Land Grant Technical Report No. 5, DEC87

EVALUATING YIELD PERFORMANCE AND PEST AND DISEASE LOSSES FOR TWO TOMATO VARIETIES

Don Vargo
Soil Scientist

Land Grant Program, American Samoa Community College, American Samoa Government, P.O. Box 2609, Pago Pago, American Samoa 96799

ABSTRACT

Locally grown tomatoes are expensive in American Samoa, primarily because pests and diseases destroy much of the crop. The purpose of this study is to determine the extent of these losses, and to evaluate yield performances using two tomato varieties from the University of Hawaii--BWN-21 and Kewalo--that have gained moderate success in the Territory. New crop protection devices and production practices, based on the results of this study, may lessen the risk of growing tomatoes commercially in the Territory.

TABLE OF CONTENTS

In American Samoa, tomatoes are generally sold 2 to 4 times above the United States market price, and supply is often sporadic. This is because growing tomatoes commercially in the Territory is risky. Wilt diseases, primarily bacterial wilt, Pseudomonas solanacearum, and an abundance of year-round pests, chiefly birds and the fruit-piercing moth, Othreis fullonica, plague the plant and its fruit. Air-shipping charges make imported fruit, usually of inferior quality, comparatively priced with locally grown tomatoes. Consequently, needs exist for increasing the marketable yield and ensuring a steady supply of locally grown tomatoes.

Although pests and diseases are the major constraints to tomato production, losses have not been assessed quantitatively. The purpose of this study is to document the extent of losses due to these agents, and to evaluate two tomato varieties for their bacterial wilt tolerance and yield performance.

METHODS AND MATERIALS

Kewalo and BWN-21 are, respectively, a bush variety and a vine-type hybrid tomato that are nematode resistant and bacterial wilt tolerant, and are recommended for Western Samoa, (1,2).

For each variety two seeds were planted 30 April 1987 in cells containing 160 cm^3 of moist Jiffy Mix™ Cells were placed outside in partial sun, protected from rain and watered as needed. The mean daily temperature was 27°C. After two weeks the germination rates were determined to be 92% and 96%, respective-

(Table 1). Prior to transplanting on 8 June, when at the 6-leaf stage, the seedlings were treated to a 0.2% solution of Simplot™(12-6-18) on 15 May and 22 May, a dusting with Yates Tomato Dust™(2% maldison, 4% carbaryl, 5% maneb) on 20 May to control leaf-eating pests, and a 0.2% solution of urea (45-0-0) on 1 June. The experiment was to include testing the effectiveness of Bacillus thuringiensis, Berliner, in controlling caterpillar pests. A split-plot experimental design with 6 replications was planned, using insect pest treatment as main plots and tomato varieties as subplots, each at 2 levels with 2 plants per observation

A 28 ft by 20 ft (9 m by 6 m)* field with stony clayey soil, previously planted with taro, Colocasia esculenta, was selected as the study site. Holes 1 ft (0.3 m) in diameter and 1 ft deep were dug 4 ft (1 m) apart. About 0.7 L of moist Jiffy-Mix containing 5 g superphosphate (0-20-0) per liter of Jiffy-Mix was added to each hole. A mixture of 12 parts sieved soil, 4 parts Perlite™, 2 parts chicken manure and 1 part powdered limestone was added to fill the holes. The filled holes were thoroughly watered and the seedlings transplanted 5 days later. Two weeks after transplanting, several plants began showing symptoms of bacterial wilt. These plants were removed and destroyed. Eventually, 10 of 48 plants succumbed to this disease, (Figure 1) The field was mulched 15 June with cardboard and staked 14 June through 27 June in a 4-pole tepee configuration. The plants were not pruned.

* All metric conversions are approximations.

Because of an absence of serious leaf-eating caterpillar pests, the insect treatment was abandoned before implementation. This, together with the loss of plants due to bacterial wilt, resulted in altering the original split-plot design to a Randomized Complete Block Design with 17 replications, (Figure 1).

Fruit was picked at the first sign of reddening in order to minimize losses due to birds and rodents. Consequently, harvesting was generally done on alternate days. Fruits were weighed individually on a triple beam balance to the nearest gram. Weight of damaged fruit was estimated based on apparent size. Each plant's accumulated yield was used in the analysis of variance.

RESULTS

Harvesting began 16 August, 69 days after transplanting (D.A.T.) and continued until 7 October, 121 D.A.T. Yields for both varieties quickly rose to peak 84 D.A.T., then gradually declined, (Figure 2). This decline may be attributed to a September drought when only 1.4 inches (35.6 mm), or about one-fifth the normal amount, of rain fell, (Figure 3). BWN-21 outyielded Kewalo by about 30%, (2.26 versus 1.75 kg fruit per plant, respectively), but an analysis of variance indicated no significant difference in yield between varieties, (Table 2). Frequency distributions of fruit weights for each variety are skewed right, BWN-21 more than Kewalo, indicating a deviation from the normal distribution toward larger fruit weights, (Figure 4). Average fruit weights were 96 g and 80 g, respectively.

Damage caused by birds and rodents accounted for over 10% of fruit losses, (Figure 5). BWN-21 appeared more vulnerable to attack by fruit-eating caterpillars, including the fruit-piercing moth, and the African snail, Achatina fulica. The latter may have preferred BWN-21 because of its denser foliage. Pests, diseases and blemishes accounted for losses of 32% and 24% of marketable fruit for BWN-21 and Kewalo, respectively.

DISCUSSION

BWN-21 and Kewalo are indeterminate tomato varieties with globe-shaped fruit that require about 70 days from transplant to harvest. Though both varieties are described as bacterial wilt tolerant, both succumbed to this disease with losses of 25% and 17%, respectively. Fruit losses due to pests and disease are high, with vertebrate pests responsible for much of the damage In order to minimize losses, plants may be grown inside wire cages covered with netting to exclude birds. A band several inches high along the bottom of the cage would also bar snails. This will be attempted in a future study. Alternatively, switching to a determinate tomato variety and planting at 2 to 3 week intervals might obviate use of a barrier. By inundating pests briefly with ripening fruit, losses might be limited by depriving pests of a continuous source of food. This strategy is used, in part, by home gardeners who prefer to use cherry tomato varieties. Several determinate tomato varieties will be tested in a future study.

ACKNOWLEDGEMENTS

I wish to thank Mr. Lloyd Ali and Mr. Malala Misa for their excellent technical assistance. Funds for this study were made available through Hatch Grant Project Number SAM-002.

REFERENCES

1. BWN-21 and Kewalo tomato varieties are available from the University of Hawaii, College of Tropical Agriculture and Resources, Seed Program, Department of Horticulture, St. John Plant Science Building, 3190 Maile Way, Room 112, Honolulu, Hawaii 96822.

2. Finlay, F., Lomekina Pahulu, D.A. Slade, M. Tofinga and J.E Wilson. 1983. Vegetable Cultivars Recommended for Western Samoa, Alafua Agric. Bull. 8(3), p 69.

TM Registered Trade Mark products appearing in this report are listed for the reader's information and do not constitute an endorsement by the Land Grant Program.

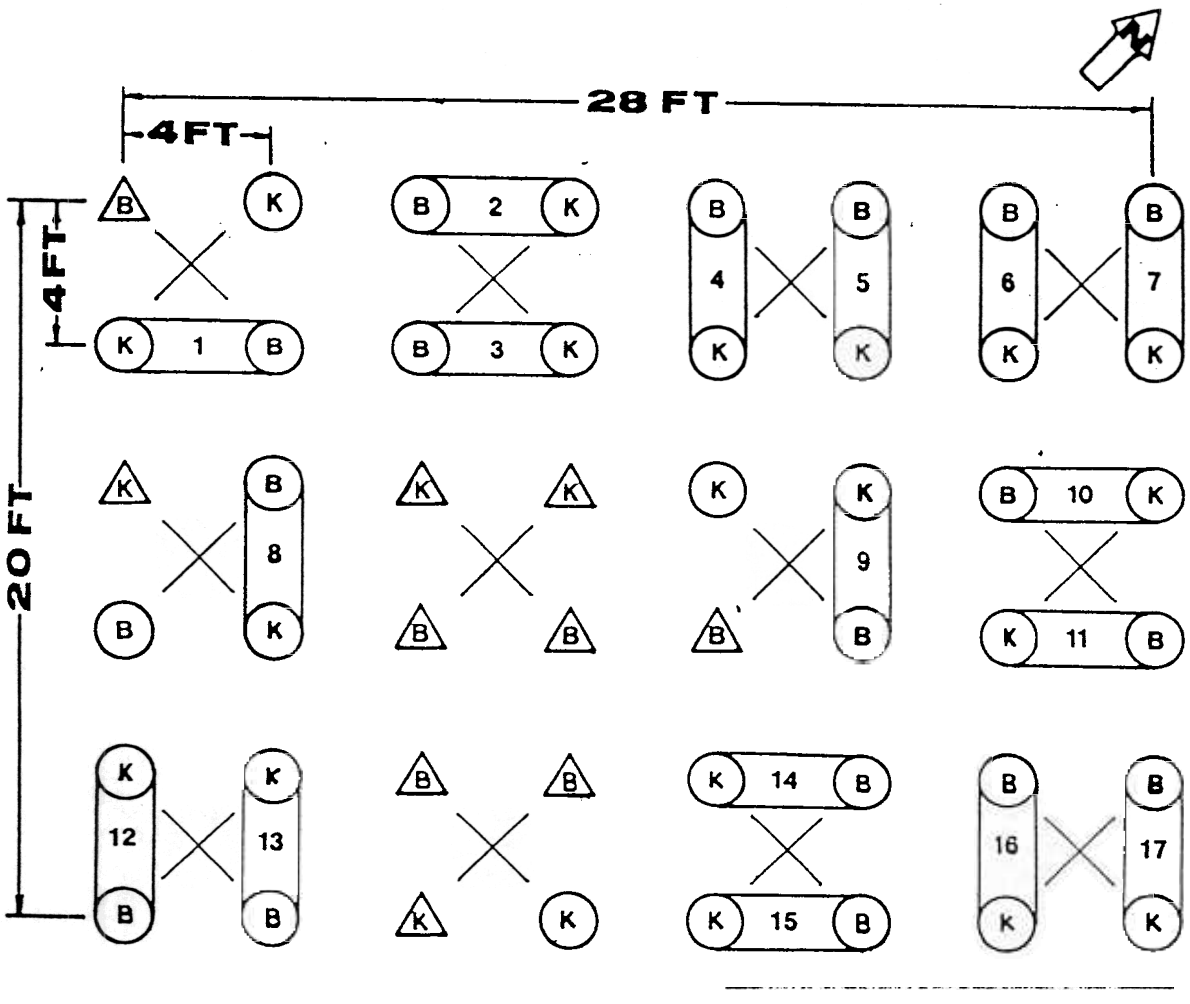

Figure 1. Field layout of tomato variety trial. A 20 ft by 28 ft field was originally laid out on a split-plot design, but later modified for a randomized complete block design with 17 blocks with one Kewalo (K) and one BWN-21 (B) plant per block. Plants were 4 ft apart and staked on a 4-pole tepee trellis, as indicated by crosses. Plants represented by triangles were attacked by bacterial wilt disease.

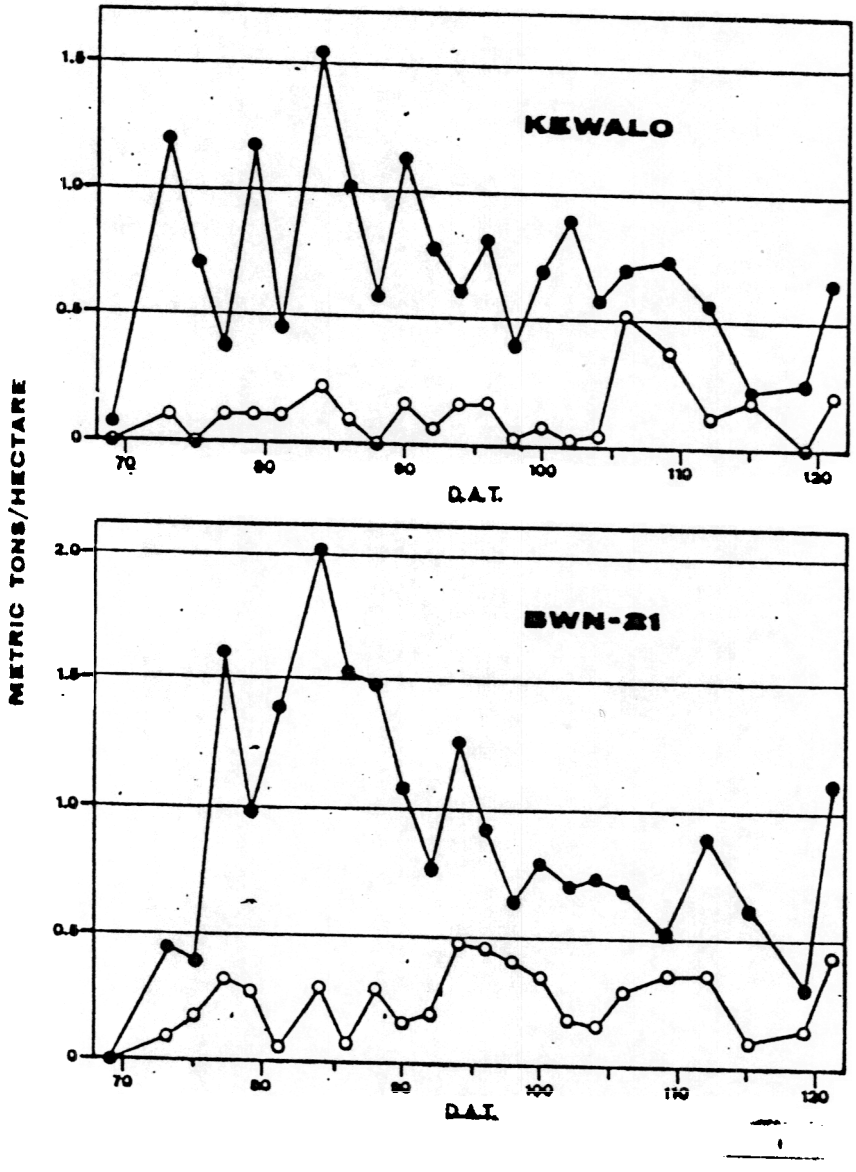

Figure 2. Yields and losses for tomato varieties. Kewalo and BWN-21 tomato varieties were harvested between 69 and 121 days after transplanting, (D.A.T.), and their yields (●) and losses (O) recorded.

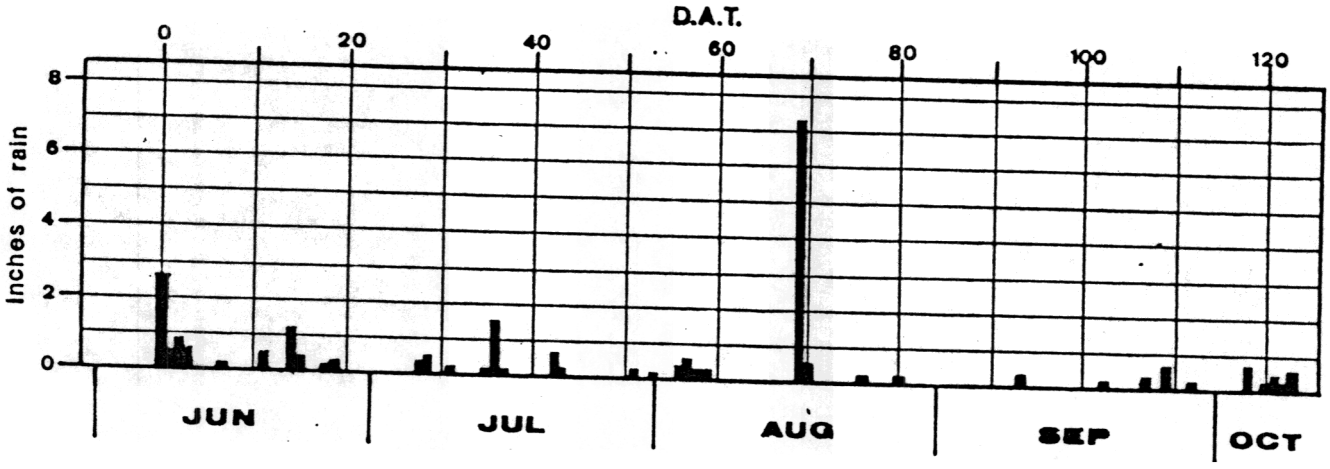

Figure 3. Rainfall record during tomato study. Rainfall was recorded daily to the nearest 0.1 inch during the course of the study: 8 June 1987, when seedlings were transplanted in the field, until 7 October 1987, the last harvest date. Except for an unusual 7.3 inches of rain on 16 August, (69 D.A.T.), when harvesting began, rainfall for August and September were considerably below average. The actual inches of rainfall for June 1987 to September 1987 compared to the mean monthly rainfall* for these months are, respectively: JUN(6.7 vs. 7.94), JUL(3.6 vs. 6.77), AUG(9.0 vs. 7.36) and SEP(1.4 vs. 6.68).

* Recorded at Pago Pago Airport between 1960 to 1980.

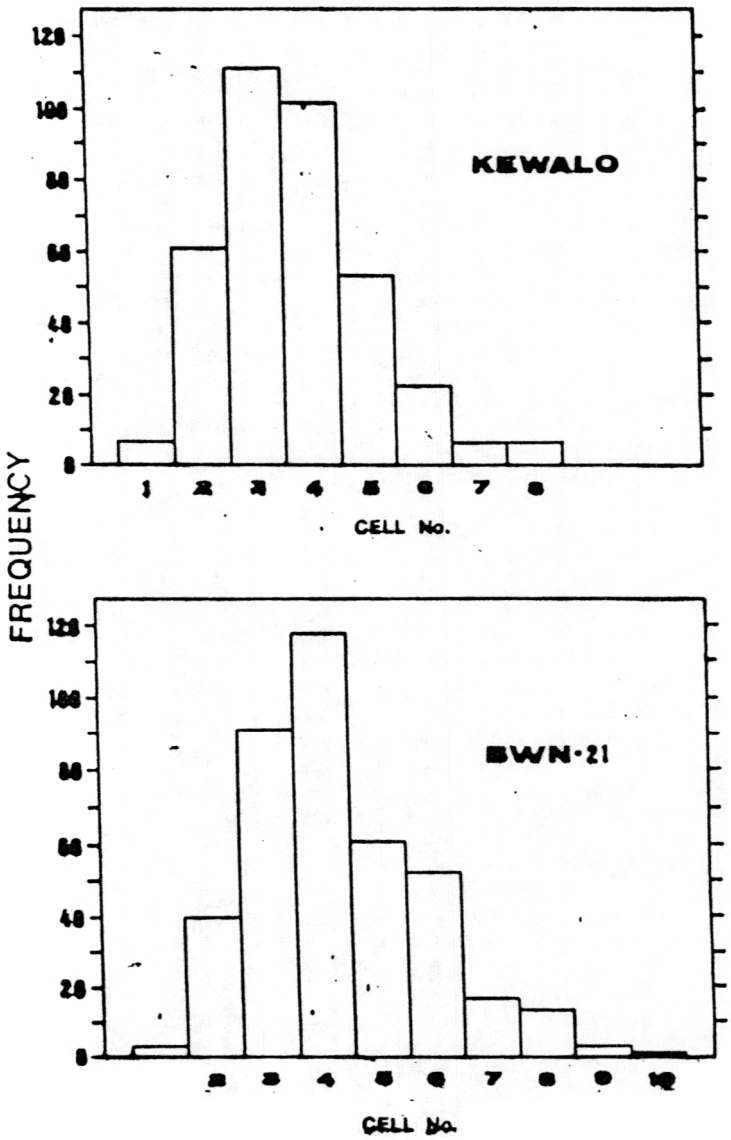

Figure 4. Frequency distribution of individual tomato weights. The 392 Kewalo and 400 BWN-21 tomatoes harvested during the study were grouped into 10 cells of 25 gram increments, i.e., cell 1 contained tomatoes weighing between 1 to 25 g; cell 2 contained tomatoes weighing between 26 to 50 g; etc. Both distributions are skewed right of normal toward heavier tomato weights.

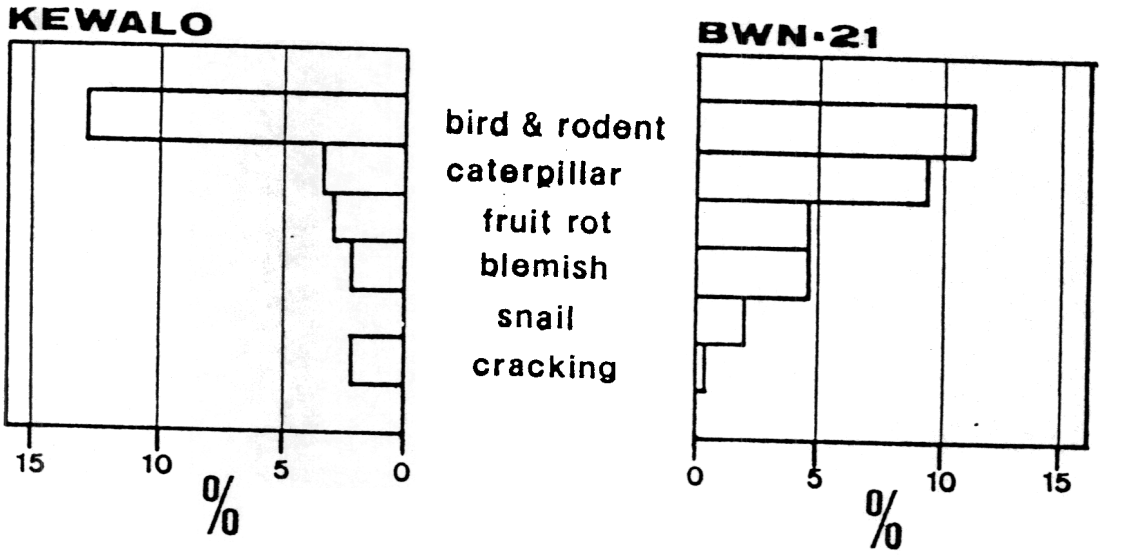

Figure 5. Fruit losses due to pests, disease and blemishes. Percent losses are based on weight. Total losses for Kewalo and BWN-21 varieties are 24% and 32%, respectively.

Table 1, continued

x	P BWN-21	Kewalo
0	0/16	0/16
1	2/16	3/16
2	14/16	13/16

Using these P values in the above three equations for x = 0, 1, and 2 gives the following in situ germination rates:

x	p BWN-21	Kewalo
0	1.0000	1.0000
1	0.9330	0.8669
2	0.9354	0.8770
Averages:	0.956	0.915

Therefore, the in situ germination rates for BWN-21 and Kewalo tomato varieties are 95.6% and 91.5%, respectively.

Table 2. Analysis of variance of accumulated yield, in grams, between BWN-21 and Kewalo tomato varieties.

Source of Variation	df	Sum of Squares	Mean Squares	F-Value
Total	33	83 688 933.5		
Blocks	16	44 846 465.5		
Varieties	1	2 255 957.7	2 255 957.7	0.99†
Error	16	36 586 510.3	2 286 656.9	

†Not significant

The accumulated yields, in grams, for the above ANOVA are:

Block	Kewalo	BWN-21
1	2 470	1 564
2	3 696	2 387
3	1 005	1 088
4	2 114	3 289
5	4 035	1 763
6	1 611	1 467
7	1 192	3 400
8	966	858
9	1 319	1 563
10	3 169	1 598
11	635	2 245
12	1 579	7 041
13	1 914	7 113
14	661	1 010
15	1 626	581
16	1 405	810
17	307	685
	29 704	38 462