CROP BREEDING AND APPLIED BIOTECHNOLOGY

CULTIVAR RELEASE

IAC VR211 and IAC VM211: new high-yielding cultivars of mung bean and black mung bean

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Abstract: *IAC VR211 and IAC VM211 were developed for growing in Brazil with the aim of responding to the domestic and export market. The cultivars have a mean cycle of 85 days and yield potential of 2,191 kg ha^{-1} for IAC VR211 and 1,603 kg ha^{-1} for IAC VM211.*

Keywords: Vigna radiata, Vigna mungo*, plant breeding, pulses*

INTRODUCTION

Beans are in second place among the most-consumed plant proteins, only after soybean. Bean consumption has grown mainly as an alternative to consumption of animal protein (Azarpazhooh and Ahmed 2022). These legumes of dry seeds, also known as "pulses", can be consumed in several ways, from the whole bean to the form of meal. Pulses also include chick peas, common beans, dried peas, cowpeas, mung beans, and others (Belhassen et al. 2019).

Pulse crops have become an important component of niche or lifestyle diets, meeting the needs of new forms and choices of consumption. Such is the case of vegetarian, vegan, functional, and special diets, which constitute a dietary trend in Brazil and worldwide (Carbonell et al. 2021).

Pulses also have high contents of other compounds beneficial to health, thus assisting in reducing chronic diseases such as hypertension, cardiovascular diseases, and cancer (Sharma et al. 2021). Consequently, pulse crops have attracted Brazilian growers through demand for these types of grain on the international market (Vieira et al. 2011). European countries and especially Asian countries, such as China, have considerable demand for these protein-rich foods for the diets of their populations.

In Brazil, mung beans, *Vigna radiata* L. with grains with green seed coat and *Vigna mungo* L. with black seed coat, are known for consumption as "bean sprouts" or "moyashi", but they can also be consumed in the form of protein powder as a replacement for meat and starch, as well as used in preparation of a dessert called "sarim" or in "vermicelli", a kind of pasta (Ambrosano et al. 2014). This demand for mung bean is a major opportunity for Brazilian farmers to supply the market in India and other markets already served by Australia, such as Japan, the Philippines, the USA, and Europe (Vieira et al. 2022). More than half of the area cultivated with mung bean worldwide is located in India

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(Kang et al. 2014), and its annual production was 2,16 million tons in 2016-2017 (Kumar and Raju 2018) followed by China and Myanmar (Kang et al. 2014).

The grain yield of mung bean observed over the years is a result of improvement in crop management, through the use of inputs and suitable agronomic practices and the use of improved cultivars. In Brazil, some mung bean cultivars have already been released (Vieira et al. 2002, Vieira et al. 2008, Vieira et al. 2022). In 2000, the cultivar 'Ouro Verde MG 2' was released with medium-sized green seeds (around 51 g for 1000-seed weight). 'MG Esmeralda' was released in 2007 with medium-sized to large green seeds (around 68 g for 1000-seed weight), and the cultivar 'BRSMG Camaleão' was released in 2022 with an average yield of 1493 kg ha^{-1} and 1000-seed weight around 78 g.

Therefore, the aim of this paper is to present the mung bean cultivar IAC VR211 and the black mung bean cultivar IAC VM211 with high yield potential, early maturity, drought tolerance, and limited requirements of soil fertility.

GENETIC ORIGIN AND DEVELOPMENT

The cultivars IAC VR211 and IAC VM211 were developed from selection of pure lines within populations of Vigna VG 53 and VM 90, respectively, from a total of 16 populations evaluated in the second crop season of 2018 (Feb.-Apr.), belonging to the active germplasm bank BAG-IAC Vigna RM, to meet the demand of markets interested in promoting production and consumption of this species in Brazil, especially for export purposes. This increasing demand for genetic materials bred and adapted to Brazil has revealed the needs of farmers in the regions of central Brazil and the Northeast and Northwest, especially in the states of MT, MS, GO, TO, and BA, in obtaining legal cultivars / seeds with genetic origin.

In 2019 (dry season) in Campinas, SP, competition tests were carried out and the cultivars IAC VR211 and IAC VM211 had mean yield of 1,425 kg ha^{-1} and 1,100 kg ha^{-1}, respectively, superior to the standard landrace check variety (VR 1000 = 600 kg ha^{-1}) sown by traditional farmers in Brazilian Midwest region (Table 1). In 2020 (rainy season), in Campinas (SP), competition tests were carried out again and the genotypes were selected based on the agronomic traits of growth habit, cycle, and yield, in a randomized block design with 3 replications (four 4-m-long rows). In these tests the cultivar IAC VR211 obtained yield of 1,284 kg ha^{-1} and the cultivar VM211 obtained yield of 840 kg ha^{-1}, compared to the check variety with 363 kg ha^{-1} (Table 1). These results classified the cultivars IAC VR211 and IAC VM211 for regional yield trials in the 2021 crop season.

Table 1. Grain yield (kg ha^{-1}), coefficient of variation (CV%), and least significant difference (LSD: by Dunnett Method) compared to the check landrace variety (VR 1000) of the regional trials considering four growing environments in the years 2019, 2020 and 2021: Campinas Dry Season in the year 2019, Campinas Rainy Season in the year 2020; Sorriso Dry Season in the year 2021; Votuporanga Dry Season in the year 2021 and Campinas Dry Season in the year 2021

	Mean grain yield (kg ha^{-1})					
Genotypes	**Campinas 2019**	**Campinas 2020**	**Sorriso 2021**	**Votuporanga 2021**	**Campinas 2021**	**Joint Analysis**
IAC VR211	1425*	1284*	334 a	2191 a	690*	1185 *
IAC VM211	1100*	840*	564*	1603 a	390*	899.4 a
Check Landrace (VR 1000)	600 a	363 a	237 a	1543 a	146 a	577.8 a
LSD	202	421	232	681	215	334
CV (%)	15.2	9.2	13.4	18.7	13.6	16.8

* Significant at 5% by the Dunnett test. [1] Yield values followed by the same letter in the columns do not differ statistically by Dunnett test at 5% significance level.

YIELD CAPACITY

The regional trials of 2021 (dry season) were sown in a randomized block design with 3 replications (four 4-m-long rows) in Campinas and Votuporanga (SP) and Sorriso (MT) for evaluation of the stability and adaptability of production. The genetic yield potentials were 2,191 kg ha^{-1} and 1,603 kg ha^{-1} for the cultivars IAC VR211 and IAC VM211, respectively (Table 1). The meaning of the names of the cultivars IAC VR211 and IAC VM211 are:

IAC: Instituto Agronômico de Campinas;

VR: name of the species *Vigna radiata;*

VM: name of the species *Vigna mungo*

21: year of registration in MAPA/RNC;

1: registration number of *V. radiata* and *V. mungo* by IAC.

In the Feb.-Apr. 2021 season, the seeds of these cultivars, registered in the National Cultivar Registry (Registro Nacional de Cultivares - RNC) of the Brazilian Ministry of Agriculture (Ministério da Agricultura, Pecuária e Abastecimento – MAPA), began to be produced. The cultivars were registered on Oct. 22, 2021, under number 49692 for IAC VR211 and number 49691 for IAC VM211.

In comparison with the cultivar IAC VR211, Vieira et al. (2022) obtained similar results with the cultivar BRSMG Camaleão. From seven experiments carried out, the cultivar obtained an average yield of 1,493 kg ha^{-1}.

OTHER TRAITS

The cultivar IAC VR211 has an annual cycle, with mean flowering at 28 days and maturity at 70 days after emergence, mean plant height of 75 cm, upright shrub growth habit, and the presence of tendrils. Mean 1000-seed weight is 56 grams, and it has a green seed coat. The cultivar IAC VM211 has an annual cycle, with mean flowering at 28 days and maturity at 85 days after emergence, mean plant height of 75 cm, with tendrils, and upright shrub growth habit. Mean 1000-seed weight is 62 grams, and it has a black seed coat characteristic of the species *V. mungo*. The cultivars IAC VR211 and IAC VM211 are tolerant to the soil pathogen *Fusarium* spp., moderately resistan to the powdery mildew and moderately resistant to the cercospora leaf spot.

They have non-uniform pods at maturity and harvest, with the pods exhibiting 80-85% yellow or black/brown coloring. As a characteristic of the species, they are drought tolerant and tolerant to low soil fertility; nevertheless, they respond to improvement in the growth environment.

TECHNICAL RECOMMENDATIONS AND SEED PRODUCTION

Considering the environments of the experimental trials for evaluation of the yield and disease reaction components, with the other phytotechnical components exhibiting similar edaphic and climatic conditions, the cultivar IAC VM211 is recommended for the South/Southeast region in the states of PR, SP, and MG, and in the Center-West region in the states of MT, MS, GO, TO, and DF. It can be sown normally in rows spaced 0.5 m apart, or more densely in rows spaced 0.3 m apart (up to 40 plants m^{-2}). The strong demand for new mung bean cultivars for the pulse production chain and the demand for these products for export are relevant factors in this study. There will also be stimulus for use of legal seeds in the production system, with reduction in the use of saved seeds and low-quality seeds. The cultivars IAC VR211 and IAC VM211 are already in the process of commercialization of seeds by the Instituto Agronômico de Campinas - IAC, with genetic seeds being transferred to seed producing companies.

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