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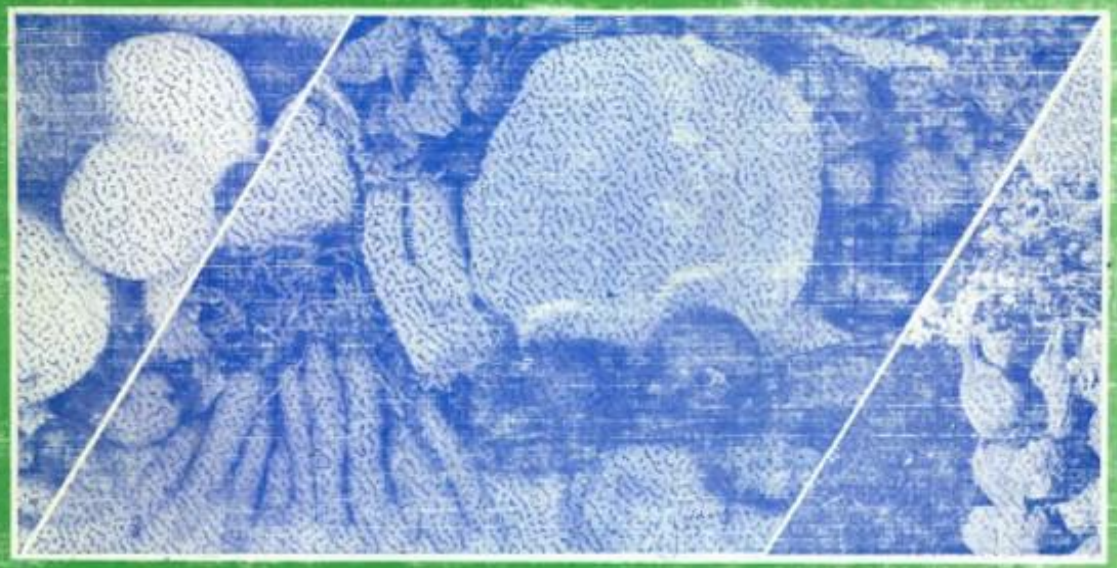

INSTITUTE OF AGRICULTURAL RESEARCH

SESSION III - ROOT AND TUBERCROPS

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In general, the results of trials undertaken over the years indicate that improved varieties such as AL-148 (Anita), AL-624 (BR-112-113) and AL-253 (CEX. 69.2) are superior in yield, quality and disease resistance to the local varieties available in the country.

All potato trials were under taken at Holecta, Bako, Indibir, Sneno, Nazareth Awassa and Jimma.

REVIEW

Observations were made on the growth and yield of some potato varieteis at Bako. Because of the unfavourable climatic conditions, the yield were extremely low. The variety B-5504-E was the best yielder with 305 q/ha (Bako Ann. Prog. Rep. 1969-1970). During the crop season of 1969/70, potato variety trials were conducted under irrigation and rainfed conditions. The trial was carried out on black alluvial soils in Ghibe plain. Since the black soil on the banks of the Ghibe river has a high water-holding capacity, three irrigation seemed sufficient. At each irrigation, approximately 200 mm of water was used. As the potatoes were planted on virgin fertile land, no fertilizer was applied. During the rainy season, another variety trial was carried out on different soils. The aim was to observe the performance of the 10 Dutch varieties on different soils and under different climatic conditions and to study their reaction to disease. The highest yielding varieties on the black soil - Spartaan and Radosa gave more than 300 q/ha. Loss of tubers due to disease were in general low, except with the variety Alpha which yielded 188 q/ha out of which 10.4 q/ha was diseased tubers. Resistance to *Phytophtora infestans* was generally high except with the variety Bintje which was nearly compeletely destroyed by the disease. On the red soil, in spite of the application of twice as much fertilizer (50 kg/ha each of N, P_2O_5 and K_2O) as on the black soils, the yields were much lower. The best yieding variety was Malta which gave 206 q/ha. The percentage of diseased tubers of this variety was however, relatively high (10.4%). Spartaan and Radosa again gave good yields - 165 and 170 q/ha respectively and disease incidence was low (Bako Ann. Prog. Rep. 1970/71). As in the previous years, several variety trials and observations were carried out under rainfed and irrigation conditions in 1970/71 on black and red soils. Out of 10 Dutch potato varieties, Malta and Gineke adapted well to the Bako area. It was reported that Malta gave a yield of 428 q/ha under rainfed conditions on red soils and 369 q/ha under irrigation on black soils. The comparable yield of Gineke was 390 q/ha and 528 q/ha respectively. An early planting at the beginning of the rainy season, resulted in a much better yield in all the varieties tested than later plantings. During this season, potato tuber moth was observed for the first time. On the irrigated dark valley soils of Bako, potatoes yielded up to 522 q/ha (Bako Ann. Prog. Rep. 1971/72).

Sixteen potato clones were tested in single observational rows of 3m at Holetta in the crop season of 1972/73. The spacing used was 70 cm between rows and

30 cm between plants in the row. Planting was done in December 29,1972 and harvesting was in April 9,1973, 110 days after planting. Nitrogen and Phosphorus was applied at the rate of 150 kg/ha each after emergence. In general, the yield obtained from the trial was considerably low (less than 50 q/ha) when compared with what farmers are getting. Porcupine damage was very serious on clones Cobra, Isola, Cosima and Digna (Department of Hort., Root and Tuber Prog. Rep. 1977/78 - 1979/80, Unpublished, IAR, Addis Ababa).

In the crop season of 1972/73, two variety trials at Bako and one at Didessa sub-station were conducted. The first trial consisting of 10 Dutch, 14 German Varieties and one local was carried out on a red soil at Bako during the rainy season. The yields were lower than in the 1971/72 cropping season due to difference of weather conditions, in spite of the same early planting date. In this trial, yield difference was highly significant. Three varieties Hydra, Datura and Cosima yielded more than 300 q/ha each. The highest yielding varieties had the lowest percentage of diseased tubers. Two diseases that caused the greatest loss in yield were late blight *(Phytophtora infestans)* and Bacterial wilt *(Pseudomonas solanacearum)* . The former disease affected, in particular, varieties Bentije, Grata, Hansa and Sieglinde, and bacterial wilt was heavy on the local variety. Digna was attacked by both diseases. Two varieties, Rheinhort and Condea, were reported to be very susceptible to early blight*(Alternaria solani)* while many of the varieties showed mild symptoms of leaf roll virus. However, symptoms of virus X, Y or A were not observed. Since potato tuber moth was problematic in the 1971/72 trial, potato tubers were treated with D.D.T + malathion mixture before planting against this pest. At Didessa, variety trial consisting of 9 Dutch and German varieties was carried out under rainfed conditions. Yields ranged from 68 to 280 q/ha and several varieties performed better at this location than at Bako. Five varieties - Isola, Rhinehort, Patrones, Clivia and Hydra gave over 200 q/ha each. In this year, a third variety trial consisting of 23 German varieties was conducted under irrigation at Bako. An overhead sprinkler irrigation was used at weekly intervals at the rate of 35 mm. No fungal disease appeared due to the very low relative humidty. Neither bacterial wilt nor the potato tuber moth was recorded. Precautions were taken by treating the seed potatoes with D.D.T. + Malathion and removing Datura weeds which serve as host plants. Ten varieties gave yields of more than 300 q/ha each, 9 yielded between 250 and 300 q/ha while only 4 varieties gave below 250 q/ha (Table 1). It was observed that the earliest maturing varieties were lower in yield than the rest. (Bako Ann. Prog. Rep. 1972/73). Another potato variety trial consisting of 16 varieties was carried out at Awassa in 1972/73 using irrigation. The performance of most of the cultivars was very satisfactory. While Bako gave tuber yields of 353 q/ha, about half of the varieties gave tuber yields over 200 q/ha (Department of Hort. Root and Tuber Prog. Rep. 1977/78 - 1979/80), Unpublished IAR, Addis Ababa).

A five-hill nursery plantings of 215 clones representing seedlings from Andigenum - Tuberosum, Andigenum - Andigenum and Tuberosum - phureja crosses were planted on August 5, 1975 at Holetta and Adama farm of the Nazareth Station. In these trials, it was intended to observe the performance of these populations under different environmental conditions. In this season, a screening and adaptation trial was conducted at Bako Station. There were different and specific objectives for conducting the screening programme at this experiment station. Bacterial wilt is known

to be very prevalent in Bako area and it was chosen to be the center for bacterial wilt screening trial. Five tuber samples of 316 clones representing mainly Tuberosum - phureja crosses were planted on August 27, 1975 on soils known to be infected with the wilt-causing pathogen. It was observed that 75% of the seedlings were destroyed by the wilt disease. The infection appeared so early and was not possible to follow up the vegetative and other horticultural characteristics of the clones. It has been also reported that among the 316 clones planted, only 50 clones survived up to harvesting. It was recorded that the 50 clones which survied might not have some resistance because the distribution of the wilt causing pathogen was not uniform in the field where the screening trial was conducted.

Further evaluation in a uniform infected soil would be necessary to isolate clones that may have resistance to the organism causing the bacterial wilt (National crop Improvement Committee, 1975, IAR, Addis Ababa).

In 1976, an observational trial of 91 different clones and varieties was conducted at Nazareth. These materials were irrigated for the first two months to catch up with the rain in the later part of their growing period. The yields in most of these materials were quite satisfactory. Eighteen of these clones planted gave tuber yield of more than 1 kg/plant. For the second time, another observation trial was conducted at this station using rainfall. The yield reports for the crop season of 1976 from this station were comparatively lower than the previous year. It was reported that unfortunately, there was not sufficient rain right after plantings and during most of the growing periods of this trial. Even under such unfavourable moisture conditions, some of the selections and varieties (ARE-69-1, B-6401, B-4972, CFC-69-1, B-6402, B-6334, B-6403, Spunta and Annet) gave satisfactory tuber yields. It has been also reported that, on the basis of field observations made, a large proportion of these materials had sufficient field resistance to late blight. In March 1976, 88 clones and varieties were planted in 5-hill observational trial at Holetta. It appear that the Holetta condition is exceptionally suitable for high yield production of the potato. More than 50% of the clones tried, gave a tuber yield of more than 1 kg/plant. Clones - R-570-60, Br-102-168, Br-1202.197, Br-112-7, Br-112-116, Br-112-42 gave tuber yields of close to 1 kg/plant. At a spacing of 30 x 70 cm between plants and between rows respectively, this yield is equivalent to about 40 tons/ha. It should be pointed out that there was no fertilizer used in this trial (National Crop Improvement Committee, 1976, IAR, Addis Ababa). Another potato variety trial consisting of thirty clones at Holetta in 1976 showed low yield due to high incidence of late blight *((P. infestans)*, early blight *(Alternaria solani)* and damage of tubers by porcupine. It has been also reported that long storage of planting materials under poor conditions and poor land preparation during planting time contributed to the low yield of tubers. (Department of Hort. Root and Tuber Prog. Report 1978-1979/80, Unpublished, IAR, Addis Ababa).

143 different clones of potato from Tuberosum - phureja crosses were planted in 1976 at Bako. The objective and other cultural practices were the same as that for 1975 potato screening and adaptation trial at Bako. It was reported that the following 8 clones were partially infected late after flowering by the bacterial wilt.

1. Br-102-38
2. Br-113-67
3. Br-112-8
4. Br-102-20
5. Br-113-38
6. Br-113-86
7. Br-1-1-22
8. Br-113-22

5 clones listed below did not show any visible wilting symptoms.

1. Br-112-116
2. Br-113-41
3. Br-112-145
4. Br-102-145
5. Br-114-107

This result is encouraging in that some of the clones from these crosses may turn out to have satisfactory resistance to this serious potato disease (National Crop Improvement Committee, 1976, IAR, Addis Ababa).

Three potato variety trials were executed at Holetta in 1977/78 - 1978/80, with the objective of identifying the best adapted and high yielding cultivars for the area. Planting materials were obtained from the College of Agriculture, Alemaya. It has been reported that, in many cases, the tuber seeds were not in good condition. Due to long storage and long distance transportation from Alemaya some tubers were rotten while others had disprouted. From 1977/78 crop season trial, considerable differences were observed in tuber yield among cultivars. The highest yielder USDA/6 (557.7 q/ha) gave more than four time yield than that of the least yielder M-15 (129.6 q/ha) and Mago (122.6 q/ha). This indicated that certian cultivars are more adaptable to the area than others. Continuous screening trials could enable clones that are well adapted to the area to be obtained. In 1978/79 project year, 27 different cvs from that of 1977/78 were tested in a plot size of 4.5 m^2 and a spacing of 75 cm between rows and 30 cm between plants in the row used. Al-M-6 gave significantly higher yield than the other cultivars except Al-M-9 and Al-M-1. These two cultivars gave significantly higher marketable yield than the remaining cultivars except Al-M-35, Al-M-17, Al-U7. In general yields were low at Holetta (Table 2).

In the crop season of 1979/80, 25 different clones from the previous year and one local check were tested. It was reported that except for AL-344 and local check, the stand percent was satisfactory. The yield was generally good (Table 3). AL-477 (R-96-99), local check, AL-257 and AL-344 gave the highest percentage of unmarketable tuber yields (50% and above). All the clones gave significantly higher total tuber yield than the local check. (Department of Hort. Root and Tubers Prog. Rep. 1977/78-1979/80, Unpublished, IAR, Addis Ababa).

Starting 1978/79 cropping season, potato variety trials were conducted at Indibir. Planting materials were poor like those at Holetta. Only two cvs were used resulting in small sized plots and few replications. Although the

yield was not subjected to statistical analysis, the varieties Al-M-17, Al-M-20 and Al-M-1 yielded 46.67, 45.56 and 45.11 q/ha respectively. Low yield was obtained from this trial because of damaged planting materials and late planting in July 14, 1978 (Department of Hort. Root and Tuber Prog. Rep. 1977/78-1979/80, Unpublished, IAR, Addis Ababa).

In 1979/80, 25 different varieties and one local check were tested. The amount and condition of planting materials at arrival was unsatisfactory. Therefore, two rows with 10 tubers each were considered as a plot. Nitrogen and phosphorus in the form of DAP was applied at the rate of 64 kg N and 164 kg P_2O_5/ha at planting time. Many tubers failed to germinate due to their poor condition before planting. Late blight was observed on some clones early in the growing season. However, high marketable and total yield were obtained from the improved cultivars when compared with the yield of the local check. This was an encouraging result in the densely populated Enset growing regions of the area. The major constraint at present with potato development in the area is lack of reliable planting materials. Other problems such as storage facilities for both ware and seed potatoes need to be solved (Department of Hort. Roots and Tubers Prog. Rep. 1977/78- 1979/80, Unpublished, IAR, ADDis Ababa).

Thirty potato clones were tested in single observation plots at Jimma, the major objective being to observe their level of resistance to late blight and yield. It was observed that disease incidence was not serious except for a few clones. AL-568 (Br-114-114) gave the highest yield (414 q/ha) followed by AL-608 (393 q/ha) AL-542 (363 q/ha) and AL-444 (362 q/ha) (Department of Hort. Root and Tubers Prog. Rep, 1977/78-1979/80, Unpublished, IAR, Addis Ababa).

Three separate variety trials under the general title potato National Yield Trial were conducted at Indibir in 1980/81 crop season. These trials were labeled groupI, II and III for quick reference. Seed tubers were not enough in some plots, because of rotten and disprouted tubers. In the first group, ten varieties were used. Five clones AL-646 (Br-113-72), AL-624 (Br-112-113), AL-634 (Br-113-67), Al-562 (Br-114-40) and Al-252-CGN 69.1 gave total yields above 500 q.ha. AL-624 (Br-112-113, AL-634 (Br-113-67 and AL-200 gave relatively higher marketable yield. On overall performance, AL-634 (Br-113-67) and AL-624 (Br-112-113) were found to be superior over the other clones in the group. In group II, twelve clones were entered. Very small plot sizes were used for AL-510 (Br-102-139) and yield was exaggerated to be 705.26 q/ha. AL-563 (Br-114-32), AL-634 (Br-113-67), AL-417B (R-28-86) were found to be superior in marketable yield which yielded more than 230 q/ha each. In the third group, twelve clones were included. As in other group, shortage of planting material was experienced. Al-148 (Anita) was found to be superior over the other clones in marketable yield (281.7 q/ha) and was also second (567.4 q/ha) in total yield after AL-517 (Br-102-215) which yielded 610.9 q/ha (Roots and Tubers Research Team, Hort. Sec. Prog. Rep. 1980/81-1982/83, Unpublished, IAR, Addis Ababa).

A series of variety trials and variety observation trials were conducted at Holetta during 1980-1982/83. Most were potato National yield trials for which all planting materials were received from Alemaya. It was difficult to draw any conclusions since different clones were used at different times. In 1980/81 cropping season, 15 clones that have wide adaptability and 9 clones

that are expected to adapt well on the highland were tested. In this trial AL-148 (Anita) and AL-252 (CGN 69.1) were observed to be relatively tolerant to late blight. On the other hand, AL-646 (Br-113-72) and AL-634 (Br-113-67) were found to be more susceptible to this disease. AL-252 (CGN 69.1) gave significantly higher marketable tuber yield than all the clones except AL-624 (Br-112-113), AL-148 (Anita) and AL-517 (Br-102-215). These three cultivars in turn gave marketable tubers significantly higher from the others except AL-253 (CEX 69.1), AL-562 (Br-114-40) and AL-560 (Br-114-60). In general, those clones which gave higher total tuber yield gave higher marketable yield (Table 4). From this trial, it was observed that variation in yield was very high, AL-255 (ATK 69) giving 72.4 q/ha while AL-624 (Br-112-113) gave 585- q/ha) therefore it could be inferred that the possibility of getting a variety adaptable to the area was high. In a high altitude adaptability trial, 9 cultivars were entered. All clones were attacked by late blight, although the severity differed among the cvs. AL-624 (Br-112-115) and AL-110 (Br-112-69) was found to be less susceptible to the disease (Lb). AL-557-Br-114 AL-252 (CGN 69.1) and AL-264 (IND 73) gave yields of 534.5, 530.9 and 462.6 q/ha respectively(Table 5), (Roots and Tubers Research Team, Hort. Sec. Prog. Rep. 1980/81-1982/83), Unpublished, IAR, Addis Ababa).

A variety trial consisting of 21 clones was tested in 1981/82 at Bako. DAP at the rate of 300 kg/ha was broadcasted and then incorporated with the soil before planting. In this trial, it was observed that plants were free from late blight infestation till flowering. The varieties, AL-568 (Br-114-114) Al-646 (Br-113-72) and AL-148 (Anita) gave a yield of 435.9, 374.9 and 367 q/ha respectively (Table 6). During this cropping season (1981/82), a variety trial was carried out at Holetta. It was reported that all the clones were attcked by late and early blight starting one month after planting. Considerable differences inthe severity of late blight among clones were observed. In this trial, AL-204 (B5504 M_2) and AL-148 (Anita) gave the highest yields of 225.5 and 221.8 q/ha respectively and they were found to be tolerant to late blight (Table 7). Red ant, mole rat and porcupine were found to be major pests in the trial. Potato tuber moth was also observed but was not serious. The local check was significantly inferior in marketable and total yield than other clones. (Roots and Tubers Research Team, Hort. Sec. Prog. Re. 1980/81-1982/83, Unpublished, IAR, Addis Ababa).

Another variety observation trial was carried out at Indibir in 1981/82. In this observational trial thirteen clones were tested. As in other trials, the condition of the planting material was poor, i.e. seed tubers were disprouted and rotten during transportation. Three of the 13 clones (AL-700, 701 and 702) failed to form tubers due to severe infection by late blight. AL-204 (B5504-M_2) was observed to be slightly more tolerant to this disease than the others. Potato tuber moth was also observed but not serious. Red ant was said to be a serious problem, which was the major reason for unmarketability. In this trial, AL-148 (Anita), AL-616 (Br-112-32) and AL-107 were high yielders, giving 244,215 and 170 q.ha respectively. (Root and Tubers Research Team, Hort. Sec. Prog. Rep. 1980/81-1982-83, Unpublished, IAR, Addis Ababa).

A potato variety observation was also conducted at Sheno in 1981/80 cropping season. Planting materials for this trial were also in poor condition. Eleven of the clones included performed poorly at this station. Due to its high altitude (2820 m.a.s.l) there was a serious frost incidence. Frost tolerant clones are expected to do well in such area. Disease and insect damage

was not serious at this site. The major reasons for low yield and poor quality harvest was the poor planting material, frost damage and lack of moisture in the soil during planting. In spite of all these problems, some clones such as AL-701, AL-702, AL-634 (Br-113-67) and Al-107) yielded 174, 174, 165 and 152 q/ha respectively. (Roots and Tubers Research Team Hort. Sec. Prog. Rep., 1980/81-1982/83, Unpublished, IAR, Addis Ababa).

With the objectives to monitor the adaptability of the improved potato varieties, twenty clones were tested at six IAR/ADD testing sites in 1981/82. The trial was replicated only at Shambu. The design used was RCB with 3 replications. The others were laid out as observational trial. In all the locations, fertilizer, DAP, at the rate of 300 kg/ha was applied. At Shambu, clones AL-615 (Br-112-64), AL-204 (B5504 M_2), AL-253 (CEX 69.2) gave the highest yield of 216.9, 190.5 and 187.3 q/ha respectively. On the other hand, AL-569, AL-580 (Br-114-70) and Al-578 (Br-114-121) gave very low yields of 20.9, 63.3 and 64.2 q/ha respectively (Table 8). Of all the varieties, AL-634 (Br-113-67) gave the highest marketable percent of 92.8%. Even though the degree of infestation by blight *(P. infestans)* differed from variety to variety, none of the cultivars were completely free of the disease. In general, the improved clones showed good stand and higher yield than local check at all the test sites. With better management, it seemed that better yields could be obtained specially at Robe, Bure, Mota and Debre Tabor. (IAR/ADD Joint Research and Extension Programme, Prog. Rep, 1981/82).

A demonstration trial on farmers field was conducted using different cvs at Bako, Holetta and Indibir. At Bako the trial was conducted on three sites, one on farmers' cooperative and two on individual farmers' fields. From these trials, it was reported that promising cultivaras were observed with respect to yield and late blight tolerance. High marketable and total yields of about 400 q.ha were obtaiend from AL-567 (Br-114-131), AL-563 (Br-114-32) and Al-575 (Br-114-30) on Gambella Tere Producers Cooperative, Gebremedhin and Guna fields respectively. In general, the clones tested on farmers' fields were found to be high yielders and relatively tolerant to late blight compared with local varieties. At Indibir, three farmers sites were chosen and five clones in observational plots were planted at each sites. The vegetative growth of plants was satisfactory. During harvesting, clones were mixed by mistake by farmers and some tubers were also stolen. As a result the data of the first site was discarded. On the second site, tubers failed to emerge. This happened mainly due to rotten seed tubers received from Alemaya. Low and poor yield were obtained from the third site at Indibir. Proper care such as cultivation, weeding and protection against animal damage was not given to the trial. From the third site, AL-517 (Br-102-215), AL-570 (Br-114-36) and Al-201 yielded 265.3, 220.2 and 205.1 q/ha respectively. The 1981/82 demonstration trial at Indibir was carried only in one site (Asteppo). Plot size of 27 m^2 was the same for all clones. None of the last year clones was included in the current years trial so it was difficult to compare the two years' result. However, the current year's marketable and total tuber yield were considerably higher than that of 1980/81 demonstration trial. Unmarketability of tubers was reported to be due to rot, insect damage, undersized and oversized tubers. AL-575 (Br-114-39) led in marketable yield (212 q/ha) followed by AL-563(Br-114-32) (119 q/ha) and AL-624 (Br-112-113) (159 q/ha). AL-253 (CEX 69.2) performed least in all aspects. (Root and Tubers Research Team, Hort. Sec. Prog. Rep. 1980/81-1982-83), Unpublished, IAR, Addis Ababa).

Other potato demonstration trials were conducted on two farmers' association fields in 1980/81 around Holetta. From this trial, it was reported that unmarketable tuber yield was high at both sites (more than 50%). AL-624 (Br-112-113) and AL-563 (Br-114-32) were found to be relatively better at Misrak Sholaber and Wolmera Choke respectively. In 1981/82, the demonstration trial was repeated on two sites namely, Misrak Sholaber and Markos. This time, the same clones four in number, were tested at both sites. Yield was found to be high when compared with 1980/81. The overall performance at Misrak Sholaber and better than Markos. AL-568 (Br-114-114) gave 120 and 71 q/ha marketable yield at Misrak Sholaber and Markos respectively. In general, AL-568 (Br-114-114) (203 q/ha) followed by AL-517 (Br-102-215) (202 q/ha) were high yielders compared with mean of the two sites. Farmers who got the chance to visit the demonstration trial asked for the improved potatoes and many farmers association showed their interest to have a demonstration trial on their farms. To understand problems involved in potato production and to monitor the performance of the improved varieties on farmers' fields such demonstration trials should be conducted on larger plot sizes than the previous trials (Root and Tubers Research Team , Prog. Rep. 1980/81-1982/83, Unpublished, IAR, Addis Ababa).

Four Dutch cultivars in 1982/83 and six cvs in 1983/84 were obtained from Wolf and Wolf Potato Seed Company to test their adaptability under Ethiopian conditions. Cardinal was suspected of scab by the quarantine officer and was grown in isolation and was released as free material after the second growing season. No disease sysmptom was observed in 1982/83, but was observed in 1983/84, because in the first season, the trial was conducted under irrigation while production was rainfed in the second planting. Yields were also high in the first growing season in all varieties. (Root and Tubers Research Team Prog. Rep. 1980/81-1982-83, Unpublished, IAR, Addis Ababa).

In 1982/83, planting materials maintained from 1981/82 variety trial were planted at Bako. In this trial, AL-570 (Br-114-36), AL-575 (Br-114-39), AL-567 (Br.114-131), AL-568 (Br-114-114) and AL-578 (Br-114-121) showed slight blight symptoms earlier than the others. Egyptian leaf worm was also reported in this season and virus disease was serious on AL-569. In general, yield was satisfactory (Table 9), considering the fact that the materials were grown at Bako for the third time, the same trend having been observed as in 1981/82. (Root and Tuber Research Team, Hort. Sec. Prog. Rep. 1980/81-1982/83, Unpublished,IAR, Addis Ababa).

In the crop season of 1982/83, a variety trial consisting of 20 clones was conducted at Holetta. From the varieties included, AL-580 (Br-114-70), Al-560 (Br-114-41) and AL-563 (Br-114-32) were completely wiped out by late blight before tuber initiation and prior to flowering. It was also reported that AL-528 (Br-114-121), AL-601 (Br-112-42) and AL-257 gave high yields of 459.3, 414.7 and 398.9 q/ha respectively. On the other hand, AL-556 (Br-114-26) gave low yield 99.5 q/ha of which 55.33 q/ha were unmarketable yield (Table 10). Root and Tuber Research Team, Hort. Sec. Prog. Rep. 1982/83, In Preparation, IAR, Addis Ababa).

Several conflicting figures were reported with potato yields on farmers' field. Yield figures varied depending on the area, cultivation, cultural practices used and effort put in by individual farmers regarding, ridging, weeding and harvesting. Therefore, to obtain an idea of yield and understand the problems

involved with the farmers, yield assessment was done on five potato grower's (farmers association) fields around Holetta in 1980/81. Considerable yield differences were observed (Table 11) among growers. These were atttributed to disease incidence mainly late blight, use of unknown and different spacings, ridging, planting date, harvesting date, harvesting techniques and other cultural practices. It was also observed that most of the farmers usually left their potato unharvested for a long time using the soil as a store. Those farmers who harvested their potatoes 3-4 months after planting obtained higher marketable yield comparatively than those who left the tubers for long time in the soil. This is due to loss of tuber weight, insect and disease damage. Generally, it was observed that the mean yield of the 5 potato growers was about 150 q/ha. Therefore, introduction of disease-tolerant, high yielding cultivars and proper use of cultural practices is believed to improve the existing low yield obtained by farmers (Root and Tubers Research Team, Hort. Sec. Prog. Rep. 1980/81 - 1982/83, Unpublished, IAR, Addis Ababa).

POTATO PRODUCTION CONSTRAINTS

1. Lack of Coordianted Research Programme

There are many institutions involved in potato research in the country without any coordination. Uncoordinated research programmes will result in the wastage of resources and manpower.

2. Lack of Certified Seed Potato Supply

At present, there is no organization/institution which produces and distributes certified seed potato. In view of the fact that potato is subject to different vital, bacterial and fungal diseases which may be carried by the tuber, the need for certified, healthy seed potato supply cannot be overemphasized.

3. Lack of High Yielding and Disease Resistance Varieties

The yield potential of the local potato varieties is very low resulting in low potato production in the country. These local varieties are also susceptible to early, late blight and bacterial wilt which considerably reduce tuber yields. Therefore, to promote potato production and expansion in the country, high yielding and disease resistant varieties have to be introduced.

4. Poor Agronomic Practices

The advantages of using the optimum plant population, rate and method of fertilizer application and pest control practices, row planting and best method of cultivation have not been adequately investigated and extended to growers.

5. Lack of Storage Facilities

The potato tuber, being a living organ, is subject to rot, decay, shrinkage and sprouting, if specific storage requirements are not met. In Ethiopia, there is lack of storage facilities for both ware and seed potatoes, thus resulting in price fluctuation in ware potatoes and reduced quantities of seed potatoes for expansion at research and production levels.

6. Lack of Trained Manpower and Funds

There are very few trained horticulturists in the country and funds allocated for potato research is so small that a sound potato research programme cannot be carried out at this time.

FUTURE RESEARCH DIRECTION

1. Screening and evaluation of already introduced varieties for adaptability to the different ecological zones of the country. These varieties will be screened for their high yield potential, tolerance to the major insects and diseases, drought resistance and earliness.

2. Introduction of a wide range of new potato germplasm of better yield, quality and other characteristics than the current itnroduced or local varieties.

3. Agronomic studies:

   - The type, rate of application and placement of fertilizers.
   - Plant population, planting date.
   - Planting depth.
   - Insect and disease control practices.
   - Rotation, mixed or double cropping.
   - Rapid potato seed multiplication techniques.

4. Ware and seed storage studies.

Emphasis must be given to storage. Studies to develop low cost improved storage technology to maintain quality seed potatoes and stablize market supply.

5. Farming system studies. When a recommended package is developed, it has to be tested under the farmers' condition.

Table 1: Yield results potato variety trial, Bako, 1972/73.

Rank	Variety		Yield q/ha	Big %	Medium %	Small %
1	I sola	M	331.4	16.00	66.90	17.10
2	Clivia	M	329.5	11.30	67.10	21.60
3	Hansa	M	326.3	9.20	60.80	30.00
4	Grata	M	326.3	13.10	67.20	19.70
5	Condea	L	320.5	5.80	76.80	17.40
6	Bison	L	318.6	19.90	70.40	9.70
7	Hydra	M	310.9	22.60	66.80	10.60
8	Baku	L	308.3	13.20	70.80	16.00
9	Digna	L	305.00	21.20	60.00	18.80
10	Cosima	M	303.80	16.40	64.30	19.30
11	Arensa	M	300.00	6.60	69.20	24.10
12	Olympia	M	296.20	4.20	70.00	25.80
13	Ulla	M	287.20	18.50	73.10	8.40
14	Fanal	L	276.30	9.30	80.70	10.00
15	Nemea	M	275.00	18.10	50.20	23.70
16	Maritt	M	275.00	16.20	73.00	10.70
17	Cobra	E	274.40	17.70	61.90	20.40
18	Fina	M	255.10	27.60	56.70	15.70
19	Datura	E	251.50	9.90	69.50	20.60
20	Rheinhort	E	246.80	26.50	56.10	17.40
21	Saphir	M	246.20	5.70	78.30	16.00
22	Seiglinde	E	273.50	9.40	60.50	30.10
23	Thyra	E	197.40	23.70	57.60	18.60
	Mean		± 288.45	15%	67%	18%

LSD (for yield)	q/ha
5%	56
1%	75

E = Early maturing
M = Medium maturing
L = Late maturing

Table 2: Marketable yield in q/ha, potato variety trial, Holetta, 1978/79.

Treatment (clones or cultivars)	Late blight disease Score (1-5)	Yield in q/ha		
Al-M- 6	2	184.00	a	A
Al-M- 9	1	157.78	ab	AB
Al-M- 1	2	151.56	abc	ABC
Al-M-20	1	120.67	bcd	ABCD
Al-M-35	3	104.89	bcde	BCDE
Al-M-17	3	102.44	bcdef	BCDE
Al-M- 7	2	99.33	bcdef	BCDE
Al-M- 4	3	93.33	cdef	BCDE
Al-M-12	4	89.56	defgh	CEF
Al-M-21	2	89.56	defgh	BCDE
Al-M-28	4	89.33	defgh	BCDE
Al-M- 2	4	79.56	defghi	BCDE
Al-M-19	1	73.78	defghi	CDE
Al-M-14	3	65.56	defghi	DE
Al-M-22	3	64.89	defghi	DE
Al-M-24	4	64.67	defghi	DE
Al-M- 3	4	60.67	defghi	DE
Al-U- 3	3	56.67	efghi	D
Al-U- 1	3	53.78	efghi	D
Al-M- 4	0	41.78	efghi	DE
Al-U- 8	3	41.56	efghi	DE
Al-U- 2	2	38.89	fghi	DE
Al-M-18	4	32.89	ghi	E
Al-U- 9	4	31.78	ghi	E
Al-U- 6	3	26.22	hi	E
Al-M-13	3	24.89	i	E
Al-M- 8	3	23.33	i	E
Mean		76.42		

Mean separation by Duncan's multiple range test - Mean in columns that are not followed by the same letter (s) are significantly different at 5% (small letters) and 1% (capital letters) levels of significance.

Table 3: Yield and other data, potato variety trial, Holetta, 1979/80.

Treatments (clones and cultivars)	Stand % at harvest	Flower color	Marketable Average Tuber Wt. in grams	Unmarketable Tuber in % of the total	Yield in q/ha		
					Marketable	Total	
AL-569	98	Light Rose	96	39	292.22	479.33 a	A
" 563	98	" "	116	40	279.78	468.22 a	AB
" 624	85	White	106	42	268.89	460.89 a	AB
" 601	96	"	113	46	230.00	423.11 ab	ABC
" 574	95	Light Rose	131	37	256.44	408.22 abc	ABCD
" 204	88	" "	171	33	272.67	407.78 abc	ABCD
" 557	100	" "	108	37	242.89	383.56 abcd	ABCDE
" 568	81	" "	110	36	253.56	370.45 abcde	ABCDE
" 522	100	White	85	39	224.00	370.22 abcde	ABCDE
" 657	100	Light Rose	114	44	205.78	369.78 abcde	ABCDE
" 634	85	White	107	28	265.11	366.22 abcde	ABCDE
" 114	96	"	104	38	224.44	363.10 abcdef	ABCDE
" 201	98	Light Rose	123	47	176.44	332.44 bcdef	ABCDEF
" 658	95	White	123	28	231.78	320.67 bcdef	BCDEF
" 474	85	Light Blue	102	64	107.33	301.33 cdfg	CDEF
" 253	93	Dark Rose	88	49	149.11	292.66 cdefg	CDEF
" 500	93	White	93	42	165.56	286.23 defg	CDEF
" 148	88	Light Rose	103	34	189.11	285.33 defg	CDEF
" 108	93	White	131	33	184.44	273.77 defg	CDEF
" 218	95	"	104	28	191.11	264.89 efg	DEF
" 212	93	"	111	36	159.56	248.89 fgi	EFG
" 471	80	Light Blue	108	38	125.77	204.21 gh	FG
" 209	85	White	93	36	130.67	202.89 gh	FG
" 257	86	Dark Rose	114	53	90.88	195.10 gh	FGH
" 344	66	Light Blue	123	50	61.56	122.67 hi	GH
Local check	75	White	68	56	28.89	65.11 i	H
Mean	90		109	41	192.62	37.96	

Mean separation by Duncan's Multiple Range Test. Mean in last column that are not ollowed by the same letter (s) are significantly different at 5% (small letters) and 1% (capital letters) levels of significance.

Table 4: Potato variety trial (wide adaptability), Holetta, 1980/81

Treatments (cultivars	Stand % at harvest	Average marketable tuber in g.	Unmarketable tuber in % of the total	yield in q/ha			
				Marketable		Total	
AL-624	78	122	47	312.38 ab	AB	585.00 a	A
AL-252	93	136	39	351.90 a	A	581.53 a	A
AL-148	90	110	36	303.09 ab	AB	474.52 ab	AB
AL-517	83	94	36	286.62 abc	ABC	441.67 ab	ABC
AL-253	88	84	44	240.95 bcd	ABCD	428.09 ab	ABC
AL-615	92	82	65	150.48 def	DEFG	424.29 ab	ABC
AL-560	92	113	52	197.62 cd	BCDE	407.56 b	ABCD
AL-662	78	107	40	226.90 bcd	ABCD	406.43 b	ABCD
AL-680	78	103	50	169.05 de	CDEFG	340.48 bc	BCDE
AL-553	88	109	43	188.09 de	BDCEF	330.24 bc	BCDE
AL-200	97	172	57	126.90 ef	DEFG	297.14 bcd	BCDEF
AL-676	55	118	54	98.81 efg	EFG	215.19 cde	DCEF
AL-211	82	101	62	79.29 fg	EFG	211.19 cde	DCEF
AL-634	95	73	69	57.86 fg	FG	184.52 cde	DEF
AL-257	-	-	66	76.90 fg	EFG	175.00 cde	DEF
AL-646	78	75	64	49.29 g	G	135.24 de	EF
AL-255	-	-	40	63.33 fg	FG	72.38 e	F
Mean	84.40	106.60	50.82	175.26		335.97	

Table 5: Potato variety trial (high altitude adaptability), Holetta, 1980/81.

Treatments (Clones or cultivars)	Stand % at harvest	Average marketable tubers in gr.	Percent of unmarketable tubers of the total	Yield in q/ha			
				Marketable		Total	
AL-557	93	118	48	277.98 ab	A	534.52 a	A
AL-252	93	110	45	291.67 a	A	530.95 a	A
AL-264	95	95	33	310.71 a	A	462.62 ab	A
AL-563	88	108	40	263.81 abc	A	440.47 ab	A
AL-536	93	137	45	230.95 abc	AB	423.33 ab	AB
AL-466B	85	116	56	182.14 bcd	AB	409.52 ab	AB
AL-253	80	87	51	169.76 cd	AB	349.52 bc	AB
AL-447	55	160	32	235.24 abc	AB	345.95 bc	AB
AL-610	53	112	59	93.57 d	B	227.38 c	B
Mean	81.67	115.67	45.44	228.43		413.80	

Table 6: Yield data, potato variety trial, Bako, 1981/82.

Treatments (clones)	Unmarketable tubers in percent of the total	Yield in q/ha				Average of late-blight score (0-5% scale)
		Marketable		Total		
AL-568	11	388.00 ab	A	435.95	A	1.85
AL-646	2	369.78 a	A	374.89 a	A	1.35
AL-148	5	350.89 abc	A	367.78 abc	A	1.30
AL-517	2	327.33 abcd	A	334.00 abcd	A	1.00
AL-204	4	230.89 def	ABCD	324.89 ab	AB	1.00
AL-556	8	296.22 abcd	A	321.78 ab	AB	0.65
AL-578	7	291.78 abcd	A	313.78 ab	AB	1.30
AL-624	12	271.33 abcde	ABC	308.00 ab	AB	0.30
AL-108	7	287.11 abcd	AB	308.78 ab	AB	1.50
AL-580	9	271.11 abcde	ABC	298.44 abc	ABC	1.70
AL-634	9	257.33 abcde	ABC	291.11 abcd	ABC	1.35
AL-601	7	252.44 bcde	ABC	271.56 abcd	ABCD	1.80
AL-615	9	243.78 bcde	ABC	268.22 abcd	ABCD	2.00
AL-580	10	233.11 def	ABCD	258.89 bcde	ABCD	2.60
AL-563	5	257.78 bcde	ABC	257.78 bcde	ABCD	1.15
AL-253	11	226.00 def	ABCD	253.56 bcde	ABCD	1.50
AL-257	6	235.33 cdef	ABCD	248.22 bcde	ABCD	2.20
AL-567	6	159.33 efg	BCD	193.33 cdef	BCD	1.30
AL-569	8	168.22 efg	BCD	182.22 def	BCD	1.30
Local check	9	128.89 fg	CD	141.78 ef	CD	1.85
AL-575	14	97.78 g	D	113.78 f	D	1.15
Mean	8	277.13		252.19		1.43

Table 7: Yield and other data, potato variety trial, Holetta, 1981/82.

Treatments (cultivars or clones)	Potato T.M. score (1-10)	Late blight score (1-5)	Average wt. of a tuber in gms.	Unmarketable tubers in % total	Marketable yield in q/ha			Total yield q/ha	
A1-204	4.3	1.0	134	44	127.11	ab	AB	255.58	a
A1-148	4.0	1.0	79	35	143.33	a	A	221.77	a
A1-634	3.1	2.0	86	42	106	abc	ABC	182.67	ab
A1-253	4.9	2.0	58	45	100.44	bed	ABCD	182	ab
A1-578	4.3	3.0	59	49	91.56	bed	ABCD	180	ab
A1-646	3.2	2.0	89	44	96	bed	ABCD	170.44	bc
A1-108	5.4	2.0	69	52	81.4	cde	BCD	170.44	bc
A1-624	3.5	4.0	74	39	103.33	bed	ABCD	169.33	bc
A1-517	5.1	3.0	66	47	85.11	bed	BCD	161.11	bed
A1-568	5.1	5.0	60	53	74.44	cde	BCD	159.55	bed
A1-615	6.2	4.5	39	52	76.67	cde	BCD	160	bd
A1-556	5.7	4.0	55	58	64.89	cde	CD	155.56	bcde
A1-580	4.1	4.5	61	51.5	75.56	cde	BCD	153.78	bcde
A1-257	5.5	3.5	58	48	77.11	cde	BCD	148.67	bcdef
A1-601	4.5	3.5	77	50	74	cde	BCD	148.44	bcdef
A1-563	4.4	4.0	56	52	61.11	de	CD	126	cdefg
A1-569	4.0	3.0	53	60	47.33	e	DE	119.11	defg
A1-570	3.5	5.0	66	44	63.33	de	CD	112.22	efg
A1-575	5.0	4.5	63	56	47.28	e	DE	108.89	fg
A1-567	2.7	4.5	80	34	64.44	cde	CD	97.33	g
Local check	2.1	5.0	47	70	8.44	f	E	28	hf
Mean	4.3	3.4	68.05	48.84	79.48			150.99	

Table 8: Yield and late blight infestation of potato varieties at Shambu IAR/ADD site, 1981/82.

Varieties	Late blight infestation 0-5 sclae	Total yield q/ha	Marketable yield q/ha	Unmarketable yield in % of total yield	Rank
A1-253	3.17	187.30	151.50	19.10	3
A1-108	3.33	144.40	92.50	19.20	12
A1-634	1.67	155.20	144.10	7.20	9
A1-575	3.67	157.70	139.10	11.80	8
A1-646	2.80	148.20	125.90	15.00	10
A1-566	2.90	110.80	104.60	5.60	14
A1-148	3.10	162.10	144.80	10.70	6
A1-615	1.60	216.90	176.90	18.40	1
A1-204	3.40	190.50	161.40	15.30	2
A1-580	2.00	63.30	51.50	18.70	19
A1-517	2.70	162.10	138.80	14.40	6
A1-601	1.50	106.50	81.50	23.50	16
A1-567	2.40	75.30	61.40	18.50	17
A1-556	2.50	183.60	158.90	13.50	4
A1-568	2.40	146.90	125.20	14.80	11
A1-257	3.40	112.70	82.70	27.30	13
A1-578	2.00	64.20	49.40	23.10	18
A1-624	1.70	167.90	129.30	23.00	5
A1-569	1.90	20.90	13.80	35.30	20
A1-570	2.50	107.80	88.40	17.90	15
Mean	2.53	134.17	109.59	17.64	
S.E.	10.53	14.20			
C.V.%	23.63	6.22			
LSD% 5%	0.99	40.74			
LSD% 1%	1.55				

Table 9: Yield data, potato variety trial, Bako 1982/83.

Treatments (clones)	Average No. of tubers per hill	Percent of unmarketable of the total	Yield in q/ha					
			Marketable			Total		
A1-601	12	29	312.89	a	A	445.33	a	A
A1-624	15	43	257.89	ab	AB	419.55	ab	A
A1-615	15	21	241.11	ab	AB	308.88	abc	AB
A1-569	8	16	232.22	b	AB	281.11	bcd	ABC
A1-578	9	31	187.77	bc	BCD	257.77	bcde	ABC
A1-646	7	20	208.89	b	ABC	264.44	cdef	ABC
A1-634	8	28	178.89	bcd	BCDE	251.33	cdef	ABC
A1-108	7	48	117.77	cde	CDEF	188.65	cdefg	BC
A1-517	9	37	114.00	cde	CDEF	184.88	cdefg	BC
A1-568	10	35	112.22	cde	CDEF	174.44	cdefg	BC
A1-257	6	33	95.55	e	CDEF	144.88	defg	BC
A1-570	9	29	97.55	e	CDEF	139.77	defg	BC
A1-204	9	24	104.44	de	CDEF	139.11	defg	BC
A1-253	6	49	81.33	e	DEF	134.21	defg	BC
A1-563	9	24	95.55	e	CDEF	127.55	defg	BC
A1-148	6	33	84.44	e	DEF	119.99	edg	BC
A1-556	8	49	56.00	e	F	112.66	fg	BC
A1-580	8	37	68.44	e	EF	109.55	fg	BC
A1-575	7	37	57.78	e	F	93.33	g	BC
Local check	6	28	65.55	e	EF	92.22	g	BC
A1-567	8	17	54.22	e	F	82.89	g	BC
Mean	8.69	31.81	134.5			193.93		

Table 10: Yield results in q/ha and other data, potato variety trial at Holetta, 1982/83.

Varieties	Yield in q/ha		Unmarketable yield in % of the total yield	Means of late blight score (1-9)
	Total yield	Marketable yield		
A1-528 (Bl.102.146)	459.33	178.22	61.23	2.2
A1-404 (R.188.61)	308.44	71.11	76.97	1.8
A1-601 (Br.112-42)	414.68	268.88	49.65	1.8
A1-257 (BMD-69-1)	398.89	124.44	68.82	1.0
A1-578 (Br-114-121)	382.44	153.33	59.93	2.0
A1-108 (Seberco)	377.50	99.33	73.72	1.2
A1-615 (Br-112-64)	375.11	161.55	56.95	2.2
A1-646 (Br-113-75)	360.00	86.88	75.80	2.0
A1-624 (Br-112-113)	349.33	136.22	61.03	2.0
A1-264 (INV-73)	345.77	144.66	58.18	1.0
A1-100 (Kenya Baraka)	335.33	106.22	68.31	1.2
A1-253 (Cex-69-2)	314.00	120.00	61.82	1.0
A1-148 (Anita)	312.44	173.77	44.47	1.0
A1-568 (Br-114-114)	304.22	129.55	57.43	1.0
A1-204 (13-5504)	296.66	48.88	83.54	1.0
A1-305 (R-513-25)	286.00	166.44	41.83	1.4
A1-556 (Br-14-26)	99.55	44.22	57.85	4.6
A1-580 (Br-114-70)	-	-	-	8.6
A1-560 (Br-114-41)	-	-	-	8.8
A1-563 (Br-114-32)	-	-	-	8.8
Mean	336.45	126.70	52.88	2.73
CV%	15.91	28.42		
SE	32.89	20.89		
LSD 5%	94.74	60.28		
1%	127.71	81.20		

Table 11: Potato yield assessment trial, farmers' fields, Holetta 1980/81.

Location	Planting date	Harvesting date	Area in m^2	Unmarketable % of the total	Yield q/ha	
					Marketable	Total
Misrak Shola Ber	March 1980	June 24, 1980	100	39	188	306
Wolmera Choke	February 1980	June 04, 1980	100	30	160	228
Guntuta	May 1980	December 24, 1980	25	67	26	85
Markos Prod. Coop.	March 1980	December 18, 1980	25	67	25	82
Kebele 02	April 1980	January 9, 1980	100	73	16	55
Mean				83	83	152

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