# POTATO BREEDING FOR RESISTANCE TO BACTERIAL WILT IN KENYA

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## SUMMARY

*Pseudomonas solanacearum* (bacterial wilt) is a major limiting factor in potato production in Kenya. In 1971 research was initiated to select potato cultivars resistant to bacterial wilt, to identify sources of resistance and to develop and maintain a potato germplasm collection. Seedlings grown in polythene sleeves are infected by soil inoculation. Survivors are transplanted to an infected plot and interplanted with highly susceptible clones. Resistant, flowering individuals are intercrossed and resulting seedlings screened again during the next season. Selected individuals are cloned for retesting and selection as commercial cultivars.

## RESUME

*Pseudomonas solanacearum* (fletrissement bacterien) est un facteur limitant majeur dans la production de la patate au Kenya. En 1971 des travaux de recherche ont été entrepris pour sélectionner des cultivars de patate résistants à cette maladie, pour identifier les sources de résistance et pour développer et entretenir une collection de plasme germinatif de la patate. Les plantules cultivées dans des manchons polythènes sont infectées par l'inoculation du sol. Les survivantes sont repiquées sur une parcelle infectée et plantée en mélange avec des clônes qui ont une sensibilité élevée. Les individus résistants et fleuris sont entrecroisés et les plantules qui en sont issues triées de nouveau pendant la saison suivante. Les individus sélectionnés passent au clône pour étre testé de nouveau et sélectionnés sous forme de cultivars destinés au commerce.

## RESUMEN

*Pseudomonas solanacearum* (marchitez bacterial) es uno de los principales factores limitantes de la producción de papa en Kenya. En 1971 se iniciaron las investigaciones para seleccionar cultivares de papa resistentes a la marchitez bacterial, identificar fuentes de resistencia y desarrollar y mantener una colección de germoplasma de papa. Se infectan plántulas, desarrolladas en mangas de polietileno, por inoculación del suelo. Los sobrevivientes se transplantan a un lote infectado y se intercalan con clones altamente suceptibles. Los individuos resistentes que florean se intercruzan y la progenie resultante se selecciona, otra vez, durante la siguiente temporada. Los individuos seleccionados se propagan como clones para continuar pruebas de selección como cultivares comerciales.

## INTRODUCTION

Potatoes in Kenya in 1971 occupied approximately 60,699 hectares, mostly between 1371 and 2742 meters altitude[4]. It is the second root crop to cassava in production. The climate of these areas is ideal for potato cultivation[1,8]. Approximately 98 percent of potatoes are grown by small-scale and the remainder by larger scale farmers[4]. Two potato crops per year are commonly grown in Kenya. Nutritionally, the potato is as good as any other tropical root crop.[12] Presently, due to the changing of eating habit, ease of growing and of food preparation potato has become the most popular root crop in Kenya. According to the Ministry of Agriculture Annual Report[5] potatoes give a higher return per hectare than maize, sunflower, cassava groundnuts, bean or sorghum. That the potato still has the status of a minor crop in Kenya is due partly to late blight (*Phytophthora infestans*), bacterial wilt (*Pseudomonas solanacearum*) and other problems of potatoes which were reviewed by Moreau[6].

In Kenya bacterial wilt (*Pseudomonas solanacearum*) is severe and widespread between about 1400 and 2000 m.[3] Approximately half of the potato crop in Kenya is grown within this altitude range. Late Blight (*Phytophthora infestans*) is more severe at higher altitudes (about 1800–2750 m). While cultivars with high resistance to late blight (*Phytophthora infestans*) have been introduced from temperate countries and some have been bred in Kenya, there is no commercial cultivar with resistance to bacterial wilt (*Pseudomonas solanacearum*).

## BREEDING FOR RESISTANCE TO BACTERIAL WILT

In 1964 Robinson and Ramos[9] reported that potato cultivation in Kenya would cease unless resistant cultivars were developed. No material under Kenyan conditions had sufficient wilt resistance, and it was

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considered necessary to exploit the resistance that exists in *Solanum phureja* as reported by Thurston and Lozano[13] or *S. phureja* x *S. tuberosum* hybrids.[11]

However, not until September 1971 was a research project to develop commercial potato cultivars resistant to bacterial wilt initiated in Kenya. Other objectives of the programme were to detect sources of resistance and to develop and maintain germplasm that would be useful for future potato breeding in Kenya. The Potato Research Project in Kenya is a joint effort between the British and the Kenyan Governments.

Three thousand seeds of the interspecific hybrid between Colombian *S. phureja* x *S. tuberosum* were received from Dr. P.R. Rowe as shown in Table 1. Where possible, approximately 100 seeds of each cross were planted in sifted loam soil in the greenhouse. Poor germination or poor growth reduced the number of the test plants considerably (see Table 1). After 21 days, individual seedlings were transplanted to polythene sleeves, gauge 150, size 3¼" x 5". The polythene sleeves were filled with steam sterilized soil mixture of 3 parts loam soil, 1 part sand, 1 part compost or coffee hull and 1 part 1/8" ballast. Plants were held in the greenhouse benches for six weeks after transplanting and watered daily. Two weeks after transplanting each seedling was watered in 25 cc dilute solution of 'solufeed' containing nitrogen 22.4% W/W, phosphoric acid $P_2O_5$ (Soluble) 19.2%, and potash $K_2O$ 16.0%.

A single strain of *Pseudomonas solanacearum* (biochemical type 2/race 3) attacks potatoes in Kenya[3]. Investigations on the most efficient screening technique carried out by Harris (personal communication) showed that soil inoculation four to six weeks after transplanting was superior to stem inoculation and that the 'susceptibility' of seedlings increases with age from four to six weeks. Hence, each seedling received 10 cc from the $10^8$ cells/ml suspension. The inoculated seedlings were placed outside and records were kept daily for four weeks on the incidence of wilting. Survivors were planted in an infected field which had been planted with highly susceptible clones the previous season. Wilting plants were recorded daily for a further 90–120 days after planting in the field. Progenies which survived and produced flowers were intercrossed and resulting seeds were screened in the same routine the following season.

## RESULTS AND DISCUSSION

Preliminary results show that some progenies from crosses previously rated as resistant in Wisconsin by Rowe and Sequeira[10] gave several survivors during the first season and from these 33 clones were selected as provisionally resistant (Table 1). Subsequent planting in a highly contaminated field reduced this to only thirteen clones. The other twenty were either susceptible to storage rot or wilted during the second planting. Among the thirteen resistant clones, four have been selected for bulking and testing for quality with a view to release for commercial use.

Data in Table 1 shows that when two susceptible *S. phureja* parents are crossed some resistant plants may be obtained. Resistance to *Pseudomonas solanacearum* may therefore be partially regulated by recessive genes. Data in Table 2 indicate tremendous phenotypic variation within and between progenies. It appears that when two resistant parents are crossed transgressive segregation to greater resistance may occur in the progeny. Other tests have shown that *S. phureja* clones are more resistant to wilt than *S. tuberosum* clones. Some of the selected wilt resistant clones will be inter-crossed with a hope of developing highly resistant clones for tropical use.

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## TABLE 1

Seedling reaction to bacterial wilt (*Pseudomonas solanacearum*)

| Ref. No. | Parentage | | No.of seedlings | % wilted* after 4 wks. | No. planted out | Survivors after 90-120 days | No.I % survivors | No.II % survivors |
|---|---|---|---|---|---|---|---|---|
| 1. | 1339.28(S) | xx1350.42(R) | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. | 1339.38(S) | x 1386.12(R) | 29 | 24 | 22 | 0 | 0 | 0 |
| 3. | 1339.28(S) | x 1386.13(R) | 3 | 0 | 3 | 0 | 0 | 0 |
| 4. | 1339.28(S) | x 1386.26(R) | 14 | 29 | 10 | 3 | 21.35 | 3 |
| 5. | 1350.9 | x 1350.42(R) | 9 | 67 | 3 | 1 | 11.11 | 0 |
| 6. | 135).42(R) | x 1386.15(R) | 6 | 34 | 4 | 0 | 0 | 0 |
| 7. | 1386.1(R) | x 1386.13(R) | 5 | 0 | 5 | 0 | 0 | 0 |
| 8. | 1386.13(R) | x 1386.26(R) | 26 | 39 | 16 | 1 | 3.84 | 0 |
| 9. | 1386.15(RO | x 1339.28(S) | 39 | 49 | 20 | 2 | 5.13 | 1 |
| 10. | 1386.26(R) | x 1339.28(S) | 55 | 13 | 48 | 3 | 5.45 | 1 |
| 11. | 2 - 1 | x P - 7 | 11 | 0 | 11 | 1 | 9.10 | 0 |
| 12. | N-68 | x 314.1 | 3 | 0 | 3 | 1 | 33.33 | 1 |
| 13. | N-68 | x 317.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. | P-3 | x 8-43 | 67 | 21 | 53 | 6 | 8.95 | 2 |
| 15. | Atzimba | x 318.1 | 6 | 0 | 6 | 0 | 0 | 0 |
| 16. | Atzimba | x P-3 | 59 | 10 | 53 | 4 | 6.82 | 1 |
| 17. | Atzimba | x P-7 | 74 | 16 | 62 | 5 | 6.76 | 1 |
| 18. | Greta | x P-3 | 63 | 16 | 53 | 5 | 4.76 | 0 |
| 19. | Greta | x P-7 | 90 | 38 | 56 | 1 | 1.11 | 1 |
| 20. | 8-14 | x Atzimba | 42 | 24 | 32 | 2 | 4.76 | 2 |
| | | Total L clones kept | | | 33 | | | 13 |

R - resistance
S - susceptible
* plants were classified as wilted as soon as advanced wilt symptoms were observed on haulms.

**TABLE 2**

**Seedling reaction to bacterial wilt (*Pseudomonas solanacearum*)**

| Ref No | Parentage | No.of seed-lings | % wilt-ted after 4 wks* | No. plan-ted out | Sur-vi-vors after 90-120 days | % plants not wil-ting |
|---|---|---|---|---|---|---|
| 1. | (8-14 x Atzimba(2) x 1386.26 x 1339.28(4) | 150 | 71.33 | 43 | 6 | 4.00 |
| 2. | 8-14 x Atzimba(2) x P-3 x 8-43(4) | 71 | 69.01 | 22 | 5 | 7.04 |
| 3. | 1386.26 x 1339.28(3) x 8.-14 x Atzimba(2) | 111 | 13.51 | 96 | 0 | 0.00 |
| 4. | Atzimba x P-7(4) x P-3 x 8-43(6) | 52 | 71.17 | 15 | 2 | 3.85 |
| 5. | (1386.15 x 1339.28) x P-3 x 8-43 | 44 | 45.45 | 24 | 4 | 9.09 |
| 6. | 1386.26 x 1339.28 x 1350(2) | 428 | 58.64 | 177 | 28 | 6.54 |
| 7. | Atzimba x P-7 x NF/66 | 88 | 72.72 | 24 | 8 | 9.09 |
| 8. | (P-3 x 8 - 43) x KA | 10 | 70.00 | 3 | 1 | 10.00 |
| 9. | 2-1 x P-7 x P-3 x 8-43 | 21 | 57.14 | 9 | 2 | 9.52 |
| 10. | 135) x 1339 x KA | 37 | 91.90 | 3 | 0 | 0.0 |
| 11. | P-3 x 8-43 Selfed | 295 | 93.22 | 21 | 2 | 0.68 |
| 12. | P-3 x 8-43 (1) Selfed | 46 | 82.61 | 8 | 1 | 2.17 |
| 13. | P-3 x 8-43(3) Selfed | 168 | 94.64 | 9 | 1 | 0.59 |
| 14. | 1339.28 x 1386.26 x KA | 158 | 82.91 | 27 | 4 | 2.53 |
| 15. | Atzimba x P-7(1) Selfed | 400 | 81.25 | 75 | 7 | 1.75 |
| 16. | Atzimba x P-7(2) | 233 | 79.11 | 51 | 8 | 3.43 |

* Plants were classified as wilted as soon as advanced wilt symptoms were observed on haulms.