Crop Breeding and Applied Biotechnology 8: 170-173, 2008
Brazilian Society of Plant Breeding. Printed in Brazil

IAC-Boreal and IAC-Harmonia: common bean cultivars with striped grains

Alisson Fernando Chiorato[1*], Sérgio Augusto Morais Carbonell[1], Margarida Fumiko Ito[1], Luciana Lasry Benchimol[1], Carlos Augusto Colombo[1], Eliane Francischinelli Perina[1], Marcio Akira Ito[2], Edson Ulisses Ramos Junior[2], Rogério Soares de Freitas[3], and José Carlos Villa Nova Alves Pereira[4]

Received 01 February 2008

Accepted 01 April 2008

ABSTRACT - *Common bean types with special grains are considered an alternative for certain domestic and export markets. IAC-Boreal and IAC-Harmonia were developed by the Instituto Agronômico Campinas and offer an excellent type of commercial grains, upright plant growth, earliness and high yield to supply these markets.*

Key words: *Phaseolus vulgaris* L., common bean, yield, genetic breeding.

INTRODUCTION

Special common bean types, among them the striped, are native to the Andes and represent around 15 commercial groups. These grains are different from the generally consumed (carioca and black) by the Brazilian population. They differ in colors and grain size and are known as Jalo, Bolinha, Striped, Pintado, Branco; the types with small and medium-sized seeds are Rosinha, Vermelho and Mulatinho.

The cultivation of special beans is on the rise as an alternative product of greater added value on the internal market. In the long term, it would even be possible to think of exportation, since the product sold on the international market are large-grain bean types.

In Brazil, most cultivated bean types are of the variety carioca; nearly the full output is sold on the internal market. The other varieties grown in the country are Black bean (approximately 15%), Cowpea (approximately 12%), striped bean, Jalo Vermelho, Canário, etc (approximately 3%).

At the international level, an average 27 million hectares are planted annually and approximately 20 million tons of common bean are harvested, in over 100 countries. Of this total, 60% of the world production is concentrated in six countries: Brazil, India, China, Myanmar, Mexico, and the United States.

The genetic breeding in Brazil for these special beans (Jalo, Bolinha, Jabola, Vermelho, Striped, Brancos, Pintados and Canários) is still considered sparse and inchoate when compared to the carioca

[1] Instituto Agronômico – IAC, Centro de Análises e Pesquisa Tecnológica do Agronegócio dos Grãos e Fibras, C.P. 28, 13.001-970, Campinas, SP, Brasil. *E-mail: afchiorato@iac.sp.gov.br
[2] Pólo Regional de Desenvolvimento Tecnológico do Agronegócio - APTA Sudoeste Paulista, Rodovia Sebastião Ferraz de Camargo Penteado - SP 250, Km 232, C.P. 62, 18.300-970, Capão Bonito, SP, Brasil
[3] Pólo Regional de Desenvolvimento Tecnológico do Agronegócio - APTA Noroeste Paulista, Rodovia Péricles Belini, km 121 (sentido Nhandeara), C.P. 61, 15.500-970, Votuporanga, SP, Brasil
[4] Pólo Regional de Desenvolvimento Tecnológico do Agronegócio - APTA Centro Leste, Av. Bandeirantes, 2419, C.P. 271,14.001-970, Ribeirão Preto, SP, Brasil

and black types, mainly in the state of São Paulo. The cultivars IAC-Boreal and IAC-Harmonia were developed by the Instituto Agronômico de Campinas (IAC), SP, Brazil, to supply farmers and companies in search of a product advantage over carioca and black bean and in some cases the export market. The grain quality of IAC-Boreal and IAC-Harmonia is excellent, the yielding potential high, the growth type upright and early, and the cycle from emergence to harvest lasts approximately 80 days.

GENETIC ORIGIN AND DEVELOPMENT

Cultivar **IAC-Boreal** was originated by a cross performed at the IAC, in Campinas, state of São Paulo, in 1999, between the cultivars (Cal 153 . IAC-Carioca Aruã) x Cal 153. This cross was designated Gen 99TGR60 and plant selections until the harvest of the rainy season of 2001 identified the promising line Gen 99TGR60-9, with red-striped grain.

Cultivar **IAC-Harmonia** was originated by the cross IAC Carioca Aruã x Iraí, performed at the IAC, in 1999. This cross was denominated Gen 99TG50 and plant selections until the harvest of the rainy season of 2001 identified line Gen 99TG50-47, with red-striped and flecked grains.

In the rainy season of 2005 these lines were included in the VCU trials of 2005/2006/2007 of special grains of the state of São Paulo. Due to the plant traits, grain size and grain color, disease resistance, yield and stability of production the line Gen 99TGR60-9 was named **IAC-Boreal**, and line Gen99TG50-47 was designated **IAC-Harmonia.** The genetic seed production was initiated in 2007.

GRAIN YIELD POTENTIAL

The yield potential of **IAC-Boreal** and **IAC-Harmonia** in 24 VCU trials with 15 genotypes was 3,518 and 3,828 kg ha^{-1}. In these trials the mean yield of IAC-Boreal was 1,971, 1,999 and 2,405 kg ha^{-1} in the rainy, dry and winter seasons, respectively. The mean yield of IAC-Harmonia in the three growing seasons was 2,474, 2,077 and 2,424 kg ha^{-1}, respectively, and. 2,160, 2,028 and 2,211 kg ha^{-1}, respectively, for the standard cultivar Jalo Precoce (Table 1).

The MSD (minimum significant difference – 5%) in the mean yield of these cultivars was significant for the different growing seasons and in the joint analysis.

OTHER TRAITS

IAC-Boreal: upright growth (type I), anthracnose resistance, 1.000 seed weight of 505 grams. The cycle from emergence to physiological maturation lasts 80 days, the guides are medium, the flowers uniform and white and the pods yellow /straw-colored.

IAC-Harmonia: upright growth (type I), moderate anthracnose resistance, 1.000 seed weight of 415 grams. The cycle from emergence to physiological maturation lasts 75 days, the guides are medium, the flowers uniform and pink, and the pods are yellow/straw-colored with some red streaks.

The mean cooking time (minutes) of IAC-Harmonia was slightly longer (31.90) than of Jalo Precoce (29.32). The cooking time of IAC-Boreal was shorter (27.79), but both exhibited whole grains and excellent broth quality in the end of the cooking period. The grain protein content varied according to the environment and was in the mean 21.01 and 22.0% for IAC-Harmonia and IAC-Boreal, respectively (Table 2).

Table 1. Yield (kg ha^{-1}), coefficient of experimental variation (CV%) and minimum significant difference (Dunett-5%) compared to the control mean (C), per growing season and all seasons together, in the common bean VCU trials for the state of São Paulo 2005-2007

Common bean cultivars	Growing season			Mean 2005/2006/2007 (kg ha^{-1})
	Rainy (9 environments)	Dry (8 environments)	Winter (7 environments)	
	kg ha^{-1}			
Jalo Precoce (C)	2160	2028	2211	2131
IAC-Boreal	1971	1999	2405	2107
IAC-Harmonia	2474	2077	2424	2327
Mean[1] (kg ha^{-1})	2268	2142	2372	2256
C.V. (%)	16.69	16.55	16.62	16.64
MSD (kg ha^{-1})	290	288	343	175

[1]Experimental means of 15 cultivars and lines, with a coefficient of variation below 25%
*Dunnett test (5%) compared to the standard cultivar (Jalo Precoce)

Table 2. Technical/nutritional quality: mean cooking time in minutes in a Mattson cooker and protein content (%) in common bean grains in VCU trials in the state of São Paulo, in 2005/2006/2007

Season	Location	IAC-Boreal		IAC-Harmonia		Jalo Precoce	
		Cooking time (min)	Protein content (%)	Cooking time (min)	Protein content (%)	Cooking time (min)	Protein content (%)
Rainy/2005	Mococa	25.37	16.96	29.67	19.01	29.07	18.35
Rainy/2005	Capão Bonito	29.04	15.56	40.52	19.35	35.76	24.06
Rainy/2005	Monte Alegre do Sul	20.89	18.23	28.71	21.27	23.92	23.67
Dry/2006	Mococa	26.35	24.06	29.09	16.06	32.43	24.18
Dry/2006	Avaré	24.87	25.43	25.05	19.85	20.27	22.36
Dry/2006	Capão Bonito	34.03	27.36	22.94	26.76	25.26	26.80
Winter/2006	Colina	35.34	20.43	31.87	18.14	24.97	19.46
Winter/2006	Ribeirão Preto	23.61	25.83	18.85	26.70	31.19	24.59
Winter/2006	Fernandópolis	28.67	21.14	33.97	19.93	24.97	22.58
Rainy/2006	Avaré	26.86	23.11	31.31	20.48	30.58	21.68
Rainy/2006	Mococa	22.26	21.42	31.56	18.09	23.53	21.66
Rainy/2006	Capão Bonito	21.30	23.02	25.50	17.76	22.78	27.68
Dry/2007	Avaré	24.39	20.70	32.31	21.31	29.15	24.65
Dry/2007	Tatui	27.28	20.28	33.21	21.54	27.95	20.38
Dry/2007	Monte Alegre do Sul	37.18	19.48	46.24	18.98	32.38	23.17
Winter/2007	Colina	31.27	26.96	48.90	24.66	52.93	27.61
Winter/2007	Araras	34.25	21.90	32.69	21.30	34.69	22.76
Winter/2007	Mococa	27.19	24.06	31.89	26.91	25.91	28.29
Mean rainy season		**24.29**	**19.72**	**31.21**	**19.33**	**27.61**	**22.85**
Mean winter season		**30.06**	**23.39**	**33.03**	**22.94**	**32.44**	**24.22**
Mean dry season		**29.02**	**22.89**	**31.47**	**20.75**	**27.91**	**23.59**
Overall mean		**27.79**	**22.00**	**31.90**	**21.01**	**29.32**	**23.55**

TECHNICAL RECOMMENDATION AND SEED PRODUCTION

IAC-Boreal and **IAC-Harmonia** are recommended for sowing according to the ecological zoning of the state of São Paulo in the three growing seasons, with 45 cm between-row spacing and 10 plants per meter, totalizing 220,000 plants per hectare.

Due to the earliness and the upright growth type 1, IAC-Boreal and IAC-Harmonia are recommended for monoculture or intercropped with other crops, to maximize the exploitation of the cultivation area.

The IAC is in charge of the seed production of these cultivars. The cultivars IAC-Boreal and IAC-Harmonia were registered by the MAPA/RNC (22629 and 22627) as of 28/12/2007and the protection application for these cultivars is being analyzed by the MAPA/SNPC.