Description of cultivar

Orion: a new variety of garlic for the north central zone of Mexico

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Abstract

In order to carry out genetic improvement to generate garlic varieties that allow increasing yields in the garlic-producing areas of Aguascalientes, the variety Perla Orion of white garlic type was developed in the Experimental Field Pabellon-National Institute of Forestry, Agricultural and Livestock, derived from the clone R-35-10-1B, which is considered as an alternative to be exploited in the region due to its excellent botanical, horticultural and yield characteristics; the commercial use of the Orion variety allows obtaining from 16 to 18 t ha^{-1}, compared to the average yield of 12 t ha^{-1}, which represents an increase of over 30% and consequently the profitability of the crop.

Keywords: *Allium sativum* L., improvement, selection, yield.

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By 2015, garlic production worldwide was concentrated in China, with a contribution of 82%, India with 5%, South Korea with 2%, Egypt and Russia with 1%, respectively (Chepkemoi, 2017), during this period, Mexico participated with 0.4% and despite the low volume of production, it is considered one of the main garlic producing and exporting countries in the world, with an established area of 5 346 ha, with an average yield of 10.6 t ha^{-1} (SIAP, 2015).

Aguascalientes ranked fifth in the area devoted to this crop where the problem of a decrease in yield has arisen, in such a way that from 10.5 t ha^{-1} obtained in 1984, it decreased to 7.5 t ha^{-1} in 1991, and whose main cause was the use of seed with low productive potential, due to the fact that for many years the producers marketed the largest and highest quality bulbs and kept the smaller ones with less commercial value as seeds (Macías *et al*., 2009), similar practices have been reported in some producing regions of China (Xinhua and Wufeng, 1997), this process is known as 'negative selection' (Burba *et al*., 2005).

Garlic is a species that presents a wide plasticity to adapt to environmental variability, which is manifested through the genotype x environment interaction, this relationship facilitates the generation of clones and varieties by plant breeders for a specific region (Gvozdanovic *et al*., 2004). INIFAP has implemented a genetic improvement program by individual selection, generating varieties for different environments in the country such as INIFAP 94, Tacatzcuaro, Tinguindin, Chino Blanco, for the El Bajío area (Heredia and Heredia, 2000); San Marqueño, for Aguascalientes and Zacatecas (Macias *et al*., 2009); CEZAC-06 with excellent adaptation in the states of Aguascalientes, Durango, Chihuahua, Coahuila and Zacatecas (Reveles *et al*., 2011).

These varieties are a source of genetically uniform germplasm for other regions of the country such as Caborca, Sonora, where they evaluated the adaptation to desert conditions of varieties with high productivity and quality (Macías *et al*., 2010). Before starting a garlic breeding program, it is important to consider and ensure genetic variability in the collected clones (Gómez *et al*., 1991).

To obtain the improved varieties 'Vietnamese' and 'Creole-3', Izquierdo and Gómez (2007) and (2010) rescued genotypes adapted to the tropical climate of Cuba and with good yield potential, through the selection of more productive genotypes in farms of the best garlic producers, causing these clones to show good agronomic behavior, high yield and good seed quality.

The objective of this scientific note is to publicize the Orion garlic variety obtained by individual selection and due to its outstanding agronomic characteristics, it can be used by producers in the region.

Orion garlic variety registration

The Orion variety is owned by the National Institute of Forestry, Agricultural and Livestock Research (INIFAP) and is registered in the National Catalog of Plant Varieties (CNVV) of the National Seed Inspection and Certification Service (SNICS), with a definitive registration number Ajo-011-090318.

Origin and development of the variety

The clone that originated this variety comes from the collection of bulbs in several commercial lots of producers, with more than 100 bulbs in year one; in year two, only the bulbs with desired characteristics were selected and in year three, bulb 35 belonging to the original collection was the one that gave rise to clone R-35-10-1B; from year four to eight, the individual selection was made that gave rise to the Orion variety and later the massive propagation was carried out for its establishment in commercial lots; Figure 1 shows the scheme used to obtain this variety.

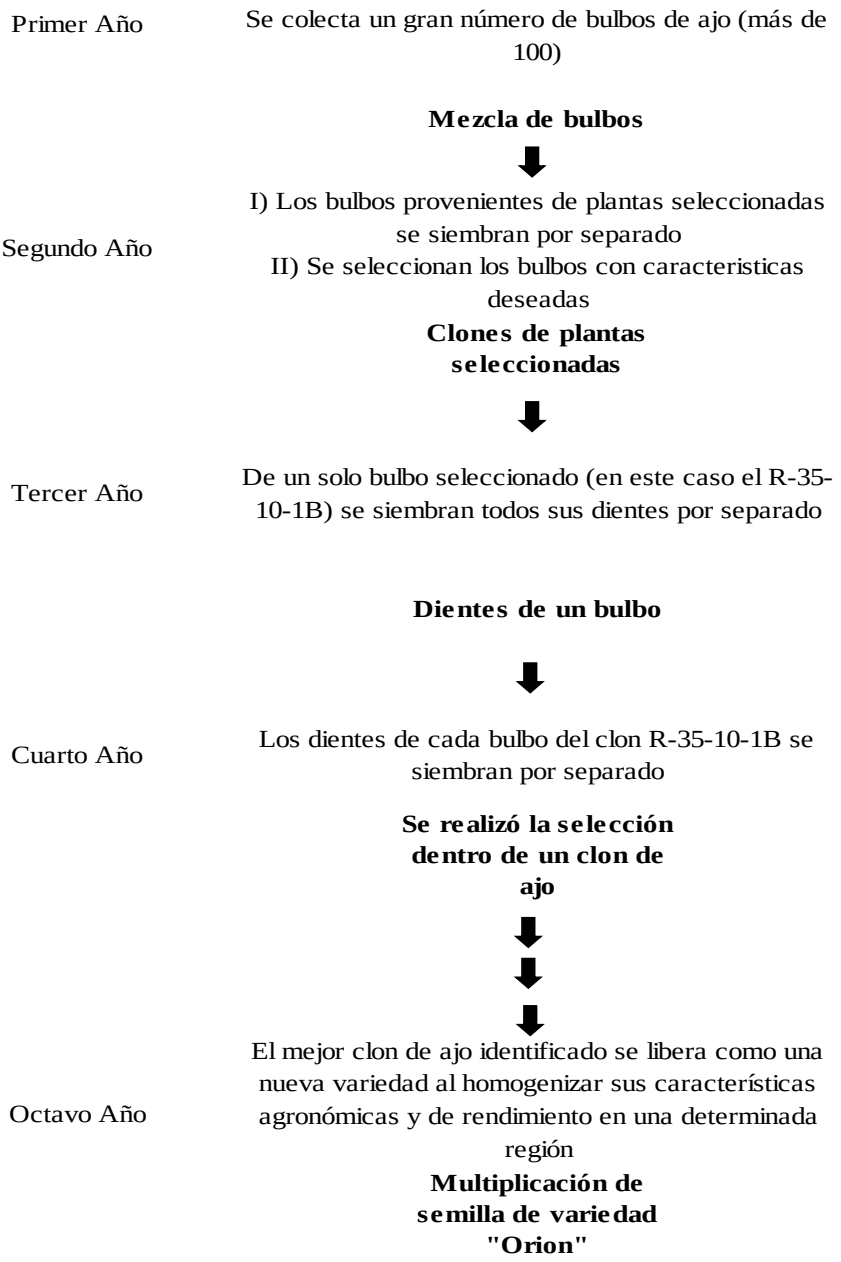

Figure 1. Representative scheme of the improvement of garlic by clonal selection to obtain the variety of garlic Orion.

The Orion variety of garlic produces pearl-type white bulbs, has a vegetative cycle of about 210 to 220 days, its bulbs are creamy white with an average of 13 tooth and covered by six to seven tunics. The average plant height is 60 cm, open foliage, with 15 leaves on average and pale green, it was obtained in the Experimental Field Pabellon of the INIFAP, through an individual selection process. It was derived from clone R-35-10-1B and this vegetative material is the property of INIFAP. Figure 2 shows the pearl type garlic origin of the Orion variety.

Figure 2. Pearl garlic origin of the Orion variety.

Description of the methodology

Orion garlic is a variety that spreads vegetatively, it arose from an individual plant, which is called a clone, as well as the progeny of that individual plant obtained by asexual reproduction over time. This variety can be defined as a group of individuals with a similar genotypic constitution, vegetatively reproduced, whose origin comes from a single ancestral zygote (Gupta, 2019).

Varietal description

It was carried out according to the methodology of the International Plant Genetic Resources Institute (IPGRI, 2001) Descriptors for Allium, which contains the list of descriptors for garlic.

Botanical characteristics. The Orion variety develops a 60 cm high plant (Figure 3), this value is higher than the San Marqueño variety and the creole Perla considered as a control (Table 1), it also has greater dimensions in the length and width of the leaf, its foliage is open with 15 leaves on average, this indicates that the plant has greater vegetative development than the genotypes with which it is being compared, the color is pale green.

"Orión"

San Marqueño

Criollo Perla

Figure 3. Comparison between the bulbs of the Orion, San Marqueño and Creole Perla varieties (control).

Table 1. Botanical characteristics of the plant and bulb of the Orion variety in comparison with the San Marqueño and Creole Perla varieties (control).

Characteristics	Orion	San Marqueño	Creole Perla (control)
Plant height (cm)	59.5 a	56.8 b	45 c
Number of leaves	14.5 a	13.9 a	12.6 b
Leaves length (cm)	50.1 a	48.8 a	39.7 b
Leaves width (cm)	3.3 a	3.3 a	2.6 b
Pseudostem diameter (cm)	1.7 a	1.7 a	1.3 b
Bulb shape	Spherical flat	Spherical flat	Spherical flat
Tooth distribution	Irregular	Irregular	Group of fans
Bulb height (cm)	4.2 a	4 a	3.96 a
Bulb diameter (cm)	6.5 a	5.7 b	5.8 b
Number of bulb covers	6 a	5.5 b	6.2 a
Bulb color	White	White	White
Disc size (cm)	2.3 a	1.6 b	2.2 a
Tooth length (cm)	3.2 a	2.9 a	3 a
Tooth width	2.6a	2.8a	2.3b
Tooth cover color	Brown	Brown	Brown

Values with the same literal are not statistically different ($p \leq 0.05$), read horizontally and for the same variable.

The bulb stands out in dimensions (Table 1), they are of a pearly creamy white color, round in shape and with teeth of an adequate size and similar to the peripheral ones with the central ones, which represents a good quality of the bulb, with acceptance both for the market national and export, with an average of 13 tooth per bulb.

Characteristics of the variety

The Orion variety shows a vegetative cycle of 210 to 220 days from sowing to harvest when it is sown between October 15 and November 15, the bulb formation approximately occurs between February 15 and March 15, it is moderately sensitive to the accumulation of cold and little susceptible to the disease of alternate. At an experimental level, the average yield of the Orion variety is 18 t ha^{-1} and in relation to its commercialization, market niches have been identified in several European countries and in the United States of North America.

Yield evaluation and scope of application

In the autumn-winter 2018 cycle, the average garlic yield at a commercial level was 12.1 t ha^{-1}, which is considered low due to the fact that it is more competitive in the domestic and export markets and due to the high costs of cultivation, it is necessary to obtain yields above 16 to 18 t ha^{-1}.

With the adoption and use of the Orion variety by the producers of the Aguascalientes region, the yield can be increased from 16 to 18 t ha^{-1} (Table 2); that is, an increase in productivity from 42 to 54%, which may present variations from one year to another, depending on the climatic conditions that occur in the region, basically related to the accumulation of cold, the management of the cultivation as the timely application of irrigation, dose and correct application of fertilizers and adequate control of harmful organisms.

Table 2. Yield of the Orion variety bulb in comparison with the San Marqueño variety and with the Creole Perla (control).

Agricultural cycle	'Orion'		San Marqueño		Creole Perla (control)	
	Yield (kg ha^{-1})	Number of teeth per bulb	Yield (kg ha^{-1})	Number of teeth per bulb	Yield (kg ha^{-1})	Number of teeth per bulb
2009-2010	17 203 a	15 a	17 820 a	13.9 b	9 922 b	14.2 a
2010-2011	17 722 a	13.4 a	15 641 b	12.7 b	9 424 c	11.5 c
2011-2012	18 351 a	13.2 b	17 156 b	14.8 a	8 033 c	11.3 b
2012-2013	20 087 a	13.4 b	19 428 a	14.4 a	9 139 b	12.4 c
2013-2014	18 208 a	14.6 a	17 764 a	14.9 a	8 118 b	13.5 b
2014-2015	10 603 a	16.6 a	10 138 a	15.5 b	3 078 b	13.9 c
2015-2016	16 362 a	17.2 a	15 571 b	16.1 b	8 579 c	16.2 b
2016-2017	16 047 a	12.4 a	16 141 a	12.2 a	7 475 b	11 b
2017-2018	15 232 a	15.7 b	15 518 a	17.4 a	7 043 b	12.6 c
Average	16 646	14.6	16 131	14.6	7 868	13

Values with the same literal are not statistically different ($p \leq 0.05$), read horizontally and for the same variable.

The yields and number of teeth obtained in the evaluations during nine cycles show a very inconsistent response, the same happens for the San Marqueño variety and the Creole Aguascalientes considered as a control, this behavior so variable over time for both characteristics allows to conclude that the environment significantly affects the behavior of this crop.

Because it is the Orion garlic variety of the white type, it has excellent adaptation to the temperate climatic conditions of the North Central region of Mexico, especially in the states of Aguascalientes and southern Zacatecas, which have colder winters than the El Bajio area, where purple type garlic is produced. This new variety is important as it meets the characteristics demanded by both the national and export markets.

Conclusions

The Orion variety corresponds to a pearl-type white garlic and is a good alternative to be grown in the North Central region of Mexico, because it has good botanical, horticultural and productive characteristics compared to the varieties used in the region.

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