

V 240 EL: improved Costeño corn for green corn cob production

Alberto Trujillo-Campos^{1§}
Noel Orlando Gómez-Montiel²
Miguel Ángel Cantú-Almaguer²
César del Ángel Hernández-Galeno²
María Gricelda Vázquez-Carrillo³

¹Zacatepec-INIFAP Experimental Field. Zacatepec-Galeana highway km 0.5, Zacatepec, Morelos, Mexico. ZC. 62780. ²Iguala Experimental Field-INIFAP. Iguala-Tuxpan highway km 2.5, Iguala of Independence, Guerrero. AP. 29. ZC. 40000. (hernandez.cesar@inifap.gob.mx; gomez.noel@inifap.gob.mx). ³Mexico Valley Experimental Field-INIFAP. Highway Los Reyes-Texcoco km 13.5, Texcoco, State of Mexico. AP. 307. ZC. 56250. (vazquez.gricelda@inifap.gob.mx).

[§]Corresponding author: trujillo.alberto@inifap.gob.mx.

Abstract

The state of Morelos ranks second in area sown (9 687 ha) with corn for green corn cob nationwide. Costeño corn is used in the state for the production of green corn cob, this corn is an interracial complex of the Tabloncillo, Vandeño, Tuxpeño and Tepecintle races, and still has some negative characteristics in the phenotype of the plant. Faced with this situation, the objective of subjecting Costeño corn to genetic improvement was set to reduce undesirable aspects in the phenotype of the plant. From 2004, a cycle of mass selection and four cycles of recurrent selection of families of maternal half-siblings were carried out; subsequently, five cycles of individual selection, it was possible to reduce the intrinsic agronomic problems of Costeño corn, this allowed making its varietal description in the years from 2013 to 2015 and obtaining, in 2019, the registration number 3876-MAZ-2081-130319/C and the denomination V 240 EL in the National Catalogue of Plant Varieties, likewise, the breeder's title number 2314. V 240 EL has intermediate-tall size (251-300 cm), early-intermediate biological cycle (120 days), male flowering of 56-60 days and the female flowering two days later, white grain with toothed texture, yields of green corn cob and grain of 15.1 and 6 t ha⁻¹, respectively. The V 240 EL variety adapts to the environmental conditions of the low (dry tropics) and intermediate (subhumid subtropics) zones of the state of Morelos and similar regions of the neighboring states of Guerrero, Puebla and State of Mexico.

Keywords: *Zea mays* L., genetic improvement, green corn cob.

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In the state of Morelos, 9 687.5 ha of corn for green corn cob are sown every year (SIAP, 2022), whose main consumption center is the supply center of Mexico City, which demands improved hybrids due to their uniformity; however, at the local level, green corn cobs with medium to large grain size are preferred, such as that of some varieties (VS-535 and Costeño), the latter has good characteristics for the production of green corn cob; however, it also shows some negative characteristics in the plant phenotype such as: greater vegetative cycle and height of plants and corn cob, higher percentage of lodged plants, lower yield and grain health.

Given the lack of corn genotypes with favorable characteristics required by farmers in the region to produce green corn cob, researchers from the Genetic Improvement Program of the National Institute of Forestry, Agricultural and Livestock Research (INIFAP, for its acronym in Spanish) based in Zacatepec, Morelos set as an objective to carry out genetic improvement in the population of corn called Costeño in order to reduce undesirable aspects present in the phenotype of the plant.

The interracial complex composed of corn populations of the Tabloncillo, Vandeño, Tuxpeño and Tepecintle races, which is known in the region as Costeño corn, was used as the starting population. In 2008, work on genetic improvement in the aforementioned population began; a cycle of mass selection was carried out, and later four cycles of recurrent selection through the family selection of maternal siblings proposed by Lonquist (1964), in 2012 the working population was genetically stabilized, restarting its improvement with five cycles of individual selection.

In the fields of the Zacatepec Experimental Field, in the autumn-winter sowing cycles 2016-2017 and 2017-2018, the varietal description of the population of Costeño corn that was previously improved was made, for this, the guidelines for the execution of the examination of the distinction, homogeneity and stability in corn (UPOV, 2009) and the technical guide for the varietal description of corn (SAGARPA, 2014) were used. Likewise, in the Corn Quality Laboratory of the Valle de México Experimental Field of INIFAP, the determinations of physical and chemical characteristics of grain, as well as nixtamal-tortilla quality, were made using the methodologies described by Salinas and Vázquez (2006); Vázquez *et al.* (2003).

The genetic improvement carried out in the Costeño corn allowed obtaining an improved version with agronomic characteristics superior to the regional landrace corns and without altering its intrinsic characteristics of grain quality, it was registered in 2019 in the National Catalogue of Plant Varieties of the National Seed Inspection and Certification Service (SNICS, for its acronym in Spanish) with the number 3876-MAZ-2081-130319/C and the denomination V 240 EL, likewise, the breeder's title number 2314 was obtained.

The improved variety of corn V 240 EL is of intermediate-tall size (Figure 1), with plant height that ranges from 251 to 300 cm and corresponds to 20-50 cm less than regional landrace materials. Its biological cycle is early-intermediate of 120 days, with 56 and 60 days to male flowering and two more days to female flowering, this makes it five days earlier than the starting population, its average grain yield is 6.2 t ha⁻¹. The grain is toothed white with uniform color compared to other native materials (Figure 1).

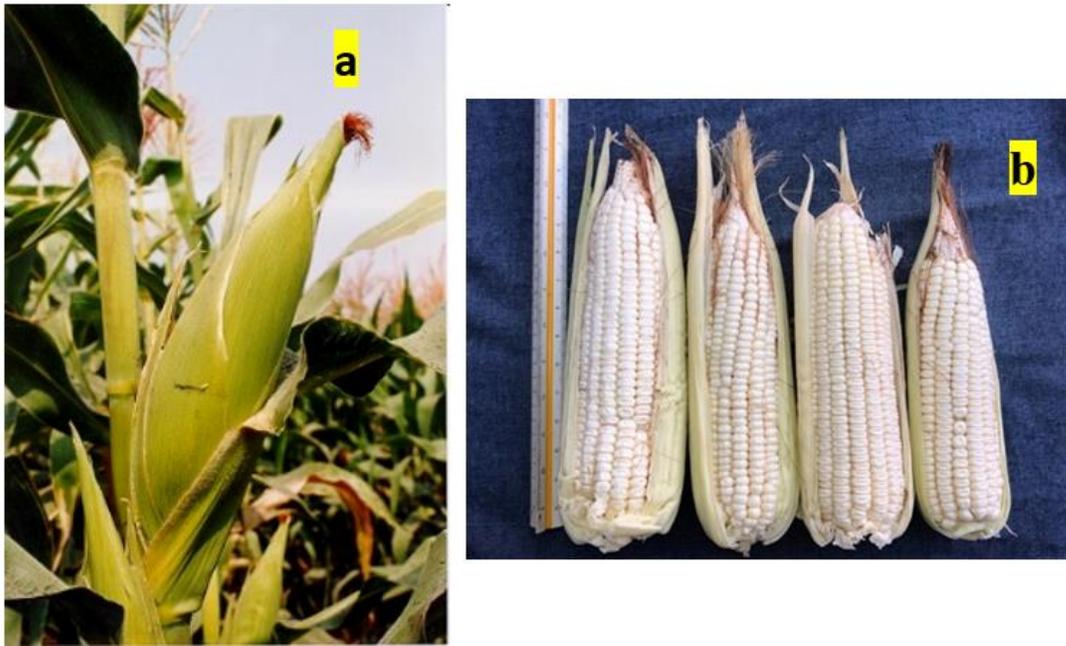


Figure 1. Appearance of the plant (a) and green corn cob (b) of the improved corn variety V 240 EL.

The commercial variety V 240 EL has slightly curved dark green leaves, its tassel is compact-semi-open with 16 to 18 primary lateral branches, red stigmas, cylindrical conical corn cob of good cover of the bracts, 20 to 25 cm long with 12 to 14 regular rows and 41 to 50 white grains per row and toothed texture, these last characteristics give it acceptance in the local market as corn for green corn cob.

The V 240 EL variety shows excellent adaptation in the low (dry tropics) and intermediate (subhumid subtropics) zones of the state of Morelos and similar regions of the neighboring states of Puebla, Guerrero and State of Mexico with altitudes of 1 000-1 800 m, with a rainfall of 800 to 1 000 mm, an average annual temperature of 23 to 25 °C, it adapts to soils that have a pH of 6 to 8 and slopes with slopes less than 15%.

In evaluations conducted in the years from 2016 to 2019, in ten different environments of the state of Morelos, the V 240 EL variety showed yields of 4.5 to 7 t ha⁻¹, with an average of 6.2 t ha⁻¹, exceeding the original landrace of 1 to 2 t ha⁻¹. This variety can have a yield of green corn cob of 15.1 t ha⁻¹. It also has favorable characteristics for the production of ‘leaf’ (totomoxtle) and its large grain is marketed as a third category ‘pozolero’, reaching a higher price than normal grain.

The physical characteristics of the grain of V 240 EL include grains of large size (weight of one hundred grains= 38.6 g), hectoliter weight of 70.2 kg hl⁻¹ and very soft grain endosperm with a percentage of floating grains of 77%, characteristics that are in accordance with its high percentage of mealy endosperm 43%, values that are common for landrace corns and that are lower than those of improved corns that are sown in the state de Morelos (Salinas *et al.*, 2010), the structural components of the grains of the V-240 EL variety are pedicel 1.9%, pericarp 5.9%, germ 13.7% and are included within those observed in commercial toothed corns (González, 2009).

As for the nixtamal-tortilla quality, due to the softness of its grain, it requires little nixtamalization time, 25 min, consequently the fuel consumption for its processing is low. The moisture of the dough was 56.9%, in freshly made tortillas 44.3% and 24 h after storage at 4 °C 42.8%, which indicates that the grains of V-240 EL are hydrolyzed quickly and reach moistures similar to those of hybrids with greater hardness, which contributes to the high yields of dough and tortilla, which were 2.2 and 1.7 kg of corn, respectively; these yields of dough and tortilla (hot and cold) were higher than the value indicated as optimal by Salinas *et al.* (2012) and, on average, similar to the yields of the original landrace.

Its tortillas, 24 h after being made, require on average 221 gf to break, and have an elongation value of 9.4 mm, which describes them as soft and elastic tortillas. However, 48 h after storage, they required 209 gf to break, and their elongation decreased to 4.9 mm.

The fact that the force required for the rupture of tortillas of the V 240 EL corn decreases after storage of 48 h can be attributed to the amylose-lipid complex, which delays retrogradation by inhibiting cross-linking and the formation of double helix structures between amylose molecules (Obiro *et al.*, 2012; Wang *et al.*, 2015).

This new variety had an average oil content of 5.2% and protein content of 11.4%. The values of lysine and tryptophan in endosperm and tortillas were within what was reported for corns of normal endosperm (Sierra-Macías *et al.*, 2010). In corn grain color V 240 EL showed lower luminosity and a slightly more defined cream tone, but a lower saturation compared to the original landrace, which gives it an appearance closer to that of a white corn.

In freshly made tortillas, they were slightly brighter, but with a less defined purity of color (chroma), while those of the original population had a creamier color. The color of the tortillas of V 240 EL was very stable during the storage of 24 and 48 h. As for the tone, these are yellow, however, since the color saturation (chroma) is very low, these remain with a light cream appearance.

The conservation of the varietal identity of V 240 EL must be carried out in an isolated lot, following the rules established in the SNICS regarding isolation by distance or time (Coutiño, 1993; Vallejo *et al.*, 2008), it is suggested to eliminate plants out of type and, in pre-flowering, to detassel segregating plants of tall corn cob, lodged or diseased. To maintain its purity, it is suggested to sow lots of 1 000 m², where 200 families of full siblings are selected from 400 obtained by controlled pollination to integrate the population that faithfully represents V-240 EL. INIFAP makes the registered seed of the variety available to producer organizations and microenterprises for sowing and conservation.

Conclusions

The genetic improvement of the interracial population of corn known as Costeño allowed reducing undesirable aspects present in the phenotype of the plant. The legal requirements for the commercial release of the population subjected to genetic improvement were met, obtaining the denomination V 240 EL, which has better agronomic characteristics than the original landrace, such as: corn cob and grain of large size, accepted in the local market as green corn cob with yields of 15.1 and 6.2 t ha⁻¹, of green corn cob and grain, respectively.

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