Use of High Temperature to Increase the Rate of Avocado Sunblotch Symptom Development in Indicator Seedlings

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ABSTRACT

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Avocado sunblotch symptoms in Collinson indicator seedlings developed significantly faster in a hot (30/28 C, day/night) than in a cool (20/18 C, day/night) glasshouse. When indicator plants were cut back 3 mo instead of 6 mo after inoculation, symptom development in plants inoculated with symptomless carrier sources of sunblotch was accelerated. Indexing for sunblotch can thus be completed in about 8 mo instead of 2 yr.

The standard method of indexing for avocado sunblotch disease is to graft buds or bark patches from plants with suspected disease onto healthy avocado seedlings of the cultivars Hass (1) or Collinson (2). This is usually done in screenhouses where temperatures are not controlled, and although symptoms may appear after only 2–3 mo (6,8,9), they often take 1–2 yr to develop (9). Indexing can thus be a long process.

Da Graça and van Lelyveld (3) showed that trees with sunblotch had increased polyphenoloxidase activity irrespective of the presence or absence of symptoms; this phenomenon is nonspecific for sunblotch, however, and enzyme analysis does not lend itself to large-scale testing of trees. Recent studies suggest that sunblotch may be caused by a viroid (5,7). If this is true, rapid indexing by polyacrylamide gel electrophoresis of RNAs may be possible.

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Although research into rapid laboratory techniques continues, our results indicate that development of sunblotch symptoms was more uniformly accelerated by indexing in a hot glasshouse and by cutting back the seedlings to force new growth.

MATERIALS AND METHODS

Of 90 3-mo-old *Persea americana* 'Collinson' seedlings raised from seed of indexed sunblotch-free trees and used as indicators, 45 were placed in a glasshouse set at 30/28 C (day/night) and 45 in a cooler glasshouse at 20/18 C (day/night).

Three sources of sunblotch were used: branches of *P. americana* 'Edranol' trees with symptoms, Edranol "recovery growth" branches, and shoots of the Mexican rootstocks (unknown cultivar) of these trees. The latter two are symptomless carriers of the sunblotch agent.

Our indexing method was based on that described by Wallace (9). Three bark patches of each of the three sunblotch source materials were grafted to each of 15 indicator plants in each glasshouse temperature regime. After grafting, each indicator of the six groups (three inoculum sources, two temperature regimes) was immediately cut back. After 3 mo, the new growth of 10 plants in each group was cut back; half of these plants were transferred from 30 to 20 C and half vice versa. Of the 30 plants not cut back at 3 mo, 20 had no symptoms by 6 mo and were then cut back and maintained at the same temperature regime. All plants were observed for symptom development for 1 yr.

RESULTS

The results are shown in Table 1. At the end of 1 yr all 30 plants kept continuously at 30/28 C had symptoms, 28 of them within 8 mo. Only two of the plants kept continuously in the cool glasshouse developed symptoms toward the end of the experiment (average, 350 days); both had been inoculated with the source having symptoms.

Plants that spent some of the time at the higher temperature began to develop symptoms during the experiment. Four of the five plants inoculated from the tree with symptoms and transferred from low to high temperature regime developed symptoms soon after 8 mo; four of the five transferred from low to high temperature

Table 1. Effect of temperature and cutting back on the development of sunblotch symptoms on Collinson avocado indicator seedlings inoculated with bark patch grafts from three sources

	Inoculum source[a]								
	Tissue with symptoms			Symptomless "recovery growth"			Symptomless rootstock shoot		
Treatment	No.[b]	Time range (days)	Average (days)	No.[b]	Time range (days)	Average (days)	No.[b]	Time range (days)	Average (days)
30/28 C only									
6 mo cutback	5/5	87–111	90.0[c]	5/5	175–365	269.4	5/5	136–230	174.4[d]
3 mo cutback	5/5	143–175	158.2[c]	5/5	141–206	159.8[c]	5/5	143–181	157.8[c]
30/28 C									
3 mo cutback and transfer to 20/18 C	4/5	329–365	347	1/5	327	327	0/5	...	...
20/18 C only									
6 mo cutback	2/5	335–365	350	0/5	...	...	0/5	...	...
3 mo cutback	0/5	...	...	0/5	...	...	0/5	...	...
20/18 C									
3 mo cutback and transfer to 30/28 C	4/5	156–259	...	0/5	...	...	1/5	329	329

[a] Edranol shoots with symptoms and symptomless "recovery growth," symptomless Mexican rootstock of unknown cultivar.
[b] Number positive/number in test.
[c] All plants had symptoms within 6 mo.
[d] All plants had symptoms within 8 mo.

took almost a year to show symptoms.

Only two indicators inoculated with symptomless carrier material developed symptoms after transfer between the temperature regimes. Test seedlings inoculated with tissue from symptomless carrier sources developed symptoms more rapidly when cut back at 6 mo if they had been maintained continuously at the higher temperature. However, the 3-mo cutback delayed symptom development in indicators inoculated with tissue from the source with symptoms.

DISCUSSION

Because sunblotch symptoms may take as long as 2 yr to develop under uncontrolled temperatures, there is obviously a need to accelerate the indexing procedure. One way is to try to develop a rapid laboratory technique, and research in this direction is being done.

A faster reacting indicator plant would be a help, but so far no avocado cultivars more sensitive than Hass and Collinson are known, and the only other host so far recorded, cinnamon, is no faster (4). Our experiment showed a clear difference in the rate of symptom development between plants kept continuously at 30/28 C and those maintained continuously at 20/18 C. Within 8 mo of inoculation, slightly more than 90% of the plants at the higher temperature range had symptoms, although only two of the plants kept at the lower temperature had symptoms and expression required an average of 350 days. The effect of the higher temperature was further demonstrated with plants that were inoculated at 18/20 C and transferred to 30/28 C after 3 mo. Symptoms developed faster in them than in plants maintained continuously at 18/20 C and in plants transferred to the lower temperature after 3 mo.

Indexing of symptomless carriers was also helped by cutting the plants back 3 mo after inoculation, instead of 6 mo as recommended by Wallace (9), if plants were maintained at the higher temperature. This treatment impeded symptom appearance, however, in the indicators receiving tissue from sources with symptoms. Normally, indexing takes longer in symptomless carriers than in those with symptoms (10), so presumably the 3-mo cutback of the latter's indicators removes the growth that is on the point of developing symptoms. In the symptomless carrier source indicators, cutting back forces new growth in which the symptoms appear more rapidly.

The reason for the time difference for the different carriers to induce symptoms in indicators is unknown. Wallace and Drake (10) suggested that plants with symptoms might have a higher concentration of the agent.

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