Description of cultivar

Morelos A-2016: variety of coarse-grained rice

Edwin Javier Barrios Gómez[§]
Leonardo Hernández Aragón
Leticia Tavitas Fuentes
Marianguadalupe Hernández Arenas
Jaime Canul Ku

Zacatepec Experimental Field-INIFAP. Highway Zacatepec-Galeana s/n km 0.5, Col. IMMS, Zacatepec, Morelos, Mexico. CP. 62780. Tel. 01(800) 0882222, ext. 86612. (hernandez.leonardo@inifap.gob.mx; tavitas.leticia@inifap.gob.mx; hernandez.marian@inifap.gob.mx; canul.jaime@inifap.gob.mx).

[§]Corresponding author: barrios.edwin@inifap.gob.mx.

Abstract

In the central zone of Mexico, rice (*Oryza sativa* L.) is planted under transplant and in direct sowing under irrigation; most varieties have been released for transplant. In 2005, one of these lines was used as a parent and continued with the generational advance to F_5. In 2011, a preliminary performance test was carried out on several groups of lines, around 256 materials, from which C14Za06 was identified as outstanding (currently, Var. Morelos A-2016). In 2014 and 2015 different lines were evaluated in performance trials in the towns of Zacatepec, Jojutla, Emiliano Zapata, Mazatepec, Coatlan del Río and Cuautla, Morelos state; in addition to the commercial witness Morelos A-2010. Of the evaluated materials, C14Za06 stood out for its yield superior to 10 t ha^{-1}, moderate resistance to pyricularia, high tolerance to grain staining, semi-erect growth habit, plant height of 130 cm, resistant to lodging; industry performance of 57% whole polished grain; conserving the Morelos quality (20% of white center).

Keywords: *Oriza sativa* L., irrigated rice, Morelos quality, tolerance to diseases.

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Origin

In recent years, there has been progress in the field of the induction of mutations in breeding, hundreds of mutants have been released as new cultivars. In rice, Micke *et al*. (1990a) reported the release, up to that time, of 251 new varieties of rice, developed with the use of induced mutations, and about 1 300 varieties of different species, 90% using cobalt-60 radiations (Micke *et al*., 1990b), for this reason this is a technique widely used to create genetic variability (Kihupi, 1984).

In 1998, at the National Institute of Forestry, Agriculture and Livestock Research (INIFAP), the improvement of rice by induction of mutations was started, for this, seed of the variety Morelos A-92 was irradiated, in the National Institute of Nuclear Research (ININ), as a result, the M3 mutant was detected as outstanding, but not with sufficient quality parameters to release it, but to use it as a progenitor in the breeding program (Salcedo and Barrios, 2012).

The process to obtain the variety Morelos A-2016 began in 2005 at the INIFAP Campo Experimental Zacatepec, Morelos. The parents used were the CAEZ116-1111-97 line and the M3 mutant. After crossing, the progeny obtained was evaluated during the following years. In 2006 and 2007, massive harvests were carried out and subsequently three consecutive genealogical selections were carried out (2008-2010). In 2011, a preliminary performance test was carried out on several groups of lines, around 256 materials, from which C14Za06 was identified as outstanding (currently, Var. Morelos A-2016). In 2013, 51 lines were sown according to the preliminary test, this in order to increase seed and perform the industrial quality test.

During 2014 and 2015, evaluations were carried out in the field, together with five other lines and a commercial control, Morelos A-2010, after each harvest the grain milling quality was evaluated in the laboratory of industrial quality analysis for rice in the Experimental Field Zacatepec (Tavitas *et al.*, 2009) and in the rice mill of Jojutla, for commercial evaluation. The results obtained indicated good response of the grain in the grinding process. Cycles 2014 and 2015, with the support of cooperating producers, the line was evaluated in different environments of the state of Morelos: Jojutla, Emiliano Zapata, Mazatepec, Coatlan del Río and Cuautla, main rice producing areas.

Field results and laboratory analysis indicated good industrial aptitude of line C14Za06. It showed stability in the different environments of the region obtaining high grain yield (>10 t ha^{-1}), moderate resistance to pyricularia or grain avalanche (disease caused by the fungus *Magnaporthe grisea*) (Hernández *et al*., 2012), habit of erect growth, height of plant of 130 cm, resistance to lodging, good milling quality (59% of whole grain) and with Morelos type grain characteristics. In 2016, a batch was established for the production of original seed and the process for the registration of the Morelos A-2016 variety began (Table 1).

Table 1. Genealogical scheme for obtaining the Morelos variety A-2016.

2005	CAEZ116-1111-97/ M3	F0	Cross of a line/mutant
	⇓		
2006	C14Za06	F1	Massive harvest
	⇓		
2007	C14Za06-1SM-2SM	F2	Second massive harvest
	⇓		
2008	C14Za06-1SM-2SM-2C	F3-F4	Gene selection
	⇓		
2009	C14Za06-1SM-2SM-2C-1C	F5	Gene selection
	⇓		
2010	C14Za06-1SM-2SM-2C-1C-0C		Seed increase
	⇓		
2011	CEZa14Za06		Evaluation in preliminary performance trials (EPR)
	⇓		
2013	CEZa14Za06 Grain industrial quality evaluation		Evaluation in compact performance test (ECR) in four environments
	⇓		
2014-2015	Evaluation, validation, confirmation of the industrial quality of the grain and varietal characterization		Evaluation in four environments in Morelos (Jojutla, Cuautla, Emiliano Zapata and Mazatepec)
	⇓		
2016	Morelos A-2016		Sowing of basic seed, CE INIFAP-Zacatepec, Morelos
			Total: four years in commercial evaluation

Description of the variety Morelos A-2016

For the description of the agronomic and morphological characters of the variety Morelos A-2016 some records were made in the field and others in the industrial quality analysis laboratory of rice, during the spring-summer (PV) 2015 and PV-2016 cycles. For the varietal description in the field, samples were taken at random in a lot established in the Experimental Field Zacatepec, Morelos.

The agronomic and morphological characteristics were described in accordance with the guide established by the International Union for the Protection of New Varieties of Plants (UPOV, 2004). As a comparative reference, the characteristics of the variety Morelos A-2010 were taken, the records obtained are shown in Table 2.

Table 2. Distinctive characteristics between Morelos A-2016 and Morelos A-2010, applying the technical guide of UPOV (2004).

Characteristics	Morelos A-2016 (C14Za06)	Morelos A2010
Limbo: pubescence of the surface:	Absent or very weak	Weak
Leaf flag: bearing of the limb (early observation):	Semi-erect	Erect
Tillering: porte:	Semi-erect	Erect
Varieties not prostrate only: stem: length (excluding the panicle):	Medium	Short
Glume: color:	Golden	Straw
Lemma: phenol reaction	Presented	Absent
Lemma: intensity of phenol reaction	Medium	Clear

Inflorescence

The glumes of the grain are pubescent towards the apex of the motto and the palea (Table 2), the stigma does not present color, the anthesis occurs 95 days after the transplant. The stem knot is predominantly green and golden in internode. The plant has good tillering ability and semi-straight growth habit (Table 3). The leaves are little pubescent, 52 cm long and 1.1 cm wide, predominantly green, semi-erect position of the apex and the flag leaf. The ligule with yellow color and split. Small size of the atria.

Maturity

Adult plant characteristics

Table 3. Agronomic characteristics of the Morelos A-2010 and Morelos A-2016 varieties.

Characteristics	Morelos A-2016	Morelos A-2010
Habit of growth	Intermediate	Intermediate
Height of plant (cm)	130	130
*Flowering (days)	95	104
*Maturity (days)	125	138
Resistance to lodging	Moderately strong	Moderately strong
Pyricularia response	Moderately resistant	Moderately resistant
Response to grain staining	Resistant	Susceptible
Ability of tightrope	Intermediate	Intermediate
Type of grain	Large elongate	Large elongate
Shred	Intermediate	Intermediate
Stability	Good response in all environments	Good response in all environments

*= days after the transplant when it is done in the month of April. The days to flowering and to maturity of the variety A-2016 were registered in Zacatepec during the P-V 2015 cycle, before the transplant it remained 38 days in pachol.

Grain quality characteristics

The results of milling and culinary quality of the variety Morelos A-2016 compared with the variety Morelos A-2010 are shown in Table 4 according to the methodologies of Tavitas *et al*. (2009).

Table 4. Grain milling and culinary quality characteristics of the Morelos varieties A-2010 and Morelos A-2016.

Characteristic	Morelos A-2016	Morelos A-2010
Brown rice (%)	76	78
Polished rice (%)	70	70
Whole rice (%)	59	57
Half grain rice (%)	5	5
White center (%)	> 20	> 20
Length (mm)	7.5	7 to 7.4
Shape	Thick	Wide
Amylose (%)	26	25
Alkali	Intermediate	Intermediate
Gel consistency	Medium	Medium
Culinary quality	Good	Good

Adaptation and performance

Under irrigation conditions by transplant, this variety presents excellent response to the environmental conditions of the 'high' (1 000-1 400 meters above sea level) and 'low' (800-1 000 meters above sea level) areas of the state of Morelos. It may respond favorably to the southern states of Mexico, Michoacán, Jalisco and north of Guerrero (Mountain) as well as the variety Morelos A-98 (Salcedo, 1998). The results obtained in the evaluations for yield and stability indicate that the variety Morelos A-2016 has good behavior in the rice producing regions of the state of Morelos; in addition to presenting minor staining of grain and is earlier than the variety Morelos A-2010. The average experimental yield of this variety compared to Morelos A-2010 in 2015 is shown in Table 5.

Table 5. Experimental yield in kg ha^{-1} of the Morelos A-2010 and Morelos A-2016 varieties in five locations in the state of Morelos. PV-2015 cycle.

Location	Morelos A-2010	Morelos A-2016
Emiliano Zapata	12 000	12 000
Jojutla	15 000	13 000
Coatlan del Río	12 000	13 000
Mazatepec	10 500	12 000
Zacatepec	10 800	13 500
Average	12 060	12 700

Availability of seed

Seed basic category of the variety Morelos A-2010 is available to all producers in the INIFAP, Campo Experimental Zacatepec, Morelos, in limited quantities, if it were the case of needing large volumes it is necessary to make the request one year before to increase it. Morelos A-2016 has the definitive registration ARZ-027-230217 in the National Catalog of Plant Varieties (CNVV) of the National Service of Inspection and Certification of Seeds (SNICS). The breeder's title is in process.

Conclusions

The generation of new varieties of rice is important because diseases affect a greater proportion of old varieties; with this variety with tolerance to diseases, it will help to reduce cultivation costs by avoiding the use of chemical products.

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