

## IAC-Alvorada and IAC-Diplomata: new common bean cultivars

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**ABSTRACT** - *The aim of common bean breeding programs is the development of high-yielding cultivars, with multiple disease resistance and high technological and nutritional grain quality. Two cultivars, IAC-Alvorada with carioca grain, and IAC-Diplomata with black grain, meet these standards, according to the results of trials of Value for Cultivation and Use (VCU) 2005/2006/2007 in São Paulo. The cultivars, developed by the Instituto Agronômico de Campinas, were registered by the MAPA/RNC.*

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

### INTRODUCTION

Brazil is worldwide leading in the production and consumption of common bean (*Phaseolus vulgaris* L.), where this leguminous crop is the main source of plant protein. Common bean together with rice represent the basis of nutrition of the Brazilian population, in practically all states. Over the last years, different high yielding cultivars were made available by the genetic breeding program of common bean of the Instituto Agronômico de Campinas (IAC), resistant to the anthracnose pathogen (*Colletotrichum lindemuthianum*) and with excellent nutritive quality. Based on the technological innovations and also the demand of the production sector for cultivars of high technological quality in terms of grain traits, the genetic

breeding program of common bean of the IAC has developed cultivars of carioca and black grain to meet this demand.

### GENETIC ORIGIN AND DEVELOPMENT

The cultivars IAC-Alvorada and IAC-Diplomata were originated by the cross {(IAC Carioca Pyatã . A686) x [(IAC Maravilha . G2338) . (IAC Maravilha . And277)]} x L317-1, performed at the IAC, state of São Paulo, in 1996. This cross was designated Gen 96A98 and plant selections until the winter growing season of 2000 identified the promising lines Gen 96A98-13-1-52-1 and Gen 96A98-5-1-1-55 with carioca and black grain, respectively. From the rainy growing season of 2000 onwards these lines with outstanding yield and stability, besides high grain quality,

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were evaluated in preliminary trials. In the rainy season of 2005 they were included in trials of Value for Cultivation and Use (VCU) 2005/2006/2007 of carioca and black grains of the state of São Paulo. Due to the plant traits, color of grain and broth, disease resistance and yield and stability of production, the line Gen 96A98-13-1-52-1 was designated IAC-Alvorada and the line Gen 96A98-5-1-1-55 named IAC-Diplomata. The production of genetic seed began in the dry season of 2007.

### GRAINYIELDPOTENTIAL

The yield potential of the cultivars IAC-Alvorada (4.351 kg ha<sup>-1</sup>) and IAC-Diplomata (3.681 kg ha<sup>-1</sup>), observed in the environment of the 24 VCU trials with 19 genotypes, demonstrated the yield potential of these cultivars in favorable environments. The mean yield of IAC-Alvorada in these trials was 2,811, 2,554 and 2,430 kg ha<sup>-1</sup> in the rainy season (9 trials), dry season (8 trials) and winter (7 trials), respectively. The mean yield of IAC-Diplomata in these trials was 2,730, 2,370 and 2,409 kg ha<sup>-1</sup> in the rainy, the dry and the winter growing seasons, respectively (Table 1).

The MSD (minimum significant difference – 5% Dunnett) of the mean yield of these cultivars was not significant in the separate growing seasons and in the joint analysis of the seasons, compared to the controls of national reference Pérola (carioca grain) and FT-Nobre (black grain). The new cultivars were registered by the MAPA/RNC due to their excellent grain quality, although their yield did not exceed the controls.

**Table 1.** Yield (kg ha<sup>-1</sup>), coefficient of experimental variation (CV%) and minimum significant difference (Dunnett-5%) compared with the control mean regarding the trait grain color, evaluated per growing season and all seasons together in common bean VCU trials for the state of São Paulo, from 2005 to 2007

Common bean cultivars (grain: C=Carioca and P=Black)	Growing season			Mean 2005/2006/2007 (kg ha <sup>-1</sup> )
	Rainy season (9 environments)	Dry season (8 environments)	Winter (7 environments)	
	kg ha <sup>-1</sup>			
Pérola (C)	2980	2597	2465	2703
FT-Nobre (P)	2955	2566	2309	2637
IAC-Alvorada (C)	2811	2554	2430	2614
IAC-Diplomata (P)	2730	2370	2409	2517
Mean <sup>1</sup> (kg ha <sup>-1</sup> )	2903	2582	2380	2644
C.V. (%)	11.75	15.32	16.26	14.13
MSD (kg ha <sup>-1</sup> )	269	331	346	180

<sup>1</sup>Experimental mean of 19 cultivars and lines and with coefficient of variation below 25%

\* Dunnett Test (5%) compared to the corresponding standard cultivar in the groups black grain (FT-Nobre) and diverse grain types (Pérola)

### OTHER TRAIT

IAC-Alvorada: semi-erect growth (type III), with moderate anthracnose resistance, high weight of 1,000 seeds (275 grams), cycle of 92 days from emergence to physiological maturation, yellow/straw-colored pods. In view of the resistance to darkening and the grain size (mesh 14 and 13), the grain quality of this carioca grain is considered high.

IAC-Diplomata: upright plant growth (type II), resistance to anthracnose (to the physiological races 31, 65 and 89), 1,000 seed weight of 225 grams, high grain quality, black broth. The cycle from emergence to physiological maturation lasts 92 days, with purple pods. The pods are concentrated in the mid- and upper third of the plants. Viable inflorescences with more than four pods with five seeds in the terminal apices are commonly found in environments of high temperature.

The mean cooking time (minutes) for cultivar IAC-Alvorada is shorter (27.53) than for Pérola (30.97) and the grains remain intact and light-colored until the end of cooking. The grain protein content in IAC-Alvorada varied according to the environment and was in the mean 1.48% (Table 2).

The cooking time for cultivar IAC-Diplomata is slightly longer (29.21) than FT-Nobre (28.41); the grains remain intact and the broth is black in the end of cooking. The grain protein content of IAC-Diplomata varied according to the environment and was in the mean 21.98% (Table 2).

**Table 2.** Technological and nutritional quality: mean values of cooking time (in minutes) in a Mattson cooker and protein content (%) in common bean grains of the VCU trial, in the state of São Paulo, from 2005 to 2007

Season	Location	IAC-Alvorada		IAC-Diplomata		FT-Nobre		Pérola	
		Cooking time (min)	Protein content (%)	Cooking time (min)	Protein content (%)	Cooking time (min)	Protein content (%)	Cooking time (min)	Protein content (%)
Rainy/2005	Mococa	26.92	17.52	30.37	18.49	25.73	17.53	32.11	17.38
Rainy/2005	Monte Alegre do Sul	16.29	20.42	42.08	25.75	36.67	23.47	17.86	17.26
Rainy/2005	ESPinha	35.28	23.69	21.12	18.98	18.84	19.74	38.68	21.84
Dry/2006	Mococa	25.11	24.22	28.07	22.83	23.67	21.84	28.97	22.79
Dry/2006	Avaré	21.46	21.56	28.87	25.73	40.10	22.83	29.61	18.63
Dry/2006	Capão Bonito	29.37	18.75	22.46	20.50	31.52	18.49	22.72	18.45
Winter/2006	Colina	36.28	19.04	28.93	19.83	28.60	17.98	36.15	17.23
Winter/2006	Ribeirão Preto	20.99	21.47	25.91	21.24	18.66	20.70	29.57	22.63
Winter/2006	Fernandópolis	29.39	23.58	37.11	20.60	29.29	19.75	39.86	18.64
Rainy/2006	Avaré	24.92	20.71	22.69	22.98	26.41	21.40	40.40	21.51
Rainy/2006	Mococa	19.93	21.40	20.93	22.95	18.24	18.14	25.23	21.40
Rainy/2006	Capão Bonito	20.00	21.68	23.27	19.66	19.02	17.94	21.43	20.80
Dry/2007	Avaré	25.85	21.78	27.20	21.34	27.66	22.33	26.65	20.30
Dry/2007	Tatuí	18.27	19.15	22.93	19.60	20.97	19.62	22.53	18.43
Dry/2007	Monte Alegre do Sul	30.71	23.58	31.34	23.67	30.71	23.34	30.94	22.16
Winter/2007	Colina	44.33	25.68	35.33	24.83	43.27	27.90	44.92	28.87
Winter/2007	Araras	37.90	23.05	44.62	27.25	43.01	21.43	41.57	24.15
Winter/2007	Mococa	32.58	19.34	32.58	19.34	29.01	16.50	28.23	18.30
<b>Mean rainy season</b>		<b>23.89</b>	<b>20.90</b>	<b>26.74</b>	<b>21.47</b>	<b>24.15</b>	<b>19.70</b>	<b>29.29</b>	<b>20.03</b>
<b>Mean winter season</b>		<b>33.58</b>	<b>22.03</b>	<b>34.08</b>	<b>22.18</b>	<b>31.97</b>	<b>20.71</b>	<b>36.72</b>	<b>21.64</b>
<b>Mean dry season</b>		<b>25.13</b>	<b>21.51</b>	<b>26.81</b>	<b>22.28</b>	<b>29.11</b>	<b>21.41</b>	<b>26.90</b>	<b>20.13</b>
<b>Overall mean</b>		<b>27.53</b>	<b>21.48</b>	<b>29.21</b>	<b>21.98</b>	<b>28.41</b>	<b>20.61</b>	<b>30.97</b>	<b>20.60</b>

## TECHNICAL RECOMMENDATION AND SEED PRODUCTION

The sowing date in the three possible growing seasons should be determined according to the ecological zoning of the state of São Paulo. A between-row spacing of 50 cm with 10 to 12 plants per meter is recommended, totaling 200.000 to 240.000 plants per hectare. The IAC is responsible for the seed production of the above cultivars. IAC-Alvorada and IAC-Diplomata were registered by the MAPA/RNC (numbers 22628 and 22631, respectively) as of 28/12/2007. An application for protection of the cultivars is being analyzed by the MAPA/SNPC.

The 2007 drought in the state of São Paulo was not observed in the 2008 growing season. The yield of the 19 genotypes demonstrated the yield potential of these cultivars in favorable environments. The mean yield of IAC-Alvorada in these trials was 2,511, 2,354 and 2,430 kg ha<sup>-1</sup> in the spring, summer and winter growing seasons, respectively, and the mean yield of IAC-Diplomata in these trials was 2,730, 2,370 and 2,409 kg ha<sup>-1</sup> in the spring, the dry and the winter growing seasons, respectively.

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Table 1. Yield (kg ha<sup>-1</sup>) of 19 genotypes of common bean (Cultivar) in the 2007 and 2008 growing seasons in the state of São Paulo, Brazil, 2007-2008.

Cultivar	2007			2008		
	Spring	Summer	Winter	Spring	Summer	Winter
FL-Nabela (R)	2,511	2,354	2,430	2,511	2,354	2,430
IAC-Alvorada (R)	2,511	2,354	2,430	2,511	2,354	2,430
IAC-Diplomata (R)	2,730	2,370	2,409	2,730	2,370	2,409
Mean (19)	2,511	2,354	2,430	2,511	2,354	2,430
C.V. (%)	10.0	10.0	10.0	10.0	10.0	10.0
MSD (kg ha <sup>-1</sup> )	100	100	100	100	100	100

Cultivar	2007			2008		
	Spring	Summer	Winter	Spring	Summer	Winter
FL-Nabela (R)	2,511	2,354	2,430	2,511	2,354	2,430
IAC-Alvorada (R)	2,511	2,354	2,430	2,511	2,354	2,430
IAC-Diplomata (R)	2,730	2,370	2,409	2,730	2,370	2,409
Mean (19)	2,511	2,354	2,430	2,511	2,354	2,430
C.V. (%)	10.0	10.0	10.0	10.0	10.0	10.0
MSD (kg ha <sup>-1</sup> )	100	100	100	100	100	100