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Potato Breeding for Resistance / Tolerance to Late Blight and Low Temperatures in Ecuador

INTRODUCTION

- Ecuador has a potato planted area of 29635 ha, a production of 422589 tons and an average yield of 14.26 ton / ha (FAOSTAT,2018).
- Late blight caused by *Phytophthora infestans* (Mont.) De Bary is the most important disease for this crop, reaching up 100% of losses.
- Frost damage is a major problem in potato production, its losses could cause a reduction in annual production from 30 to 100%.

OBJECTIVE

Evaluate and select potato germplasm from the INIAP´s breeding core collection for late blight and frost resistance/tolerance.

MATERIALS AND METHODS

The research was conducted in two provinces of the Ecuadorian highlands; at the Santa Catalina Experimental Station of INIAP (province of Pichincha) at an altitude of 3050 meters above sea level and at Yacupamba (province of Chimborazo) at an altitude of 3555 meters above sea level.

- Twenty nine varieties were evaluated (22 native and 7 Improved).
- A randomized complete block design (DBCA) with three repetitions and a simple correspondence analysis (ACS) was used.
- The variables evaluated were: severity to *P. infestans* expressed in area under diseases progress curve (AUDPC) (Forbes et al., 2014); scale of damage by frost (EDF) (Table 1) and yield (ton / ha).

Table 1. Frost damage scale

Scale	Frost damage
0	No visible damage
1	Light tanning o the upper leaflet
2	A few dead top leaflets
3	Many dead upper leaflets
4	Many dead leaves
5	All dead leaves and petioles
6	All leaves and dead stems (whole plant)

Vega and Bamber (1995)

RESULTS AND DISCUSSION

In the EESC and Yacupamba, frost was produced with temperatures between 0.97 to 3.44 ^{o}C and 1 to 3^{o}C respectively (Figure 1). For late blight the environmental conditions were favorable (> 800 mm of rain) for the development of the disease (Figure 2).

Figure 1. Frost damage in the EESC.

Table 2. Average and Tukey test at 5% for EDF, AUDPC and yield (ton / ha) in 29 potato varieties in the provinces of Pichincha and Chimborazo, 2017

No.	Variedades	EESC EDF	Yacupamba EDF	PG1 EDF	EESC t/ha	Yacupamba ton/ha	PG t/ha	EESC AUDPC
1	INIAP-Estela[4]	3	4	4	35.3 a-d*	13.33 a-e	24.32 a-d	168.02 a
2	INIAP-Fripapa[3]	2	1	2	25.29 a-h	21.11 a	23.20 a-e	190.27 a
3	INIAP-Catalina[4]	1	2	2	35.63 a-d	8.69 c-f	22.16 a-f	217.05 a
4	INIAP-Gabriela[5]	2	3	3	30.38 a-f	11.47 a-f	20.93 a-g	219.08 a
5	INIAP-Victoria[3]	2	2	2	31.91 a-e	18.79 ab	25.35 a-d	299.58 a
6	INIAP-Puca Shungo[3]	2	3	3	26.68 a-g	10.08 b-f	18.38 a-h	304.92 a
7	Allypacha[3]	2	3	3	23.72 b-h	8.96 b-f	16.34 c-j	309.33 a
8	Superchola[4]	3	1	2	30.48 a-f	17.47 abc	23.98 a-d	393.50 a
9	Calvache[5]	2	2	2	40.73 a	15.39 a-d	28.06 ab	405.00 a
10	INIAP-Raymipapa[4]	3	4	3	37.06 abc	14.00 a-e	25.53 abc	416.35 a
11	INIAP-Natividad[4]	3	2	2	39.76 ab	17.17 abc	28.47 a	459.67 ab
12	Coneja Negra[5]	1	1	1	14.63 f-i	6.87 def	10.75 g-j	488.17 abc
13	INIAP-Yana Shungo[3]	5	6	5	11.4 ghi	4.31 ef	7.85 h-j	506.83 abc
14	Carolina[2]	4	3	3	19.36 d-i	10.2 b-f	14.78 c-j	559.67 a-d
15	INIAP-Libertad[2]	4	3	4	21.67 c-i	3.34 f	12.50 e-j	580.35 a-d
16	Leona Blanca[5]	3	3	3	8.82 hi	4.14 ef	6.48 ij	890.33 b-e
17	Lila Shungo[3]	3	4	4	16.74 e-i	6.33 def	11.53 f-j	895.33 b-e
18	Chaucha Roja[3]	3	4	4	19.36 d-i	9.09 b-f	14.23 d-j	936.33 d-h
19	Puña Negra[5]	2	3	3	26.94 a-g	10.17 b-f	18.56 a-h	1011.83 e-h
20	Jubaleña[5]	1	1	1	36.08 a-d	13.63 a-e	24.86 a-d	1079.5 e-h
21	INIAP-Josefina[3]	2	2	2	33.95 a-d	12.82 a-f	23.38 a-e	1213.33 e-h
22	INIAP-Cecilia[5]	3	2	3	29.09 a-f	11.01 b-f	20.05 a-g	1261.25 e-h
23	Leona Negra[5]	3	3	3	20.78 c-i	7.85 c-f	14.32 d-j	1382.83 f-i
24	Capiro[4]	3	3	3	24.86 a-h	9.39 b-f	17.13 b-i	1457.00 ghi
25	Premium[3]	4	5	4	22.24 c-i	8.4 c-f	15.32 c-j	1486.67 hi
26	Uvilla[5]	3	3	3	26.55 a-g	8.99 b-f	17.77 a-h	1486.83 hi
27	Bolona[5]	1	1	1	23.88 b-h	11.21 a-f	17.55 a-i	1795.17 i
28	Chiwila Roja[5]	3	3	3	7.1 i	3.33 f	5.22 j	2304.00 j
29	Tushpa[5]	1	1	1	29.24 a-f	11.05 b-f	20.14 a-g	3135.67 k

Tuber maturity: [2] Early (120-139 days), [3] Intermediate (140-159 days), [4] Late (160-180 days), [5] Very late (> 180 days); PG Average General between environments; * Different letters indicate significant differences between genotypes according to the Tukey test at 5%

Figure 2. Late blight (*P. infestans*) in the EESC.

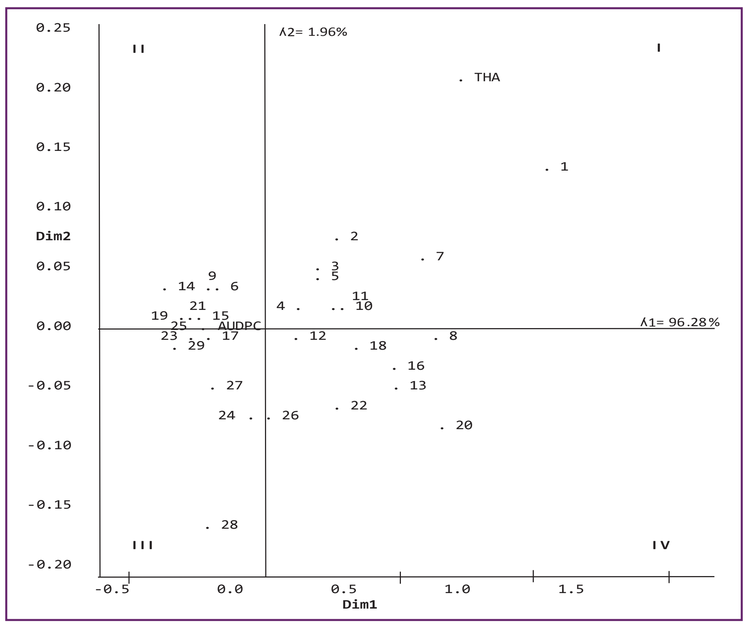

Figure 3. Dispersion of 29 varieties (Solanum sp.) According to the first two main axes (λ) of the Simple Correspondence Analysis of 2 variables yield ton / ha and AUDPC.

According to the main axes one and two (Figure 3) of the ACS it is observed that the varieties are distributed in the four quadrants. The first and second main axis had eigenvalues of λ1 = 0.34 and λ2 = 0.05, explaining 96.28% and 1.96% of the variation respectively, contributing in total 98.24% .

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