
Preliminary Evaluation of True Potato Seed Progenies for their Resistance to Phytophthora infestans (Mont de Bary), Productivity and Uniformity in Colombia

Authors: O. Pérez, R.N. Estrada, J.L. Zapata, O.S. Malamud, and J.P. Malagamba, Agronomist; Breeder, Instituto Colombiano Agropecuario (ICA) Colombia, Research Assistant; Regional Research Scientist and Senior Physiologist, the International Potato Center (CIP), Lima, Peru, respectively. Research conducted cooperatively between the Instituto Colombiano Agropecuario (ICA) and the International Potato Center (CIP).

ABSTRACT

Forty true potato seed (TPS) progenies produced at the Instituto Colombiano Agropecuario (ICA) and the International Potato Center (CIP) originated from crosses among 40 parents of several Latin American potato breeding programs were evaluated during two years for their productivity, uniformity, vigor and resistance to late blight (P. infestans, Mont de Bary).

The trials were at ICA Regional Research Center "La Selva," in Rionegro, Colombia, under semi-tropical climatic conditions.

Botanical seed of the progenies was sown in trays in a substrate of natural forest litter, sand and chicken manure. Seedlings were kept in a greenhouse for 30 days, exposed to natural environment for 10 days and then transplanted to the field where conditions for late blight infection were quite severe. Some replicates were not sprayed with fungicide.

Data on late blight resistance during plant growth, plant vigor, earliness, tuber uniformity, and yield were recorded. TPS progenies showed significant differences in resistance to late blight, yield and tuber uniformity. A market acceptability study showed only a 20% lower price for TPS-originated tubers as compared to tubers of a common potato cultivar.

Introduction

Commercial potato production in developing countries using true potato seed (TPS) seems a promising alternative for many areas. Main advantages of TPS compared to traditional potato production methods: simpler storage and transportation of seed and considerably reduced costs; eliminating losses related to storage of seed tubers; tuber seed-transmitted diseases, especially virus, minimized and therefore, a healthier and cheaper planting material would be available; the crop could be expanded to many areas where potatoes could not be introduced before due to limitations of conventional propagation methods.

Research is now taking place at several Agricultural Research Centers in different countries where improved genetic materials and agronomic practices are being developed and evaluated (1, 2, 3, 5).

In certain semi-tropical regions of Colombia, climatic conditions do not permit production and maintenance of healthy seed tubers. Therefore, total production costs are high due to transport from seed tuber producing areas. In those regions, consumers do not have strong preferences for specific tuber quality as in traditional potato areas.

Therefore, some phenotypic variability in the production of a crop from TPS could be acceptable. Information here is preliminary results of research at ICA's Regional Research Center "La Selva," Rionegro, Antioquia, Colombia. Main objective was to assess whether or not TPS progenies could advantageously compare with plants from seed tubers in productivity, disease resistance, earliness, and market acceptability.

Materials and Methods

Experiments were during the 1981-82 growing seasons. The Regional Research Center "La Selva" is at 6°20' latitude north, with an elevation of 2,130 m. Average minimum and maximum temperatures range between 11.3°C to 22.4°C, respectively. Average rainfall for the period 1979-82 was 1,841 m. Soil is a black clay silt loam with a pH of 4.5.

In the 1981 trial, TPS of nine progenies, originated from 5 open pollinated and 4 out cross pollinated (hybrids) were produced by the ICA/CIP cooperative program. The local cultivar Pan de Azúcar was used as a seed tuber propagated control.

Seedlings were produced in plastic trays using a 1:1:1 mix by volume of natural forest-litter (humus), soil, and sand. During nursery stage seedlings received weekly applications of a fertilizer solution. Seedlings were first transplanted to small plastic containers 44 days after sowing and to the field 18 days later. Seedlings were spaced in the field at 1 m between rows and 0.30 m between hills.

A randomized block experimental design with 4 replicates, using 3 rows per plot and 60 plants per replicate, was used. Periodic applications of fungicides and insecticides were made to control diseases and pests. Fertilizer (NPK 10-30-10) at the rate of 1.2 t/ha and chicken manure were applied in the field.

During plant development, late blight (Phytophthora infestans) incidence was recorded four times.

Plants were harvested 133 days after transplanting. Data on tuber uniformity (shape, size, and skin color), total weight of tubers per plot and specific gravity, measured on a random sample per plot were taken at harvest.

A total of 31 progenies from out crosses (hybrids) made at either CIP or ICA was tested in 1982.

In an non-replicated set of 31 progenies, no fungicide against late blight was applied to the plants. Thirteen other progenies in a 3-replications trial were sprayed with fungicides. Planting distances and fertilizer applications were

similar to the 1981 trial. Seedlings were grown in a mix of natural forest litter (humus), sand, and commercial chicken manure preparation at a 1:1:1 volume proportion.

Seedlings were transplanted directly to the field, bare-rooted, 51 days after growing. Planting distances were similar to the 1981 experiment. Plants were harvested 123 days after transplanting.

A marketing study observed the acceptability of potato tubers obtained from TPS progenies. A 100 kg sample of medium-size tubers classified in three skin color types (white, pink and purple) from high yielding progenies but highly segregated for color, was sent to two market sites in Medellín for sale. Tubers of the local cultivar were also sent as control.

Parental materials used in the controlled pollinations were mainly selected for resistance to late blight. In the 1982 experiment, some specific crosses for tuber shape and color uniformity were included.

Results and Discussion

Results in the 1981 trial are in Table 1. The values represent an average of four replicates. Results showed that late blight incidence was lower in all progenies than in the cultivar used as control.

Table 1. Late blight incidence, tuber characteristics and yield of 10 progenies and a local cultivar in the 1981 experiments.

	Late blight Incidence*	Tuber Uniformity (Shape, Size, Skin Color)	Specific Gravity of Tubers	Yield (t/ha)
1.	2.8	poor	1.080	17.8
2.	2.2	fair	1.082	28.5
3.	2.3	poor	1.084	27.8
4.	3.2	poor	1.082	19.4
5.	2.6	poor	1.084	18.8
6.	2.5	uniform	1.085	25.8
7.	3.0	fair	1.089	16.1
8.	2.8	poor	1.095	27.1
9.	2.7	fair	1.096	31.3
10. (check)	3.4	uniform	1.077	27.6

* Average of 4 readings. Rate 1 to 9; 1 = no attack; 9 = plant dead.

When comparing tuber uniformity, only hybrid progeny 6 was as uniform as the control. Other three progenies, 2, 7, and 9, had fair uniformity, while it was poor in the others.

Specific gravity of tubers, an indicator of total soil content, and cooking and processing quality, was higher in all progenies than in the cultivar.

When total yield was considered, progeny 9 was higher than the control and progenies 2, 3, 6 and 8 were not significantly different from it. Progenies 1, 4, 5 and 7 had considerably lower yields. In general, open pollinated and hybrid progenies did not show considerable yield differences.

Table 2 indicates basic observations for the 1982 trial. Unfortunately, no local cultivar was included in this experiment as control. Seven progenies (4, 5, 6, 8, 11, 12 and 22) showed satisfactory levels of field resistance to late blight, uniform tubers and earliness. Best performance, in terms of yield, uniformity and resistance to late blight, was by the progeny Serrana x 378044.7.

In replicates with fungicide application, higher yields resulted. Yields above 20 t/ha were from hybrids, 65ZA-5 x Pana Blanca and DTO-28 x 378198.5. This former progeny showed also high resistance to late blight in the plot without fungicide treatment and fair tuber uniformity.

Relative low yield in the 1982 experiment, especially in the plots without fungicide control, when compared with 1981 experiment was probably due to transplanting the seedlings in the center of high ridges which may have caused drought stress.

Four progenies, 4, 8, 12, and 22, had acceptable tuber uniformity as a consequence of proper parental combinations. Also, important differences in earliness and plant vigor were observed among progenies.

Market study results indicate an average price of US\$0.30 per kilo of consumption size tubers from TPS progenies as compared with US\$0.38 per kilo of tubers from the local variety Capiro. This is considered favorable implication for TPS potential, even in a country with high market standards for tuber quality and uniformity.

Therefore, considering rather strict preferences in the Colombian potato market, results of this preliminary study indicate that TPS tubers, except for a relatively small reduction in their retail price, could have adequate market acceptance. Probably the price reduction would be minimal when compared to lower production costs of a TPS potato crop.

Conclusions

Considerable differences among TPS progenies were obtained for late blight resistance, earliness, tuber uniformity, plant vigor, total yield, and tuber cooking quality. Some families were able to tolerate and produce well without fungicide applications for late blight control.

Seedlings exposed to direct sunlight by placing them in flats in the open for about 10 days before transplanting, had markedly improved plant survival if adequate moisture is provided immediately after transplanting.

Yields of TPS progeny can be as high as those obtained by normal cultivars. The range for different progenies was from 15 to 25 t/ha. Yields could be considerably increased by using proper genetic combinations selected for this particular trait.

Table 2. Late blight incidence, and some vegetative and productive characteristics of different progenies evaluated in 1982 at "La Selva" Research Center.

	Late Blight Incidence*	Plant vigor	Earliness	Tuber uniformity	Yield(t/ha)
1.	2.6	Medium	Early	Poor	7.2
2.	2.6	Medium	Medium	Poor	8.5
3.	2.0	Medium	Medium	Poor	8.9
4.	2.3	Medium	Early	Uniform	14.2
5.	2.0	Medium	Early	Fair	8.7
6.	2.6	Medium	Early	Fair	6.6
7.	2.6	Medium	Early	Poor	9.5
8.	3.0	Medium	Medium	Uniform	9.5
9.	2.0	Medium	Early	Poor	8.9
10.	2.0	Medium	Medium	Poor	7.3
11.	2.3	Medium	Early	Fair	9.8
12.	3.6	Low	Early	Uniform	6.2
13.	2.6	High	Late	Fair	14.2
14.	2.3	High	Medium	Fair	12.2
15.	1.6	High	Medium	Fair	16.4
16.	3.0	Medium	Early	Fair	6.9
17.	3.1	Low	Early	Poor	5.3
18.	2.0	High	Medium	Poor	9.9
19.	3.6	High	Medium	Fair	9.7
20.	3.6	High	Late	Fair	10.3
21.	4.3	Medium	Late	Fair	8.8
22.	3.6	Medium	Medium	Uniform	7.4
23.	4.0	Medium	Medium	Fair	11.3
24.	3.0	Medium	Medium	Fair	10.6
25.	3.0	Medium	Medium	Fair	8.9
26.	3.0	High	Late	Fair	7.8
27.	2.6	High	Late	Fair	15.8
28.	2.6	High	Late	Fair	12.6
29.	6.0	Low	Early	Fair	5.6
30.	5.0	Low	Early	Fair	12.4
31.	2.1	Medium	Medium	Fair	12.4

* Average of 3 readings. Rate 1 to 9. 1 = no attack; 9 = plant dead.

Preliminary marketing studies indicate favorable acceptance for tubers even from non-uniform progenies, showing a good potential for the economic utilization of TPS progenies in commercial operations.

The preliminary study indicated substantial potential for TPS technology including selection of high yielding progenies with resistance to late blight and uniformity.

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