Quantitative Assessment of the Effect of the Olive Knot Disease on Olive Yield and Quality

M. N. Schroth, J. W. Osgood, and T. D. Miller

Professor of Plant Pathology, Agricultural Extension Service Farm Advisor, and Assistant Research Plant Pathologist, respectively, Department of Plant Pathology, University of California, Berkeley 94720. Present address of third author: Assistant Professor, Department of Plant Pathology, Ohio Agricultural Research and Development Center, Wooster 44691.

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ABSTRACT

The incidence of olive knot disease caused by *Pseudomonas savastanoi* was related to a striking reduction in yield. The yield of olives from trees with 0.1 - 0.3 knots/0.3 m of fruit wood (light infection) and from those with 0.51 - 1.0 knot/0.3 m (moderate infection) averaged 121.3 kg (267.5 lb) and 94.6 kg (208.5 lb)/tree, respectively. The reduction in yield was also associated with a substantial decrease in the sizes of olives. The difference in average income/tree considering both yield and quality was $36.77 for lightly infected trees and $27.30 for moderately infected trees. On an acre basis, this comes to a loss of $403.38. The data indicated that it would be economically advantageous to develop a control for the disease.

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The effect of olive knot tumors on olive yield and quality is not clear except where the disease is severe and fruit wood is killed or denuded. Since the disease (2) does not generally cause unsightly damage, many growers consider it of little importance, and state that they would not adopt control procedures if available because of additional expense and time. In contrast, others believe the disease causes economic damage and continually request research on control methodology.

Despite many views as to the inconsequential nature of the disease, there were some indications that the disease was of economic importance. Olives from diseased limbs were found by a taste panel to have an off-flavor (1). This has been repeated with similar results. Furthermore, scrutiny of olives on healthy and diseased limbs suggested that the size and number were less on limbs with knots. These points prompted a study to determine the importance of the olive knot disease on yield and quality and to assist the industry in judging as to whether or not the disease justified an expenditure of time and money for research.

MATERIALS AND METHODS.—An olive ranch was selected with trees, *Olea europaea* L. 'Sevillano', that exhibited light to moderate infection. Two methods were used to study the effect of disease on olive yield. For the first method, 1969, 42 trees were placed in three disease categories arbitrarily defined on the basis of the average number of knots/0.3 m of fruit wood. Light infection = 0.1 - 0.3 knots; mild infection = 0.31 - 0.5 knots; and moderate infection = 0.51 - 1.0 knots. For perspective, a "severe" disease rating is defined as one to an infinite number of knots/0.3 m of fruit wood with some dead twigs in evidence. The knot counts were made from the terminal 0.6 m of 30 branches/tree, and then averaged. Only the outer branches were counted to reduce variability caused by shading and other factors. Trees were approximately the same in size, averaging 5.1 m in height and 5.4 m in width and were 40 years old. The skirts of the trees were about 0.75 m from the soil line. The relative size of the trees in each disease group was statistically analyzed for variation by calculating the minimum size of a box which would envelop the tree. Lightly infected trees did not differ significantly in relative size from moderately infected trees ($t = 0.353$, $t_{.01} = 2.77$), nor from mildly infected trees ($t = 0.289$, $t_{.01} = 2.77$). There was no evidence of other diseases that might influence olive yield except for an undescribed *Diplodia* sp., which infects knots and invades stem tissues (M. N. Schroth, *unpublished*). This disease is associated with most knots.

Yields were recorded for 16 lightly infected trees, 13 mildly infected trees, and 13 moderately infected trees. Samples of fruit (6.81 kg) were taken from five of the lightly infected and five moderately infected trees for size rating (Tri-Valley Growers, Oberti Olive Division).

In 1972, the olive crop was poor and there was considerable variability in yield among trees. Therefore, the effect of the disease on yield was determined by correlating the incidence of knots with number of fruits on the terminal 0.6 m of 292 branches from 25 different trees. Trees were selected for size uniformity, as previously described. The outer branches with southern exposure were counted to reduce variability as inner branches usually have fewer olives. Branches with more than six knots/terminal 0.6 m were not counted because many were dead. The data were anlayzed by determining the correlation coefficient.

RESULTS AND DISCUSSION.—Trees lightly infected with olive knot yielded 28% more olives than moderately infected trees. The average for lightly infected trees was 121.3 kg (267.5 lb) of olives to 94.6 kg (208.5 lb) for moderately infected trees ($t = 5.57$, $t_{.01} = 2.77$), or 5.25 boxes to 4.17 boxes. Mildly infected trees yielded an average of 90 kg

TABLE 1. Relation of the olive knot disease with size reduction in Sevillano olives and loss in income

	% size/olives/tree[a]			Tree income/olive size[b]	
Size	Moderate infection	Light infection	Price/lb	Moderate infection	Light infection
Super Colossal	0.54	0.87	$.1925	$ .20	$ .42
Colossal	14.49	24.38	.1800	5.18	11.02
Jumbo	32.11	42.38	.1675	10.68	17.82
Giant	28.41	14.38	.1475	8.32	5.33
Mammoth	12.18	6.95	.0925	2.24	1.61
Extra Large	4.94	3.42	.0500	.49	.43
Large	2.56	1.49	.0375	.19	.14
Total nonusable	4.77	6.12		–	–
Income per tree				$27.30	$36.77

[a] Figures represent the averages of olive samples taken from five moderately and five lightly infected trees. Samples were not taken from mildly infected trees.

[b] Calculations were based on average yield for 13 moderately infected trees averaging 90 kg (198.6 lb) usable olives/tree and 16 lightly infected trees averaging 113.9 kg (251.1 lb) usable olives/tree.

(198.5 lb)/tree or 3.97 boxes and also were significantly different from lightly infected trees ($t = 7.01$, $t_{.01} = 2.77$). There was no significant difference in yield between mildly infected and moderately infected trees. We have no explanation for this except that perhaps the decline in yield may not be proportional to an increase in disease beyond a point.

The sizes of olives from moderately infected trees were considerably smaller than those from lightly infected trees (Table 1). This has a striking impact on the income/tree, since large olives bring considerably more revenue than smaller fruits. The average income/lightly infected tree was $36.77 compared with $27.30 for a moderately infected tree. However, $2.00/tree should probably be subtracted from the income of lightly infected trees, since this represents the additional cost for picking. Therefore, on an acre basis with an average of 54 trees/acre, the difference between lightly and moderately infected trees was $403.38.

It was surprising that a moderate difference in disease rating among trees would result in such a marked reduction in income/tree, since the difference between light and moderate infection is not readily apparent unless actual counts of knots are made. Furthermore, the greatest problem with the technique is that branches throughout a tree are not uniformly infected, thus complicating the determination of the average amount of infection/tree. The differences probably would have been more striking if it were possible to assess yield differences between noninfected and infected trees. However, the nature of the disease is such that all trees in an orchard are usually infected to some degree if any trees have a disease rating of moderate. The comparison of trees in different orchards was not possible because of different cultural practices, tree age, soil type, and other factors. Furthermore, it is not possible to inoculate healthy trees in an orchard and evaluate yields, because of the difficulty in establishing a uniform amount of disease on branches.

TABLE 2. Correlation of number of olive knots with number of fruits/terminal 0.6 m (2 ft) of branches

No. branches sampled	No. of knots	Mean no. of fruit[a]
80	0	5.5
55	1	3.4
34	2	2.8
30	3	2.6
38	4	2.2
25	5	1.7
26	6	1.6

[a] Correlation coefficient $r = .5337$ for F (X, log Y). X = knots and Y = fruit. r is significant at .001 level.

Use of the second method for assessing the effect of disease on crop loss (1972) also indicated that olive knot markedly reduced the yield (Table 2). The variability in results as indicated by the correlation coefficient of $r = .5337$ may in part be attributed to the variation in the age of knots, and their locations on the terminal portions of branches; older knots are more deleterious to branches because of girdling. Knot location is important because smaller branches are more likely to be girdled. It was not practical to consider these factors in the sampling procedures.

These results, along with previous findings that the olive knot disease imparts an off-flavor to the fruit, indicate that the disease is more deleterious and insidious than suspected. It is likely that the difference in income between lightly and moderately infected trees is substantially more than shown here, if pruning costs for removal of dead and knotted branches were included in the calculations. It therefore appears that it would be profitable and desirable to control the disease.

LITERATURE CITED

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