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Update on Bacterial Canker of Avocado

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In 1980 cankerous lesions were observed on avocado trees in South Africa (Myburgh & Kotzé, 1982). The causal agent was identified as *Pseudomonas syringae* (Korsten & Kotzé, 1985). Prior to this, cankers were observed on trunks and branches of avocado in southern California, but the occurrence has generally been infrequent and the cause not determined (Cooksey *et al,* 1993). Bacterial canker occurs sporadically in all major avocado growing areas of South Africa (Korsten, 1984; Korsten & Kotzé, 1987), several counties of California (Cooksey *et ai,* 1993; Ohr & Korsten, 1990), and in Australia (Scholefield & Sedgley, 1983). At present, it is of little economic importance and the percentage of trees showing canker symptoms in groves is usually low (Cooksey *et al,* 1993). However, severely infected trees show retarded growth, defoliation, and low fruit yields (Korsten, 1984). The disease occurs predominantly on the cultivars Hass and Edranol and to a lesser extent on Fuerte (Korsten & Kotzé, 1987). Although symptoms are similar in all countries, the causal agent appears to differ.

P. syringae has been isolated from the periphery of discoloured streaks in South Africa and Australia (Korsten, 1984), and *Xanthomonas campestris* in California (Cooksey *et al.,* 1993). Isolates from South Africa and California were pathogenic to avocado seedlings in artificial inoculation studies, but not those from Australia. However, Australian researchers consider their *P. syringae* isolate to be a secondary invader, and attribute cankerous symptoms to a boron deficiency. Furthermore, although *X. campestris* was isolated from almost half the samples screened in California, the possibility exists that some of the samples could have had black streak (Cooksey *et al.,* 1993). *X. campestris* has also been isolated in South Africa, but failed to induce symptoms upon artificial inoculation (Korsten, 1984). Various analyses suggest that *P. syringae* from South Africa and *X. campestris* from California represent new pathovars (Cooksey *et al.,* 1993). Neither pathogen appears to be particularly aggressive or destructive in pathogenicity tests.

Bacterial canker presumably spreads through nursery practices, since young cankerous lesions occur on newly-planted trees (Korsten, 1984). The disease appears to be systemic, considering the necrotic tissue connecting cankerous pockets, and the phenomenon that young cankers usually appear acropetally to old lesions in infected trees. The epiphytic phase of the pathogen has been detected in South Africa on leaves and twigs by means of monoclonal antibodies raised against *P. syringae* (Korsten *et al.,* 1987). Insects apparently are not involved in disease transmission (Korsten, 1984). Cutting out cankerous pockets and applying copper sulphate to the wounds have been attempted in California. Trees injected with 3% streptomycin or 1 % chloramphenicol had fewer cankerous lesions than untreated trees (Korsten, 1984).

The aim of this report is to update growers on the most recent information on the disease and its status in SA.

MATERIALS AND METHODS

Two surveys were conducted to determine the importance of bacterial canker on avocado. These surveys were also done to determine the relationship between predisposing factors and the occurrence of bacterial canker.

The first survey was conducted on a farm in Northern Province in an orchard with a previous history (1990) of bacterial canker. Trees were rated according to amount of lesions observed (active and non-active). Twig and leaf samples were taken from active lesions (described as watery pockets with whitish exudates on the surface), soil samples were taken for monitoring the presence of *Pythium* and *Phytophthora* and to determine pH values. Leaf samples were taken to test for boron deficiency. Standard procedures were used throughout and isolations and ELISA tests were done as described by Korsten 1984 (Korsten *et al,* 1987).

Three other farms were identified with previous problems of bacterial canker. Unfortunately the survey could not be completed since these farms removed the diseased trees. Of interest was however that trees from these farms were bought at the same nursery and all showed severe cankerous symptoms after three years.

Figure 1
Cankerous lesions on the base of a Hass tree, with white powdery exudates surrounding the watery pocket.

RESULTS AND DISCUSSION

Classical symptoms can be described as follows: Cankerous lesions appear first as slightly sunken and darker areas on the bark, with a necrotic, watery pocket underneath the bark (Korsten & Kotzé, 1987). In more advanced cankers, the bark splits at the edge of the lesion, allowing fluid to ooze out. As the fluid dries, it leaves a white powdery residue at the periphery. During spring and autumn, the white residue surrounding the lesions can easily be spotted on trunks or branches (figure 1). Cankers are 2-10cm in diameter, and usually appear first at the base of the tree from where they spread upwards, mostly in a straight line. Reddish-brown necrotic tissue normally is present in the cortex underneath the canker, with similarly coloured streaks extending for up to 30 cm above and below the pocket. Necrotic streaks between cankers are usually in the xylem, sometimes toward the center of branches or trunks (Cooksey *et al,* 1993). No leaf or fruit symptoms are associated with the disease (Korsten & Kotzé, 1987).

Results from the field survey include the following: Ratings done during 1996, had less active lesions compared to lesions counted on the same trees during 1990 (table 1). Isolations made from active lesions showed low numbers of *P. syringae* and gave low ELISA signals. *Pythium* as well as *Phytophthora* occur in very low numbers. Soil pH ranged between 6,3-8,3. Boron levels were between the recommended 20 50mg/kg. It is perhaps important to mention that cankerous lesions are not associated with a boron deficiency in California since they do not have a boron deficiency problem in their orchards (Ohr, personal communication). However, the overall feeling in Australia is that cankerous pockets are directly related to boron deficiency.

No relationship could be found between certain predisposing factors and bacterial canker. This could be due to the low numbers of *P. syringae* isolated as well as the high incidence of 'less active cankers'. Furthermore, the trees surveyed grew lush due to the higher rainfall recorded the past season. Trees were obviously not 'stressed' which can often be correlated with disease incidence.

If cankerous pockets are observed on new plantings it is important to contact the nursery where the trees were bought and report these symptoms. It is possible for such nurseries to test the trees in their mother block for the presence of the bacterium. Leaves and budwood collected from such orchards can easily be tested for the presence of the bacterium using monoclonal antibodies (Korsten *et al,* 1987). The importance of this point can best be illustrated with the following observation: during 1982 a young newly planted orchard was monitored for the presence of bacterial canker. Most of the trees in this orchard had active cankerous pockets on the trunk and branches. The trees were coded and the number of active lesions counted per tree. During the drought cycle no new cankerous lesions could be observed on these trees. However, a recent new outbreak of cankerous lesions on newly planted orchards could directly be linked to the above mentioned orchard, since it was used as a mother block for the nursery. All trees showing cankerous pockets were the progeny of these originally infected trees.

Table 1
Ratings of bacterial canker, active- and old lesions, on avocado trees during 1990 and 1996

Tree-number	*1990 – Number of lesions*		*1996 – Number of lesions*	
	Active	*Old*	*Active*	*Old*
2	3	2	4	1
3	5	5	4	1
4	2	5	2	5
11	4	2	2	0
14	3	1	2	1
15	5	2	3	1
17	8	3	1	1
21	5	4	0	0
22	15	1	1	0
23	5	3	1	1
24	7	1	2	1
25	8	0	1	0
32	2	0	1	3
33	1	5	3	0
34	8	6	0	1
35	4	0	0	2
36	11	2	4	1
42	13	5	3	1
43	0	2	4	0
44	0	0	1	0
45	1	5	2	0
46	3	0	0	0

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