a	3053 a	5398 a	5098 a	3020 a	4016 a	3233 a	4053 a	3436 a	3805 a	3621 a
Treatments (\bar{x})	4499	4658	5890	3539	3579	3305	3342	3588	4050		
Check Means	3667	3394	5572	4085	3226	3583	3424	4050	3875		
CV (%)	15.97	23.55	11.38	20.04	16.34	25.38	18.87	19.56	18.69		
Means	4343	4421	5830	3641	3512	3357	3295	3612	3992		

^a Means in the same column followed by the same letter do not differ by the Tukey test, at 5% probability.

IAC 203 e IAC 204: novas variedades de arroz de terras altas para o estado de São Paulo

Resumo – *O lançamento de cultivares com bom potencial produtivo, com plantas baixas, de ciclo curto e responsivas a novas tecnologias, dá suporte ao estabelecimento da agricultura moderna. As cultivares IAC 203 e IAC 204 são uma nova opção para plantio de arroz de terras altas no estado de São Paulo.*

Palavras-chave: *Oryza sativa, arroz de sequeiro, melhoramento genético, desenvolvimento de cultivares*

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