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PRELIMINARY ASSESSMENT OF THE RESPONSES OF POTATO GENOTYPES IN THE EASTERN, SOUTHERN AND CENTRAL REGIONS OF ETHIOPIA

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ABSTRACT

In order to exploit the high yielding potentials and disease resistance abilities in seedling populations of tuberosum x andigena, andigena x andigena, tuberosum x phureja, and tuberosum x tuberosum clones, a selection program has been launched at the College of Agriculture in Alemaya. Over 3,000 seedling populations representing the four hybrid groups were obtained from the International Potato Center as true botanical seeds. After the fourth cycle of selection, adaptability trials of some representative clones from the hybrid populations were conducted in the 1976 crop season at Holeta, Nazareth, Alemaya, Endiber, Chenchu, Areka and Kulumsa stations. There were a number of clones which appeared to have not only a high yielding capacities, but also satisfactory field resistances to late blight. In some of the trial sites, 19-50% of the clones tried gave tuber yields of more than 1 kg per plant. At the plant population level used, such yields are equivalent to more than 40 tons per ha. This can be considered significant when compared to local average yields of about 5 tons per ha.

Potato (*Solanum tuberosum* L.) is one of the potentially important crops in Ethiopia. At present, it is estimated that about 30,000 hectares of potato are grown annually in Ethiopia (4). This area has probably gone down the last few years because of the highly devastating epidemic of late blight, *Phytophthora infestans* (Mont.) de Bary in most of the major potato growing areas of Ethiopia (3).

The land varieties of potatoes grown in Ethiopia are probably from the same parentage introduced in about 1858 by a German botanist called Shimper (6). Except for minor variations, they appear to be very similar in most of their general characteristics of susceptibility to late blight and poor yielding capacities.

There have been a number of reports indicating an outstanding yield performances and satisfactory field resistances to late blight in hybrids of *andigena-tuberosum*, *andigena-andigena*, *andigena-phureja*, and *tuberosum-tuberosum* crosses (1,2,5,7). In order to exploit the hybrid advantage of these genotypes, a selection program has been initiated at the College of Agriculture in Alemaya in cooperation with the Institute of Agricultural Research (IAR) and the International Potato Center (CIP) with the major objectives of developing potato varieties which have high yielding capacities and adequate field resistances to late blight. This paper presents results of a preliminary assessment on the yield and other horticultural reactions of some of the promising clones which were identified after four cycles of selections from the diverse potato populations.

MATERIALS AND METHODS

The hybrid populations used in these trials were developed from parents in three germplasm groups. Some of the major qualities of these germplasms are as follows:

1. *Solanum tuberosum*: high yielding abilities and good horticultural qualities.
2. *S. andigenum* (*S. tuberosum* ssp. *andigena*): high yielding abilities, resistance to diseases, adaptability to higher altitudes and low latitudes.
3. *S. phureja*: high dry matter content and resistances to diseases, insects, nematodes, and frost.

A total of 3096 potato seedling populations representing 27% *andigena-tuberosum*, 47% *andigena-andigena*, 25% *andigena-phureja*, and 1% *tuberosum-tuberosum* crosses were obtained as true botanical seeds in 1973 from CIP affiliated stations. The seeds were germinated in flats and upon germination, the seedlings were transplanted to individual pots in the glass-house at the College of Agriculture in Alemaya. After seedlings were allowed to mature in the pots, the small tubers formed were harvested. These were planted in a nursery as single hills in rows of 60 cm width with 35 cm between hills in the row. Since this was a very close planting, to minimize contaminations, the first year seedlings were harvested within 85 days of planting. In each seedling, we saved only those tubers which were attached to the mother plant.

During the growing season in the nursery, seedlings with undesirable vegetative growth were removed. At harvesting, tubers were examined and seedlings with bad tuber characters were discarded. In general, the selection of the seedlings at this stage was not too severe. An attempt was made to discard poor seedlings (considering vegetative and tuber characters) rather than selecting those which appeared good.

A total of 2303 selections were made from the single plant stage. These included 622 seedlings from *andigena-tuberosum* crosses, 1020 seedlings from *andigena-andigena* crosses, 640 seedlings from *tuberosum-phureja* crosses, and 21 seedlings from *tuberosum-tuberosum* crosses. In 1974-1976, further selections were made at Alemaya in 5-hill, 15-hill, and 35-hill plots on the basis of yielding abilities, resistance to late blight, and other desirable horticultural characteristics. As a result of the fourth cycle of selection at Alemaya, a total of 397 clones from the four hybrid groups were advanced for further evaluations.

During the 1976 crop season, adaptability trials of some of the new clones from each of the hybrid groups have been conducted in 7 stations characterized by more or less different ecological conditions. These cooperating stations were Areka, Kulumsa, Chench, Alemaya, Holeta, Nazareth, and Endiber. The altitude, the number of clones planted, the number of hills or plants used per clone, and the date of planting and harvesting for each location are given in Table 1. The clones used in the different stations were not the same in all cases, even though they belonged to the same hybrid groups. The same kind and number of clones were used in a pair of the stations — i.e. Areka and Kulumsa, Holeta and Nazareth, Chench and Endiber. Alemaya was used more or less as a standard check station where all the clones grown in the cooperating stations have also been under trial during the same season.

A single plot of 5 to 15-hill per entry at each station was used in this trial. In all the stations, plants were spaced 30 cm apart within the row and 70 cm between rows. All the trials have been conducted under rainfed conditions, except those in Holeta and Nazareth where they were irrigated early in the season. No fertilizers were used for the trials in all the stations.

TABLE 1. Some details of the stations where the adaptability trials have been conducted in 1976.

Station	Administrative Region	Geographic Location	Altitude (meters)	No. of Clones Planted	No. of hills per Clone	Date of Planting	Date of Harvesting
1. Holeta	Shoa	Central	2390	42	5	12/3/76	2/ 8/76
2. Nazreth	Shoa	Central	1700	42	5	12/3/76	2/ 8/76
3. Endiber	Shoa	Central	2050	17	10	27/3/76	5/ 8/76
4. Chenchä	Gamo Gofa	South	2880	17	5	25/6/76	1/11/76
5. Alemaya	Hararghe	East	1980	*	15	18/5/76	10/ 9/76
6. Areka	Sidamo	South	1750	19	5	30/6/76	12/11/76
7. Kulumsa	Arsi	Central	2200	19	10	7/7/76	10/11/76

RESULTS AND DISCUSSION

One of the three groups of stations where similar clones have been tried were Holeta, Nazareth, and Alemaya. The trials conducted at these stations consisted of the same 42 clones representing 6 clones in *andigena-tuberosum*, 2 clones in *andigena-andigena*, 28 clones in *tuberosum-phureja*, and 6 clones in *tuberosum-tuberosum* hybrid groups. The yields and other characteristics of these clones are given in Table 2. The tuber yields in most of the hybrid populations appeared to be quite promising. Examination of the data presented in Table 2 shows that 33, 52, and 19 percent of the clones gave tuber yields of one or more kilogram per plant in Alemaya, Holeta, and Nazareth, respectively. At the plant population level used in this trial, a tuber yield of 1 kg per plant is almost equivalent to 40 tons per ha. Except for few of the clones mainly in the *tuberosum-tuberosum* crosses at Nazareth station, all of the selections gave tuber yields of more than 0.5 kg per plant in all the stations. This is considered to be equivalent to about 20 tons per hectare. In contrast to the local average yields of about 5 tons per hectare (3,4), the yields of the new clones reported can be considered significantly high. This is an indication of the potential that exists to increase the local yields of potato in Ethiopia.

The late blight reactions of these clones were recorded only in Alemaya during the trial season. There were a number of clones which had an acceptable level of field resistances under the conditions of Alemaya. This appeared to be in agreement with the findings of Glinka *et al* (3). They reported a good resistance to late blight of some of these clones evaluated in the Phytopathological Laboratory at Ambo.

The second group of stations in which another adaptability trials were conducted were Chencha, Endiber, and Alemaya. The potato populations grown at these stations included 17 selections in which all the four hybrid groups were represented. The yields and other horticultural characteristics of these potato materials in each of the three stations are presented in Table 3. As compared to the yield performances at Alemaya, most of the selections gave lower tuber yields in Chencha and Endiber. According to the data presented, almost all the clones gave tuber yields of more than 0.5 kg per plant in Alemaya, whereas there were only three clones in Chencha and two clones in Endiber, which gave tuber yields of 0.5 kg per plant.

The lower tuber yields obtained in Chencha and Endiber, in contrast to the yields in Alemaya, was attributed to insufficient moisture and improper handling of the potato seed tubers. Both stations reported very low rainfall during the trial season. Because of the transportation problems, the sprouted seed tubers were also delayed too long before planting between the station of origin and the stations of the trial sites. It should be pointed out that in spite of such unfavourable conditions of moisture stress and poor handling of the seed tubers, there were few clones which gave tuber yields of 0.5 kg per plant (about 20 tons/ha). This can be considered satisfactory as compared to the local yields of less than 5 tons per hectare reported for these regions.

The yields and other characteristics of the 19 seedling populations tried in the third group of trial sites are given in Table 4. Surprisingly, the tuber yields in Areka station were much higher than in the other two stations. More than 50 percent of the clones tried gave tuber yields of 1 kg or more per plant. The highest tuber yields were obtained in Areka station, followed by Alemaya and the lowest yields were recorded in Kulumsa. About 30-50 per cent of the clones gave tuber yields of 1 kg or more per plant in Areka and Alemaya.

TABLE 2. Yield and other characteristics of selected potato clones grown in Alemaya, Holeta, and Nazareth in 1976.

Entry No.	Selections	Type of ¹ Cross	Eye ² Depth	Late ³ Blight	Yield in kg/plant in each station		
					Alemaya	Holeta	Nazareth
1.	R513—41	Adg x Tub	SE	3	0.86	1.5	0.90
2.	R513—8	Adg x Tub	SE	3	1.26	0.18	0.66
3.	R569—125	Adg x Tub	DE	2	1.50	1.77	0.38
4.	R569—143	Adg x Tub	DE	3	0.87	0.80	0.50
5.	R570—30	Adg x Tub	SE	3	0.96	1.00	0.80
6.	R570—66	Adg x Tub	DE	3	1.19	1.90	0.56
7.	R290—35	Adg x Adg	SE	3	0.92	1.30	0.80
8.	R290—4	Adg x Adg	SE—DE	3	1.01	1.61	0.76
9.	BR102—144	Tub x Phu	DE	4	0.49	1.00	0.66
10.	BR102—170	Tub x Phu	SE	2	0.68	0.72	1.60
11.	BR102—204	Tub x Phu	SE	2	0.61	0.92	1.00
12.	BR102—136	Tub x Phu	SE	2	1.00	0.60	0.76
13.	BR102—77	Tub x Phu	SE—DE	3	0.68	0.80	1.66
14.	BR102—82	Tub x Phu	SE—DE	2	0.83	0.64	0.86
15.	BR102—4	Tub x Phu	SE	2	1.08	0.62	1.26
16.	BR102—68	Tub x Phu	SE	2	1.05	0.92	1.28
17.	BR102—195	Tub x Phu	DE	2	0.97	1.05	0.66
18.	BR102—177	Tub x Phu	DE	4	0.45	0.80	0.36
19.	BR102—13	Tub x Phu	DE	2	1.36	1.30	1.20
20.	BR102—134	Tub x Phu	SE	2	1.22	0.75	0.88
21.	BR102—188	Tub x Phu	SE	2	0.84	1.12	0.72
22.	BR102—112	Tub x Phu	SE	2	0.84	0.55	0.80
23.	BR102—146	Tub x Phu	SE	2	1.12	1.12	0.70
24.	BR102—197	Tub x Phu	SE	1	0.75	2.06	0.50
25.	BR112—93	Tub x Phu	SE	1	0.64	1.37	0.86
26.	BR112—38	Tub x Phu	SE	2	1.05	2.00	0.50
27.	BR112—42	Tub x Phu	SE—DE	2	1.48	3.00	0.66
28.	BR112—116	Tub x Phu	SE	3	0.82	2.50	0.66
29.	BR112—100	Tub x Phu	SE	2	0.90	0.85	0.78
30.	BR112—7	Tub x Phu	SE—DE	2	0.81	2.50	0.48
31.	BR114—40	Tub x Phu	SE	2	1.13	3.57	0.80
32.	BR114—113	Tub x Phu	SE	2	1.08	1.02	1.02
33.	BR114—32	Tub x Phu	SE	2	1.05	2.11	0.98
34.	BR114—109	Tub x Phu	DE	3	1.08	0.87	1.22
35.	BR114—64	Tub x Phu	SE	2	0.90	0.60	0.80
36.	BR114—23	Tub x Phu	SE	3	0.86	1.51	0.98
37.	P2	Tub x Tub	SE	2	1.78	1.00	0.12
38.	B4972	Tub x Tub	SE	3	0.82	0.42	0.64
39.	B5502	Tub x Tub	SE	2	0.62	0.56	0.39
40.	B5704	Tub x Tub	SE	2	1.13	0.53	0.60
41.	B6402	Tub x Tub	SE	3	0.89	0.53	0.66
42.	P10	Tub x Tub	SE	2	0.73	0.52	0.47

¹ Adg = *S. tuberosum* spp. *andigena*

 Tub = *S. tuberosum*

 Phu = *phureja* Juz et Buk

² SE = Shallow eye

DE = Deep eye

³ Recorded in Alemaya

1 highly resistant -

5 highly susceptible

TABLE 3. Yield and other reactions of some potato clones grown in Endiber, Chenchä, and Alemaya during the crop season of 1976.

Entry No.	Selections	Type of ¹ Cross	Eye ² Depth	Late ³ Blight	Yield in kg/plant in each station		
					Alemaya	Chenchä	Endiber
1.	R570—84	Adg x Tub	SE—DE	3	0.70	0.04	0.13
2.	R513—36	Adg x Tub	SE	4	0.91	0.08	0.06
3.	R549—125	Adg x Tub	DE	3	0.84	0.10	0.05
4.	R188—44	Adg x Adg	SE—DE	4	0.76	0.06	0.04
5.	R188—63	Adg x Adg	SE	4	0.76	0.04	0.09
6.	R96—123	Adg x Adg	SE	2	1.07	0.16	0.02
7.	R96—95	Adg x Adg	DE	5	0.50	0.04	0.02
8.	R95—36	Adg x Adg	SE	3	0.69	0.04	0.22
9.	R95—25	Adg x Adg	DE	4	0.73	0.02	0.10
10.	R290—17	Adg x Adg	SE—DE	4	0.96	0.20	0.22
11.	R265—15	Adg x Adg	SE	1	1.18	0.18	0.27
12.	R140—70	Adg x Adg	SE	3	0.90	0.56	0.29
13.	BR112—32	Tub x Phu	SE—DE	2	1.24	0.18	0.50
14.	BR113—3	Tub x Phu	SE	3	0.80	0.04	0.06
15.	BR113—74	Tub x Phu	SE	1	0.75	0.24	0.04
16.	B6401	Tub x Tub	SE	3	0.78	0.58	0.50
17.	P10	Tub x Tub	SE	2	0.73	0.50	0.29

¹ Adg = *S. tuberosum* spp. *andigena*Tub = *S. tuberosum*Phu = *phureja* Juz et Buk² SE = Shallow eye

DE = Deep eye

³ Recorded in Alemaya

1 highly resistant -

5 highly susceptible

TABLE 4. Yield performances of potato clones grown in Areka, Kulumsa, and Alemaya stations in 1976.

Entry No.	Selections	Type of ¹ Cross	Eye ² Depth	Late ³ Blight	Yield in kg/plant in each station		
					Areka	Kulumsa	Alemaya
1.	R570—16	Adg x Tub	DE	3	1.00	0.36	0.59
2.	R570—21	Adg x Tub	SE—DE	2	2.20	0.36	2.00
3.	R140—25	Adg x Adg	SE	2	1.00	0.24	0.78
4.	R140—70	Adg x Adg	DE	3	1.00	0.23	0.85
5.	R188—44	Adg x Adg	SE—DE	4	1.20	0.30	0.76
6.	R140—41	Adg x Adg	SE	4	0.60	0.23	0.71
7.	R140—76	Adg x Adg	SE	5	0.20	0.06	0.63
8.	R140—5	Adg x Adg	SE	4	0.70	0.14	0.74
9.	R140—21	Adg x Adg	SE	2	2.20	0.10	1.16
10.	R96—123	Adg x Adg	SE	2	0.60	0.15	1.07
11.	R140—35	Adg x Adg	SE	2	1.00	0.56	0.19
12.	BR102—134	Tub x Phu	SE	2	0.60	0.16	1.22
13.	BR102—222	Tub x Phu	SE	3	0.06	0.10	1.05
14.	BR102—13	Tub x Phu	DE	2	0.60	0.06	1.36
15.	BR112—95	Tub x Phu	SE—DE	2	0.60	0.06	0.67
16.	BR112—44	Tub x Phu	SE	2	1.30	0.66	0.91
17.	BR112—42	Tub x Phu	SE—DE	2	1.40	0.31	1.48
18.	B6403	Tub x Tub	SE—DE	2	2.40	0.18	0.89
19.	P10	Tub x Tub	SE	2	2.20	0.39	0.73

¹ Adg = *S. tuberosum* spp. *andigena*Tub = *S. tuberosum*Phu = *phureja* Juz et Buk² SE = Shallow eye

DE = Deep eye

³ Recorded in Alemaya

1 highly resistant -

5 highly susceptible

Eventhough Kulumsa is in a region of favourable environmental conditions for potato production, the yields recorded were relatively low. This has been attributed to low moisture and hedgehog damage of the tubers in the field. On the basis of yield performances of the two clones (BR112-44 and B140-35) which gave more than 0.5 kg per plant in this station and the high tuber yielding capacities of the other seedling selections in regions with similar environments as Kulumsa station, it is possible to predict the possibility to develop potato cultivars which can be better adaptable to this region.

The clones from the hybrid populations grown in each station were evaluated mainly for yield, late blight resistances, and some horticultural characteristics. There were noticeable differences among the clones in relation to the evaluation criteria. Although the yield results could not be subjected to statistical analysis, a reasonable prediction can be made of the high yielding potentials of some of these clones. In relation to the local cultivars, the yield performances and late blight resistances of some of the clones from the seedling populations can be considered significant.

There were a number of clones in Alemaya, Holeta, Nazareth, and Areka stations which gave tuber yields of more than 1 kg per plant. Even in those stations with moisture stress and other problems, there were at least some clones which gave tuber yields of more than 0.5 kg per plant, which is equivalent to more than 20 tons per hectare. The result obtained clearly indicate of the opportunity to select and develop from these hybrid populations potato varieties which may have a combined characteristics of high yielding capacities and field resistance to late blight. Furthermore, in order to confirm their yield performances and other desirable horticultural characteristics, a systematic and more uniform variety trials of the promising clones selected from these hybrid populations should be tried under different ecological conditions in Ethiopia.

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