

## Combo-743: a new variety of Kabuli-type chickpea for producing areas of the northwest and El Bajío

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### Abstract

Mexico is the twelfth largest chickpea producer worldwide. The production of Kabuli-type chickpea is located in the states of Sinaloa, Michoacán, Sonora, Guanajuato, and Baja California Sur, where grain of high caliber is obtained, which has made the Mexican chickpea famous worldwide. The new Kabuli-type chickpea variety, 'Combo-743', was derived from the cross between from two commercial varieties, Progreso-95 × Blanco Sinaloa-92. The Combo-743 variety adapts to all chickpea production areas in Mexico; the plant is semi-erect, the flower is white, its pod is medium in size, and its grain is creamy white with pronounced roughness, similar to that of Blanco Sinaloa-92. This new variety is resistant to the wilting disease caused by *Fusarium* species. On average of five trials, Combo-743 yielded 2 317 kg ha<sup>-1</sup> compared to 2 146 kg ha<sup>-1</sup> of Blanco Sinaloa-92 (the commercial variety with the largest sown area). Combo-743 has a caliber of 43 grains/30 g and an export percentage of 94% (grains > 9 mm) compared to 91% of Blanco Sinaloa-92.

### Keywords:

*Cicer arietinum* L., export, seed yield, wilting tolerance.



Worldwide, chickpeas (*Cicer arietinum* L.) are established in 10 main countries with a production of 11 080 000 t, with India being the main producer, followed by Turkey, Pakistan, Myanmar, Ethiopia, Russia, Australia, Iran, Canada, and the United States (FAO, 2022). Mexico ranks as the twelfth largest producer worldwide and production is mainly concentrated in the states of Sinaloa, Michoacán, Sonora, Guanajuato, and Baja California Sur.

During the 2021 agricultural cycle, Sinaloa contributed 74.5% of the value of chickpea production with \$1 927 000 000.00 pesos, which represented a 55.7% increase compared to that obtained in 2020 (SIAP, 2022). There are two types of chickpeas based on their color and geographical distribution, both grown in Mexico. Kabuli (native to the Mediterranean and Middle East regions) white to cream, white flowers, and larger than the small-grained Desi (native to India) brown, yellow, orange, black or green (Adsule *et al.*, 1989).

In recent years, the impact of climate change has increased vulnerability in the production and productivity of pulses (Choudhary *et al.*, 2022). The limiting factor is susceptibility to various types of biotic and abiotic stresses, particularly due to fungal diseases, which decrease yield by 80% (Padilla-Valenzuela *et al.*, 2008). Therefore, it is necessary to identify the different characteristics of the germplasm that provide information about the variety and specific traits (Nabati *et al.*, 2022).

It is important to constantly evaluate genotypes that provide a broad genetic base to respond to chickpea production constraints (Shagardovsky *et al.*, 2001). As a result of genetic improvement work to develop chickpea varieties with export characteristics by the National Institute of Forestry, Agricultural, and Livestock Research (INIFAP, for its acronym in Spanish) in Mexico, the new variety 'Combo-743' is described as resistant to root diseases.

## Origin

Combo-743 is a variety of Kabuli-type white chickpea that originated from the simple cross of Progreso-95 x Blanco Sinaloa-92. The Progreso-95 variety has an erect stem for direct mechanical harvesting, with tolerance to the pathogens that cause *Fusarium* wilt, and medium grain size (58 to 64 seeds in 30 g) (Gómez, 2001). Blanco Sinaloa-92 is the most widely sown chickpea variety in Mexico, it has a creamy white grain that is large in size (38-46 seeds in 30 g), as demanded by the international market (Gómez *et al.*, 2003).

In the different generations F2 and F3, it was harvested in mass form, individual selection was made in F4 due to health in a field lot intentionally infested with pathogenic fungi of the root (experimental wilting lot). In the F5, F6 and F7 generations, it was harvested in mass form due to its uniform characteristics of plant and grain size. Its genealogy is IIGaC0211M-M-4-M-M-M.

During the autumn-winter agricultural cycles 2017-2018, 2018-2019, 2019-2020, 2020-2021 and 2021-2022, it was evaluated as a line in experimental lots and validation plots in northwestern Mexico, in various areas of Sonora (Hermosillo Coast, Yaqui Valley and Mayo Valley), Sinaloa (Fuerte Valley and Culiacán Valley), Baja California Sur (Santo Domingo Valley) and Guanajuato (El Bajío).

The Combo-743 variety has a competitive adaptation with the best commercial varieties of each region. Its great acceptance among chickpea producers in northwestern Mexico is due to its yield capacity of 2 146 kg ha<sup>-1</sup>, and to the resistance to *Fusarium oxysporum* f. sp. *ciceris* race 5 (Velarde *et al.*, 2013) and creamy grain color characteristics.

## Varietal description

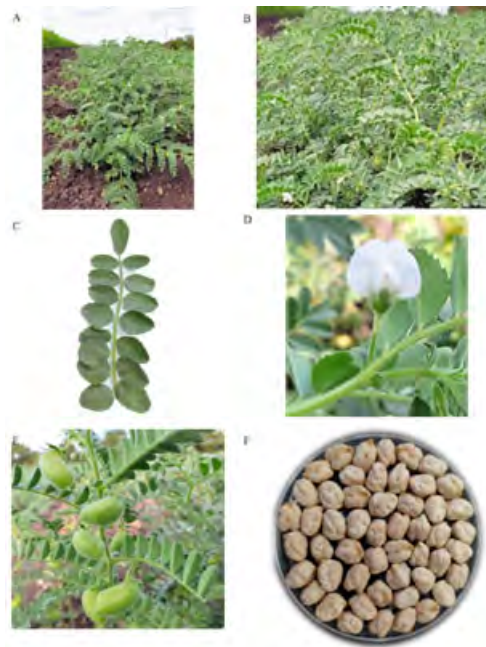
The phenotypic descriptors that identify the 'Combo-743' variety were registered in accordance with the guidelines of the International Union for the Protection of New Varieties of Plants (UPOV, 2020). The most important characteristics of Combo-743 are that it presents a plant of medium branching and height, with a semi-erect bearing, similar to the Blanco Sinaloa-92 variety, the foliage color is green with medium intensity, the leaf is of the compound type with large, oval, semi-opaque

green leaflets, the flower is white, the pod is medium in size, light green in color, and with average measurements of 25 × 15 mm.

The average grain size of Combo-743 is 70-74 g 100 seeds<sup>-1</sup>, equivalent to a caliber of 40-42 seeds 30 g<sup>-1</sup> in weight, larger than that of Blanco Sinaloa-92, its color is creamy white with pronounced roughness, similar to that of Blanco Sinaloa-92. The shape of the grain is angular round, similar to that of Jamu-96 (Gómez and Salinas, 2001).

Combo-743 produces branches 66 cm long, with an average of two primary branches and ten secondary branches. It developed the first flowers between 40 and 44 days after sowing (das), finished flowering at 90 das on average, and the maturity to cut fluctuated between 110 and 120 das, while the maturity to harvest between 126 and 135 days; therefore, it was considered to have an intermediate maturity cycle (Figure 1A-1F).

Figure 1. Phenotypic characteristics of the Combo-743 variety. a) plan size; b) foliage color; c) type of leaf; d) flower color; e) pod shape and color and f) grain shape and color.



It was registered in the National Catalog of Plant Varieties (CNVV, 2021) of the National Seed Inspection and Certification service (SNICS, 2023) with registration number: GRZ-026-170222 and breeder's title number 2952, the original seed is available at the Valle de Culiacán Experimental Field of INIFAP.

## Grain caliber and yield

In the evaluations in regional yield trials and validation plots for the producing areas of Mexico, the average was 2 317 kg ha<sup>-1</sup> of Combo-743 compared to 2 146 kg ha<sup>-1</sup> of Blanco Sinaloa-92 in five evaluation cycles. Combo-743 has a larger grain size, which contributes to a higher percentage of grain for export, between 89 and 98%, and an average caliber of 43 compared to 44 of Blanco Sinaloa-92 (Table 1).



**Table 1. Yield of origin (field), export percentage, and grain caliber of two chickpea varieties in different agricultural cycles.**

Agricultural cycles	Combo-743			Blanco Sinaloa-92		
	Yield (kg ha <sup>-1</sup> )	Export (%)	Caliber <sup>*</sup>	Yield (kg ha <sup>-1</sup> )	Export (%)	Caliber <sup>*</sup>
2017-2018	1 806	96	44	1 685	95	45
2018-2019	3 229	98	43	2 776	96	45
2019-2020	1 549	91	45	1 893	89	46
2020-2021	2 010	89	44	1 890	80	45
2021-2022	2 990	95	37	2 488	93	40
Average	2 317	94	43	2 146	91	44

\* = number of seeds in 30 g.

## Conclusions

The Combo-743 variety presented, on average, a higher yield than Blanco Sinaloa-92, of 171 kg ha<sup>-1</sup>. As for its phenotypic characteristics, it has a light green plant foliage compared to the dark green of Blanco Sinaloa-92, leaves with leaflets and pronounced serrated margin, and not pronounced in Blanco Sinaloa-92.

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