# Relationships Between Onion Leaf Age and Susceptibility to *Alternaria porri*

MARVIN E. MILLER, Assistant Professor, Texas Agricultural Experiment Station, Weslaco 78596

**ABSTRACT**

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Measurements of onion (*Allium cepa*) leaf tissue damaged by *Alternaria porri* infections were taken at weekly intervals from the time of bulb initiation until bulb maturity to determine relationships between age of onion plants and susceptibility to *A. porri*. Levels of leaf damage were significantly lower ($P = 0.05$) on younger leaves than on older leaves each week, except 1 wk before bulb maturity on New Mexico Yellow Grano (NMYG) and at maturity on both NMYG and Texas Grano 502 onions. Leaves that emerged 9,8,7,6, and 5 wk before bulb maturity required 5½,5,4½,3½, and 2½ wk, respectively, to reach 50% leaf damage, whereas leaves emerging 2, 3, and 4 wk before bulb maturity exceeded 50% leaf damage within 2 wk. Individual onion leaves were more susceptible to *A. porri* as they aged, and emerging leaves became more susceptible as the bulbs approached maturity.

South Texas is the major supplier of onions (*Allium cepa* L.) in the United States from March through May. About 6,073 ha are grown in the area during this period. Several fungi, including *Botrytis squamosa* Walker, *Stemphylium vesicarium* (Wallr.) Simmons, and *Alternaria* spp., cause foliage damage to onions grown in south Texas (1,4,9). *A. porri* (Ell.) Cif., the causal agent of purple blotch, causes the major onion foliage losses (2).

Information on relationships between the age of the onion plant and *A. porri* is limited. Nolla (5) reported that primary infections of *A. porri* usually occur just before bulb formation. Miller (2) reported that the number of *A. porri* spores collected in spore traps increased after leaf wetness periods of 12 or more hours. It is known that older senescent tissue of lower leaves is more susceptible to *Alternaria* spp. than the younger tissue of the uppermost leaves in many plants (6–8,10). Additional information is needed on relationships between onion plant age and susceptibility to *A. porri* to better understand how purple blotch epidemics develop and to improve existing fungicide control programs.

This study, initiated in 1979, was designed to compare the susceptibility of leaves in various positions of the onion plant with each other over time in order to determine the growth stage at which onion foliage is most susceptible to *A. porri*. A preliminary report was made on part of this work (3).

## MATERIALS AND METHODS

Two fields consisting of about 0.3 ha each of New Mexico Yellow Grano (NMYG) and Texas Grano 502 (TG 502)

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onion cultivars were used in this study. Within each field, three plots were established. Each plot, 12.19 × 2.03 m, consisted of two beds with four rows of onions per bed. Before bulb maturity, plots of TG 502 and NMYG were sprinkler-irrigated for three or four 15-min periods several nights each week for 5 and 7 wk, respectively, to ensure adequate free moisture for disease development. Fungicides were not applied on these onions.

Disease ratings were taken on the TG 502 and NMYG onions for 5 and 7 wk, respectively, before bulb maturity by randomly selecting five plants weekly from each plot and determining percent tissue damaged by *A. porri* infections. Percent tissue damaged was determined by measuring the length of damaged tissue on each leaf and dividing it by the total length of the leaf. We measured percent damaged tissue rather than increases of new infection sites because purple blotch lesions quickly lost their identity and the number of new infection sites could not be counted accurately. Data were taken on leaves in positions 3–8, with position 1 being the youngest leaf in the plant apex.

To determine the length of time a leaf remained in a given position, leaves in position 3 were tagged each week on 20 plants and the position of those leaves was recorded weekly until bulb maturity. Bulbs were considered mature when 50% of the onion tops had fallen over.

To determine variations in susceptibility of leaves to *A. porri* on the same plant, TG 502 onions were grown in pots in a greenhouse to the five- to six-leaf stage. The leaves in positions 2–6 of 20 plants were inoculated with 150 *A. porri* conidia per milliliter of water and placed in unlighted incubator boxes for 24 hr at 24 C (±0.5 C) and 98–100% relative humidity. After the incubation period, the plants were placed under fluorescent light banks with a 10-hr light (7,000 lux) and a 14-hr dark cycle for 48 hr at 24 C (±1.5 C). Disease ratings then were taken as described previously.

## RESULTS AND DISCUSSION

An average of one leaf emerged from both TG 502 and NMYG each week throughout the experiment until 1 wk before bulb maturity when no new leaves emerged. Leaves in positions 3–8 had emerged from the whorl and were consequently exposed to *A. porri* conidia in the environment for 2–3, 3–4, 4–5, 5–6, 6–7, and 7–8 weeks, respectively.

Levels of leaf damage caused by *A. porri* were significantly lower ($P = 0.05$) on younger leaves than on older leaves, except for 1 wk before bulb maturity on NMYG and at maturity on both NMYG and TG 502. The least amount of leaf damage occurred on the younger leaves in position 3 and increased progressively on the older leaves to position 8 (Table 1). The levels of leaf damage in positions 3 and 4 and 7 and 8 were not significantly different on most dates. Leaf damage in position 5 could generally be grouped with 3 and 4, whereas position 6 could be grouped with 7 and 8.

The level of leaf damage in each position increased the closer the measurements were taken to bulb maturity. For example, the percent leaf damage in position 3 increased from 0.0 and 0.7% on TG 502 and NMYG, respectively, 5 wk before bulb maturity to 97.3 and 96.3% at bulb maturity. Damage in the other leaf positions increased similarly.

Differences in leaf damage between leaf positions and increasing damage within a given position as the plant approached maturity could be the result of the following: 1) leaves in the higher-numbered positions are older and therefore exposed to the environment longer than leaves in the lower-numbered positions, 2) the inoculum concentration under favorable environmental conditions increases as bulb maturity is approached, 3) individual leaves become more susceptible as they age, or 4) leaves that emerge near bulb maturity are more susceptible to *A. porri* than leaves that

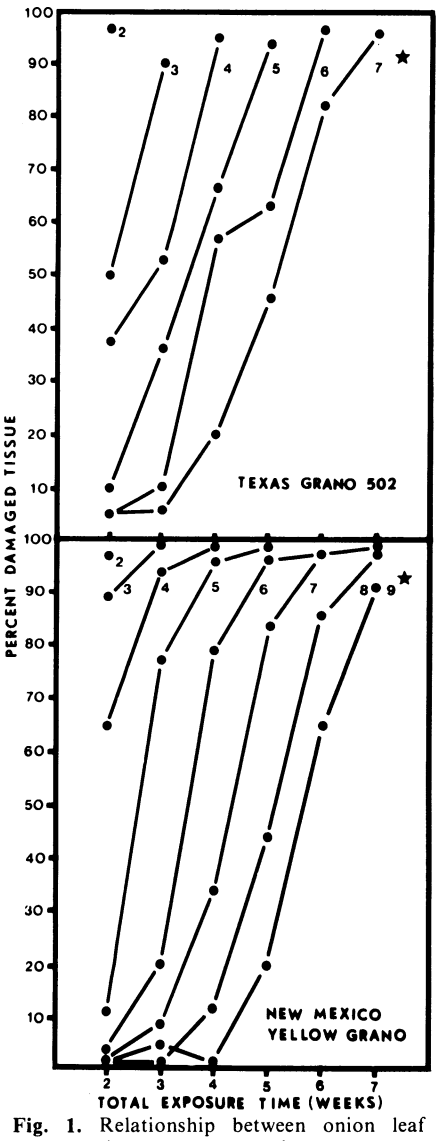


**Fig. 1.** Relationship between onion leaf exposure time and percent leaf damage caused by *Alternaria porri*. * = Weeks leaves emerged before bulb maturity.

**Table 1.** Percent tissue damaged by *Alternaria porri* in various leaf positions on two onion cultivars

| Leaf position | Weeks until bulb maturity[x] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | | | | **Texas Grano 502** | | | | |
| 3[y] | ··· | ··· | 5.7 a[z] | 5.0 a | 10.7 a | 38.3 a | 51.0 a | 97.3 |
| 4 | ··· | ··· | 1.7 a | 6.7 a | 10.7 a | 35.3 a | 51.6 ab | 95.0 |
| 5 | ··· | ··· | 4.0 a | 13.3 b | 20.0 a | 56.0 bc | 63.0 bc | 94.7 |
| 6 | ··· | ··· | 17.3 b | 16.0 b | 34.3 b | 47.0 ab | 66.3 c | 93.7 |
| 7 | ··· | ··· | 16.7 b | 25.3 c | 51.0 c | 64.3 c | 81.7 d | 97.7 |
| 8 | ··· | ··· | 40.7 c | 29.3 c | 59.3 c | 66.7 c | 85.3 d | 97.3 |
| | | | | **New Mexico Yellow Grano** | | | | |
| 3[y] | 0.0 a[z] | 0.0 a | 0.7 a | 2.0 a | 11.0 a | 64.7 a | 89.7 | 96.3 |
| 4 | 0.7 a | 3.0 ab | 0.7 a | 8.0 ab | 20.0 b | 78.0 b | 94.3 | 99.0 |
| 5 | 3.0 a | 5.7 bc | 1.0 a | 12.0 abc | 34.0 c | 79.3 bc | 95.3 | 98.0 |
| 6 | 8.3 a | 7.7 cd | 5.3 a | 20.0 bc | 43.7 d | 83.3 bc | 97.0 | 99.3 |
| 7 | 20.7 a | 10.3 d | 15.0 b | 25.3 c | 64.3 e | 86.0 bc | 98.0 | 98.7 |
| 8 | 43.0 b | 23.0 e | 20.0 b | 51.0 d | 81.7 f | 91.7 c | 98.7 | 100.0 |

[x]Each numerical entry is an average of three replicates.
[y]Leaf position 3 corresponds to the third leaf from the apex of the plant.
[z]Numbers within columns followed by the same letter are not significantly different ($P = 0.05$) according to Duncan's multiple range test.

**Table 2.** Percent tissue damaged by *Alternaria porri*[w] on Texas Grano 502 onions in five- to six-leaf stage[x]

| Leaf position | Percent damage |
|---|---|
| 2[y] | 25.6 a[z] |
| 3 | 33.6 a |
| 4 | 45.8 b |
| 5 | 72.4 c |

[w] Leaves inoculated with 150 conidia of *A. porri* per milliliter of water.
[x] Each numerical entry is an average of 20 replicates.
[y] Leaf position 2 corresponds to the second leaf from the apex of the plant.
[z] Numbers followed by the same letter are not significantly different ($P = 0.05$) according to Duncan's multiple range test.

emerge earlier.

Different exposure time of leaves to the environment in the various positions cannot account for the different levels of leaf damage between positions. When individual leaves are followed from positions 3–8, it becomes obvious that the time from leaf emergence to bulb maturity has a greater effect on percent leaf damage than does exposure time. For example, leaves on NMYG that emerged 9, 8, 7, 6, and 5 wk before bulb maturity required 5½, 5, 4½, 3½, and 2½ wk, respectively, to reach 50% leaf damage, whereas leaves emerging 2, 3, and 4 wk before bulb maturity exceeded 50% leaf damage within 2 wk (Fig. 1). The same type of trend was observed on TG 502.

Increased inoculum concentration cannot totally account for the differences in leaf damage as maturity is approached. Inoculum concentration undoubtedly increases under favorable environmental conditions when more leaves are damaged by *A. porri*; however, the data (Table 2 and Fig. 2) indicate that older leaves are more susceptible than younger leaves on a given date and that newly emerging leaves are more susceptible the closer they emerge to bulb maturity. Significant differences in damage among leaves of various ages occurred when onion plants in the five- to six-leaf stage were inoculated with a standardized inoculum (Table 2). Leaf damage ranged from 25.6% on the youngest leaf to 72.4% on the oldest leaf. Similar results were reported by Shoemaker and Lorbeer (8) when various-aged onion leaves were inoculated with *B. squamosa.*

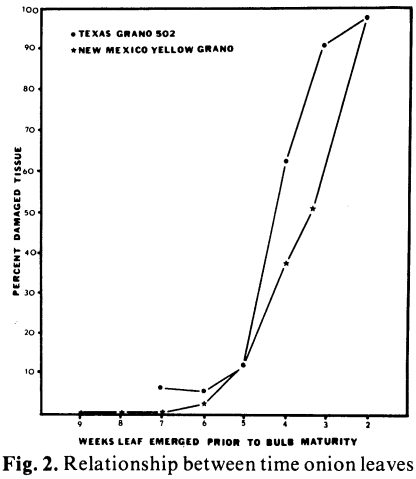

**Fig. 2.** Relationship between time onion leaves emerged before bulb maturity and percent leaf damage caused by *Alternaria porri* 2 wk after emergence.

Increasing susceptibility of emerging leaves to *A. porri* is shown in Figure 2. Leaves that emerged 6–9 wk before bulb maturity had less than 10% damage 2 wk after emergence on both NMYG and TG-502 onions, whereas leaf damage ranged from 11 to 97% on leaves that emerged 2–5 wk before bulb maturity.

Because individual onion leaves are increasingly susceptible to *A. porri* as they age and emerging leaves are more susceptible to the pathogen the closer they emerge to bulb maturity, purple blotch is increasingly difficult to control as the bulbs approach maturity. Purple blotch control with fungicides is especially difficult when environmental conditions favor sporulation and germination of conidia of *A. porri.*

## LITERATURE CITED

1. McLean, D. M., and Sleeth, B. 1959. Tip and leaf blight of onions in the Lower Rio Grande Valley. J. Rio Grande Valley Hort. Soc. 13:152-154.
2. Miller, M. E. 1975. Environmental factors associated with the spread of purple blotch of onions. (Abstr.) Proc. Am. Phytopathol. Soc. 2:35.
3. Miller, M. E., and Amador, J. M. 1981. The relationship between age and position of onion leaves and susceptibility to purple blotch. (Abstr.) Phytopathology 71:895.
4. Miller, M. E., Taber, R. A., and Amador, J. M. 1978. Stemphylium blight of onions in South Texas. Plant Dis. Rep. 62:851-853.
5. Nolla, J. A. B. 1927. A new *Alternaria* disease of onions (*Allium cepa* L.). Phytopathology 17:115-132.
6. Rowell, J. B. 1953. Leaf blight of tomato and potato plants. R. I. Agric. Exp. Stn. Bull. 320:1-29.
7. Russell, G. E. 1966. The control of *Alternaria* spp. on leaves of sugar beet infected with yellowing viruses. II. Experiments with two yellowing viruses and virus-tolerant sugar beet. Ann. Appl. Biol. 57:425-434.
8. Shoemaker, P. B., and Lorbeer, J. W. 1977. The role of dew and temperature in the epidemiology of Botrytis leaf blight of onions. Phytopathology 67:1267-1272.
9. Skiles, R. L. 1953. Purple and brown blotch of onion. Phytopathology 43:409-412.
10. Stavely, J. R., and Slana, L. J. 1971. Relation of leaf age to the reaction of tobacco to *Alternaria alternaria.* Phytopathology 61:73-78.