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HAWAII FARM SCIENCE

Agricultural Progress Quarterly

HAWAII AGRICULTURAL EXPERIMENT STATION / COLLEGE OF TROPICAL AGRICULTURE / UNIVERSITY OF HAWAII

Taping tomato scion to rootstock, caption page 4.

GRAFTING TOMATOES TO CONTROL TOMATO BACTERIAL WILT

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Bacterial wilt of tomato is caused by *Pseudomonas solanacearum* E. F. Smith and is one of the serious tomato diseases of bacterial origin. It occurs in tropical and subtropical areas of the world. In Hawaii the disease is confined to limited areas of the islands of Oahu, Hawaii, and Kauai. It has not been reported from Maui or Molokai.

*The author wishes to thank Dr. James Gilbert for providing seeds of the tomato varieties used in this experiment, Drs. E. E. Trujillo and T. W. Buddenhagen for advice and counsel on the research and manuscript, and Mr. Lincoln Takenaka for his excellent cooperation and use of his land during field tests.

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The causal bacterium has several races and strains that are specific to the host. The tomato race affecting tomatoes, peppers, eggplants, tobacco, potato, and several other solanaceous crops and weeds is the most widespread. The pathogen, once established, can remain in the soil for many years; this is especially common under tropical conditions.

Infection takes place through the roots and the bacteria multiply in the vascular system causing a brown discoloration of the woody stem, followed by wilting and rapid collapse of the foliage. Adventitious roots may develop on the stem when the wilt is gradual. A reliable and easy way to identify the disease is to place a thin piece of infected stem in a small clear glass or plastic container filled with clear tap water; in minutes a milky bacterial mass oozes out from the stem. This bacterial ooze is visible when the container is placed in front of a light source.

Controlling the disease in the field by soil fumigation has been unreliable. However, it is recommended that seedbeds be fumigated with methyl bromide at 1 pound per 100 square feet to provide disease-free rootstocks and scions. Search for resistant varieties began in the early 1900's. At present a few resistant tomato lines have been developed in Hawaii and elsewhere, but fruit size and other qualities are still inferior. Apparently it will take many years to develop an acceptable commercial variety resistant to the disease.

Grafting susceptible commercial varieties to resistant rootstocks is a successful method of control. This concept of controlling the disease was proposed as early as 1901; however, Guiana is perhaps the only country that has used grafting on a large scale in the commercial production of tomatoes. The thorny plants *Solanum demerarense* Dem., S. *juripeba* Rich., and others are used as resistant rootstocks. These are slow-growing, requiring 4 months to reach grafting size. Because these plants are not available in Hawaii, other available resistant rootstocks were tested. By this process a rapid and reliable grafting technique was developed at the Kauai Branch Station.

FIGURE 1. Vigor and productivity of N-52 tomato grafted on selection 5808-2 grown on an individual circular trellis.

SOURCES OF RESISTANT ROOTSTOCK AND SCIONS

The University selection 5808-2 from currant tomato *Lycopersicon pimpinellifolium* Mill. and two other tomato varieties from the Philippines having a high degree of resistance to bacterial wilt of tomato were used as rootstocks. Scions were obtained from commercial tomato lines N-52, N-57, and N-11. Plants used for rootstocks were started in Jiffy pots one week before the scion. The scion plants were grown in flats of bacterial wilt-free soil. Side shoots of bearing commercial tomato plants grown on bacterial wilt-free soil were also used for scions. Two-week-old seedlings were hardened for one or two weeks. Proper hardening to produce firm stem tissues was very important to prevent squashing of tissues during taping at grafting time.

In preliminary tests, selection 5808-2 showed a higher degree of resistance to bacterial wilt than the other two tomato varieties. Because of its degree of resistance and excellent compatibility with all of the commerical varieties used as scion, selection 5808-2 was used in all field tests.

RESPONSE OF COMMERCIAL VARIETIES GRAFTED ON ROOTSTOCK 5808-2 PLANTED IN TOMATO BACTERIAL WILT-INFESTED SOIL

Two hundred and seventy plants of selection 5808-2 grafted with N-52 and equal numbers of nongrafted N-52 plants were grown on the farm of Mr. Lincoln Takenaka from June to September 1968. The land used had a previous history of tomato bacterial wilt with a disease incidence of 70 percent in former plantings. One hundred plants of N-52 tomato variety grown in a bacterial wilt-free area of the same farm served as checks.

Scions of commercial N-52 tomato variety grafted onto selection 5808-2 and planted on bacterial wilt soil grew vigorously (Fig. 1) and produced higher yields of commercial-grade tomatoes as compared to the nongrafted plants of the N-52 variety grown in bacterial wilt-free soil. The rootstock produced a more extensive root system than the nongrafted plants. Apparently this supported a more vigorous plant growth; hence, higher yields of tomato were obtained with the grafted plants. Plants of the N-52 tomato variety in soil containing the bacterial wilt organism showed a significantly higher in-

cidence of bacterial wilt than grafted plants; hence, lower yields of commercial-grade tomatoes were produced by nongrafted plants (Fig. 2). The incidenee of bacterial wilt on the grafted plants was 3 percent as compared to 60 percent for nongrafted N-52. The estimated yields were 33.7, 16.4, and 27.6 tons per acre for grafted and nongrafted N-52 plants grown in bacterial wilt-infested soil and nongrafted N-52 plants grown in disease-free soil, respectively (Table 1).

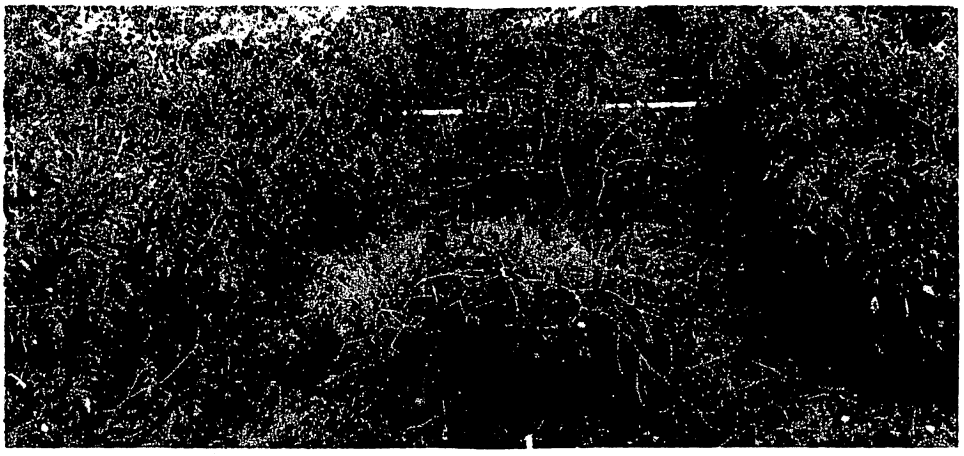

FIGURE 2. Center row shows N-52 tomato plants affected with bacterial wilt. Outside rows are N-52 plants grafted on selection 5808-2.

GRAFTING PROCEDURES

(1) Select plants 3 to 4 weeks old, properly hardened, that are more than 6 inches tall with relatively woody stems 0.25 inch in diameter. The rootstock and scion plants should be more or less of the same size for better results.

(a) The apical shoot of the rootstock is cut about 4 inches above the soil line at a 15° to 30° angle slant with a new, single-edge razor blade.

(b) Scions from the desired commercial variety are cut at an identical angle as the rootstock and the leaves are trimmed, leaving only the apical shoot.

(c) Rootstock and scion are joined together immediately after cutting and a piece of adhesive rubber tape is wrapped around the union. First, one end of the tape is pressed around the stem tightening the union; then the other end is rolled around the stem with slight degree of finger pressure (Fig. 3 and 4). For grafting tomatoes an electric rubber tape (Snapit No. 867, manufactured by Cable Electric Products, Inc., Providence 7, R. I.) was found to be excellent.

(2) Grafted seedlings should be kept in partial shade for a week or two, keeping soil moist but avoiding overwatering (Fig. 5). Plants may wilt on the 4th and 5th day but they will recover once the graft has taken. Usually the graft union is set 7 to 10 days after grafting, but a waiting period of 14 days prior to setting the plants in the field is recommended. All side shoots developing on the rootstock should be pinched off.

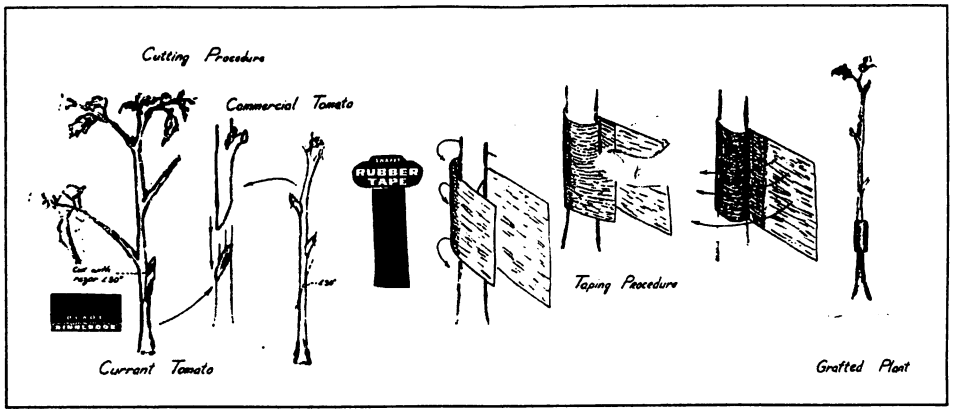

FIGURE 3. A graphic demonstration of a new cutting grafting technique for tomato seedlings. Left to right: Cutting of rootstock and scion at a 10 to 30-percent angle slant with new single-edged razor blade; placing of rubber tape around the graft joint; pressing one end of tape towards the stem and wrapping the other end around, grafted tomato plant.

TABLE 1. Effects of grafting tomato on bacterial wilt and yield

Treatment[a]	Percent "Wilted" plants	Mean yield (tons/A) Grade No. 1	Grade No. 2	Off-grade	Total	Remarks
1 Grafted N-52	3	20.5	10.2	3.0	33.7	18% yield increase due to grafting alone without "wilt" effect. 105% yield increase due to grafting and control of bacterial wilt.
2 Nongrafted N-52	60	10.5	4.8	1.0	16.4	40% decrease in yield due to bacterial wilt.
3 Nongrafted N-52	0	17.0	9.0	1.6	27.6	assumed as 100% yield.

[a]Treatments 1 and 2 were grown in a field infested with the bacterial wilt pathogen, and treatment 3 was grown in a field free of the disease. Both fields were located at Mr. Takenaka's farm.

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RECOMMENDATION

Using the technique described above, 70 to 100 plants can be grafted in one hour with 95-percent success. Snapit tape no. 867 is ideal for tomato grafting because it provides enough pressure to hold the union and sticks readily. When the tomato stem enlarges, the rubber cracks and finally breaks and falls away, thus avoiding girdling of the growing plant. The currant tomato *L. pimpinellifolium*, selection 5808-2, is compatible with three hybrids and presumably with other commercial varieties and is highly resistant to bacterial wilt, thus making a satisfactory rootstock for the control of the disease.

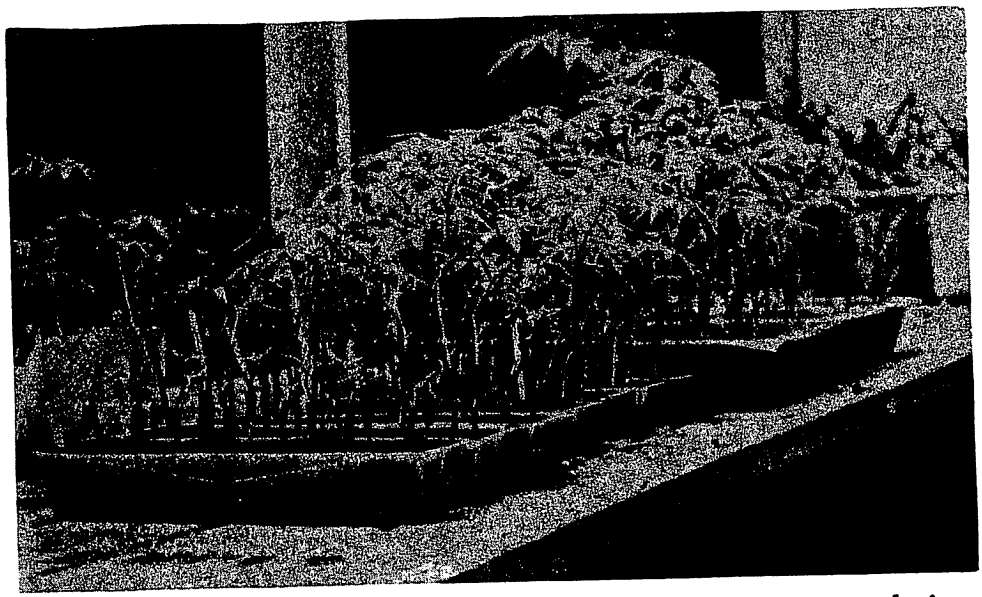

FIGURE 5. ***Post-grafting care*****—Grafted plants are kept for 1 to 2 weeks in a cool (70° to 75°F), partially shaded place.**

Hardening of seedlings is important for a successful graft. This process involves growing plants under sunlight, with low nitrogen and limited irrigation. Grafted plants should always be grown on a trellis because stems of the susceptible scion in contact with the soil send out secondary roots and the pathogen will invade the plant through these roots. Both rootstock and scion plants should be grown in soil fumigated with methyl bromide at 1 pound per 100 square feet.

COVER PHOTO: Figure 4. ***Taping*****—The longer end of the tape is wrapped around the union by rolling stem between thumb and index finger applying a slight pressure.**

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