VALIDATION OF THE NEW PAPA GRIMALARA TOLERANT CULTIVATION TO TIZON LATE AND FOR THE PROCESSING INDUSTRY IN THE NORTHERN SIERRA OF PERU

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Abstract

The experiment was carried out in the Llama, Cajamarca department, located at 6º22.280 'Latitude South, at 78º51.709' West Longitude and at an altitude of 2900 masl, using advanced clones obtained at the International Potato Center, Cultivated in extreme periods of climate change, such as periods of severe drought and wind, followed by high rainfall during the years 2008 to 2012, have contributed to the selection of clones naturally, adding to the objective of obtaining cultivars with high yield, tolerant to drought And quality attributes for fresh consumption and processing industry.

We evaluated 11 promising clones that were tolerant to heat and resistant to Late Blight, a cultivar obtained in the area and 2 cultivars produced at national level as controls. Environmental conditions have contributed to the natural selection of the advanced clone CIP 391580.30, its yield reached 30,581 MT/ha, color of clear yellow chips 1 chips and strips 1.5 values that correlate with its low content of reducing sugars, high percentage of Dry matter checked for its specific gravity 1.091, red-skinned, surface eyes, ovoid-round shape, Highly resistant to late blight. The phenological and genetic characteristics to determine the new cultivar for the northern sierra of Peru under the name of GRIMALARA, for fresh consumption and processing industry in all lines, purees and other derivatives whose values are higher than the standard for fresh consumption and International processing.

Key words: Advanced clones, Quality, Purees.

Introduction

The potato in Peru, is one of the most important crops of the agricultural sector in economic and social terms, produce an average of 3 million tons a year, about 270 000 hectares are planted annually, almost 600 000 families depend on their cultivation (MINAG, 2007). The mountains of the regions of Cajamarca, Piura and Lambayeque represent 20%, in this Andean zone global warming and changes in water availability are the ones that most impact, generating a series of extreme climatic alterations, such as droughts, frost And hailstones with implications on potato yields, as well as the onset of diseases, such as Late Blight and viral disease. The studies of Houghton *et al*. (2001) cited by Rubio and Kirk (2010), have estimated that the global temperature will increase between 1.4 and 5.8 ° C during the period from 1 900 to 2 100, Hijmans (2003) cited by Rubio and Kirk (2010), has predicted that global warming will decrease production in most regions where Currently produces potato in the world.

Estimates in the CIP indicate that approximately $ 1.8 billion per year is spent for the control of the world's wood, of this amount 600 million dollars correspond to the third world, within them Latin America, it is undoubted that the investment in obtaining Of resistant varieties would result in a significant rate of return and with the use of resistant varieties would achieve at least a 50% reduction in the cost of control of Late Blight (Landeo, 2000). One way to control the disease is through the use of genetic resistance (Bonierbale, 2002) and is the most economical means to counteract the effects of late blight versus chemical control.

The CIP breeding program is directing its efforts to address the effects of climate change through the generation of potato cultivars with resistance to major diseases such as late blight caused by Phytophthora infestans and viruses (PVY, PVX and PLRV) And tolerance to drought and heat (Amoros and Bonierbale, 2016). These populations group advanced clones that show high yield and good dry matter content in a range of 16 to 27% and multiple resistance, compared to the cultivar Kañareja obtained in the zone with native parents (Tirado, 2005). These show a great variability of tolerance to drought stress and high resistance to Late Blight, which is why native cultivars show genotypes with low indices of drought stress, indicating a great potential to identify native cultivars with tolerance to Drought (Cabello *et al*., 2014).

Few experiments have been carried out on the yield and industrial quality of the potato in the northern sierra, despite the fact that the low content of magnesium, zinc, copper and boron in the cold climate lands and the cultivars influence the quality for industry (Davenport, 2000). Characteristics of particular interest for processing include, low content of reducing sugars (glucose and fructose) and high specific gravity (Lemos, 1996). This has a positive correlation with the dry matter and a negative correlation with the content of reducing sugars.

The concentration of quality components of potato tubers varies by cultivar, crop management and storage system. Post-harvest handling takes into account the effect of storage temperatures on solids content and carbohydrate metabolism. The increase of the reducing sugars by cold is a problem for the industry and the fresh consumption. These sugars contribute to the browning of potato chips by their participation in the Maillard reaction (Blenkinsop, 2002). The quality of potato chips is inversely correlated with the sugar content (Li, 2008).

The commercial varieties against climate change in the study area have lost resistance to Late Blight, which does not have the appropriate variety with resistance to this disease and its processing. In order to obtain a late blight resistant cultivar with good quality for the processing industry, advanced clones of the International Potato Center have been multiplied, comparing them with cultivars obtained in the area and tested in summer and winter, in The town of Llama de Cajamarca at 2 800 masl.

Materials and methods

Materials

Treatments in study

Heat tolerant and quality clones for the processing industry and resistant to Late Blight of the International Potato Center (CIP) were used, comparing with the Canchan cultivar with national adaptation to the coast and sierra and Kañareja as regional witness of highly resistant saw To Late Blight, cleared of viruses and other pathogens in the CIP and micro propagated in the biotechnology laboratory of the Faculty of Agronomy of the National University Pedro Ruiz Gallo, acclimatized in the greenhouses of the Faculty of Agronomy.

Location of the experiment

The present investigation was carried out in the locality El Pargo of the district of Llama, province of Chota of the department of Cajamarca.

Establishment and conduction of the crop

Preparation of the terrain

The soil was plowed to a depth of 0.30 m. by the plowing step, then the plowing and sowing.

Sowing

It was done manually, placing a tuber per stroke at a spacing of 1.00 m and 0.30 m. between furrows and blows.

Phytosanitary control

Pest control was carried out in due course.

Harvest

Harvesting took place 120 days after sowing.

Characteristics to be evaluated

Tuber yield and other attributes

Commercial and non-commercial tubers of each treatment were weighed at the time of harvest.

Determination of Specific Gravity

It was carried out in the laboratory of the International Potato Center.

Determination of dry matter

It was determined from an oven sample at 105 ° C for 12 hours.

Determination of color of frying

It was carried out in the laboratory of the International Potato Center.

Statistic analysis

The Full Randomized Block was used, determining its commercial, noncommercial yield, number of tubers, plant size and ranch evaluations, and corresponding statistical analyzes were performed.

Results and discussions

For the total yield of tubers, high statistical significance was found for treatments, clone 393371.58 had 60,763 TM/ha. And clone 392634.52 with 53,000 MT/ha, with high resistance to Late Blight, being these statistically similar and exceeding 12 clones and varieties. Kañareja reached 43,095 MT/ha. Is highly resistant to rancha, followed by clones CIP 393077.159 with 39,984 TM/ha. And clone CIP 393280.64 which reached 30,581 MT/ha. They overcame Canchan variety cultivated throughout Peru, now very susceptible to Late Blight, reached 13,100 MT/ha. and Tacna grown in southern Peru reached 7,752 MT/ha.

From the subjective coloring scale of potato chips indicating the color and content of reducing sugars, it was determined that the creamy, slightly yellow pulp clone 393371.58 had the highest yield (60,763 MT/ha), highly significant and Very resistant to late blight, has 2 and 1 for chips and strips, and its specific gravity is 1,084, this clone was released as a cultivar by INIA in Cajamarca; The CIP clone 393280.64 of red skin and yellow pulp, whose yield is significant with 30,581 TM/ha., Has 1 and 1.5 for chips and strips which also indicate a low percentage of reducing sugars, 1.091 of specific gravity, being of higher quality, is resistance to late blight, would be a new cultivar for the northern region of the country, for fresh consumption and suitability for the industry prosecution. It can be seen in table 1, figure 1 and photos 1, 2, 3 and 4.

Table 1. Duncan significance tests (0.05) for total commercial yield and number of tubers and incidence in the evaluation of late blight resistant and heat tolerant clones for the processing industry in northern Peru.

Clones and / or varieties	**Yield (TM/Ha)**	**Yield commercial (TM/Ha) ***	**Nº of tub/plants ***	**% Inciden. *late Blight**	**Chips**	**Strips**	**Specific weight.**
393371.58	60.763 a	54.153 a	13.297 cd	0.00 a	2	1	1.084
392634.52	53.000 ab	39.305 b	14.737 bc	0.00 a	2.5	3.5	1.082
KAÑAREJA	43.095 bc	29.238 bcd	28.214 a	0.00 a	2.5	2.5	1.090
393077.159	39.984 cd	33.717 bc	13.298 cd	0.00 a	2.5	3	1.088
393280.64	30.581 cde	22.267 def	14.144 bc	0.00 a	1	1.5	1.091
391580.3	29.810 def	25.419 cde	11.678 de	0.00 a	2.5	2.5	1.085
YY 13	24.133 efg	21.133 def	9.664 fg	35.93 ab	2.5	3.5	1.086
800048	22.171 efg	17.067 efg	8.622 fg	60.74 b	1.5	2	1.099
YY 3	16.771 fgh	7.457 gh	10.343 ef	44.81 b	1.5	1.5	1.074
E 86 604	15.676 gh	12.629 fgh	9.664 ef	28.15 ab	1.5	2	1.106
XY 9	13.762 gh	11.924 fgh	7.529 fg	58.15 b	1.5	2.5	1.087
CANCHAN	13.100 gh	11.943 fgh	7.938 fg	34.44 ab	2.5	3.5	1.104
TACNA	7.752 h	5.114 h	6.499 g	41.82 b	3	2.5	1.077
E 86 695	6.362 h	4.143 h	7.469 fg	40.74 b	1.5	2.5	1.099
	X = 26.926 **DLS 0.05** = 12.23 **C.V.** = 27.04%	**X** = 21.108 **DLS0.05** = 21.108 **C.V.** = 28.56%	**X** = 11.856 **DLS 0.05** = 2.561 **C.V.** = 12.86%				

* Averages with similar letters do not differ statistically from each other (Duncan α 0.05)

Subjective color scale of frit from the International Potato Center:

1 = creamy yellow, 2 = creamy yellow with low presence of dark spots, 3 = creamy yellow with regular presence of dark spots, 4 = creamy yellow with high presence of dark spots, 5 = totally dark.

Figure 1. Performance (TM/ha.), Color of chip frying and strips of the advanced clones and experimental field cultivars.

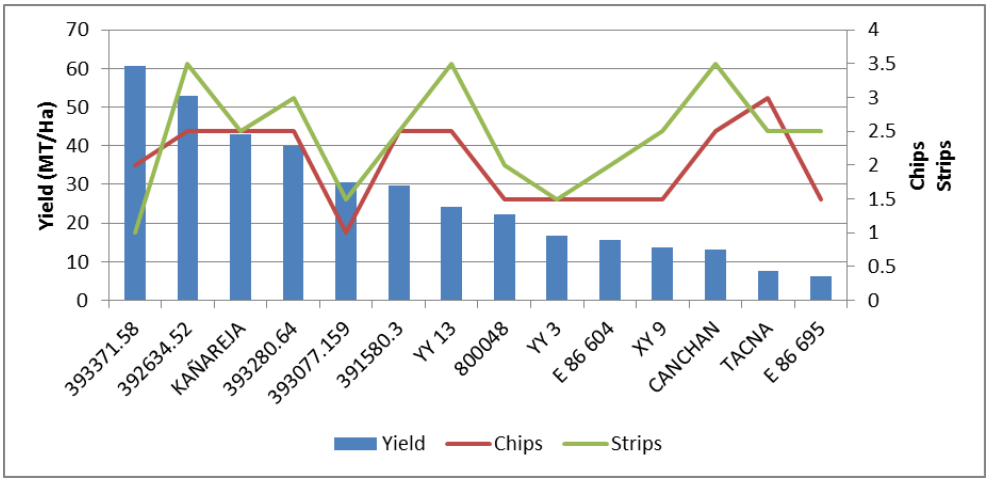

Figure 2. Photos 1, 2, 3, 4: Tubers seed, plant, tuber, promising clone chips CIP 393280.64.

CONCLUSIONS

The cultivar Kañareja reached 43,095 MT / ha. And 2.5 and 2.5 color fry chips and strips, used for fresh consumption and as a witness for its high resistance to Late Blight, beats Canchan variety cultivated throughout Peru, now very susceptible to late Blight, which reached 13,100 MT / Ha.

Clone 393280.64 reached 30,581 MT / ha, color of light yellow fried chips 1 and strips 1.5, high percentage of dry matter checked for its specific gravity 1.091 of red skin, superficial eyes, ovoid-round shape, highly resistant to Blight late. Phenological and genetic characteristics to determine the new cultivar for the northern mountain range of Peru with the name GRIMALARA.

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