Factors Affecting Stromatinia Root Rot of Gladiolus

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ABSTRACT

Soil temperature at, or exceeding, 28 C inhibited development of *Stromatinia* root rot on gladiolus. Root rot became increasingly severe as soil temperature was decreased to 24, 20, and 16 C. Soil moisture and inoculum concentration, within the range and temperatures studied, act independently but are additive in their effects on disease development. Infected gladioli grew vigorously when soil temperature was increased to 28 C. Several cultivars show moderate resistance to this disease. Phytopathology 61: 1329-1331.

Additional key words: temperature-moisture effects.

Dry rot of gladiolus (*Gladiolus hortulansus* L.), caused by *Stromatinia gladioli* (Drayt.) Whet., is widely distributed wherever commercial gladioli are grown, and is one of the major diseases of the crop (6). The fungus causes a dry rot of corms, rotting of the neck or stalk, and a root rot disease. Soil becomes infested when diseased corms are planted, followed by a rapid buildup of the organism (4). Once established in soil, the fungus can survive almost indefinitely (2).

Although it is reported that warm temperatures are conducive to infection (3, 9) and hasten death of plants (2), most severe disease seems to occur under relatively cool conditions (2, 4, 6). The disease is seasonal in California, New York, Florida, and North Carolina (2). Prolonged periods of low temperatures during the early part of the growing season are conducive to *Stromatinia* infection in North Carolina. Diseased plants often recover when the weather becomes warm and dry (4).

Gould considers temperature an important factor in infection and subsequent development of Stromatinia root rot. He suggests that if temperature is not excessively high, moisture appears to be the major determining influence (2). Moreover, he postulates that the severe losses from *Stromatinia*, which appear to be more common under cool conditions, may possibly be related to higher soil moisture that usually occurs under such conditions. According to Magie, Stromatinia root rot in Florida can be severe even in a dry year (6, 7). The present study was undertaken to determine the interacting role of temperature, moisture, and inoculum concentration on severity of Stromatinia root rot of gladiolus.

MATERIALS AND METHODS.—Corms used in these tests were grown from hot water-treated cormels produced in methyl bromide-treated soil (8). Four planting-stock corms (10-18 mm diam) were planted in fine sandy loam in 4-inch plastic pots (1,200 g sand/pot). Methyl bromide was used for sterilization of potting medium. Soil temperatures were maintained by placing pots in temperature-controlled water baths.

Cultivars Traveler and Beverly Ann were utilized to study effects of soil moisture and temperature on Stromatinia root rot. Ten additional cultivars were compared for susceptibility to this disease: Friendship; Hopman's Glory; Junior Prom; Orange Gold; Peter Pears; Roman Holiday; Spic and Span; Valeria; Vinks Glory; and White Friendship.

One isolate of *S. gladioli* used was obtained from R. O. Magie, Bradenton, Fla. A second culture was isolated from a gladiolus plant grown in infested soil in North Carolina. The fungus was grown on potato-dextrose agar (PDA) in petri dishes at 24 C for 14-21 days. Agar containing mycelia and sclerotia was suspended in distilled water, fragmented in a Waring Blendor, then made up to 50 ml aqueous suspension/culture. Fifteen ml of this inoculum was mixed with 1 kg soil before potting. Disease was evaluated 6-7 weeks after planting by estimating the severity of disease in roots, stems, and foliage. Plants showing stunting but only slight chlorosis of foliage were rated 1; moderately chlorotic plants, 2; and severely chlorotic or dead plants, 3. Stems having between 5-30%, 31-60%, and 61-100% of the surface covered with lesions were rated 1, 2, and 3, respectively. Slight, moderate, and severe root decay were rated 1, 2, and 3, respectively. Individual ratings of foliage, stems, and roots were totaled to give the disease index (5).

Saturation capacity (SC) of soil used for potting was determined by placing samples in a Büchner funnel, saturating, and allowing the excess water to drain by gravity for 2 hr (1). Soil moisture was determined by the oven-dry method, and recorded on a dry weight basis. Although it is recognized that the application of free water to the surface of an intact soil mass does not result in a uniform wetting of that soil mass, but merely gives various amounts of water distributed in various portions of the soil mass (1), the ratio of water to soil mass as maintained by daily watering is expressed herein in terms of percentage of saturation capacity. Influence of soil moisture on disease severity was examined at 30, 55, and 80% SC. Pots were watered daily by weight, using distilled water. Adjustment of total pot weight used in determining soil moisture was made weekly on the basis of a correlation previously established between plant weight and height of foliage of similar plants grown under identical conditions.

Analysis of variance was applied to disease indices, and differences between means were detected with Duncan's multiple range test. Differences, where indicated, were statistically significant at the 5% level.

RESULTS.—*Soil temperature.*—Plants were grown in *S. gladioli*-infested soil at 16, 20, 24, and 28 C, and maintained at 55% SC. No root rot or foliage symptoms developed on either Beverly Ann or Traveler plants growing in infested soil at 28 C. However, disease was evident at 24 C and was more severe at soil temperatures of 20 and 16 C. In four tests, disease indices averaged 6.9, 5.0, 3.0, and 0.0, respectively, for plants maintained at 16, 20, 24, and 28 C. Both isolates of the fungus gave essentially the same response. Plants in fumigated soil grew equally well at all four temperatures.

Soil moisture.—Although the effect of soil moisture was less pronounced than that of temperature, disease was significantly greater (5% level) when moisture was increased from 30 to 80% SC at 16 and 20 C (Fig. 1). At 24 C, disease was more severe at 55% SC than at 30% SC. Disease severity was no greater at 80% SC, however, than at 55% SC. Although soil moisture and temperature are independent factors, their effects are additive; e.g., disease severity at 30% SC and 16 C was the same as at 55% SC and 20 C. Similarly, disease severity at 30% SC and 20 C was the same as at 55 or 80% SC and 24 C.

Inoculum concentration.—Plants grown in *S. gladioli*-infested soil at 16, 20, and 24 C (55% SC) showed increased root rot severity as inoculum was increased 2- and 4-fold (Fig. 2). Although disease severity decreased as soil temperature increased, greater inoculum densities resulted in increased disease at all soil temperatures.

Temperature effect on disease recovery.—A test was designed to study the effects of increasing soil

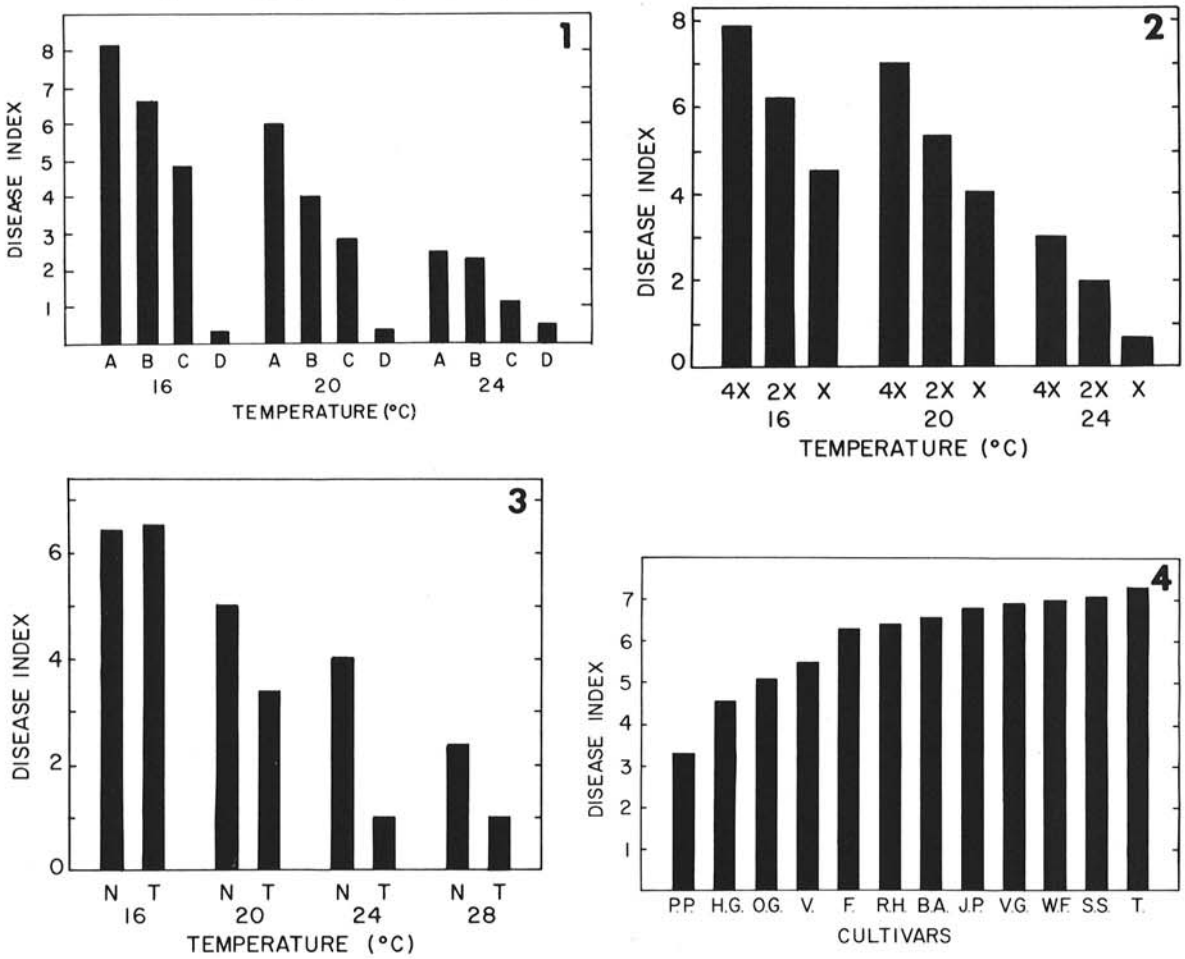

Fig. 1-4. **1)** Effect of soil moisture on disease severity. A = 80% SC (saturation capacity); B = 55% SC; C = 30% SC; D = noninoculated check at 55% SC. **2)** Effect of inoculum concentration on disease severity. X = 4×10^4 microsclerotia/pot; 2X = 8×10^4 microsclerotia/pot; 4X = 16×10^4 microsclerotia/pot. **3)** Effect of temperature on subsequent disease development when infected plants are maintained in infested or fumigated soil; N = infected plants grown in infested soil; T = infected plants transplanted into fumigated soil. **4)** Response of cultivars grown in Stromatinia-infested soil. P.P. = Peter Pears; H.G. = Hopman's Glory; O.G. = Orange Gold; V. = Valeria; F. = Friendship; R.H. = Roman Holiday; B.A. = Beverly Ann; J.P. = Junior Prom; V.G. = Vinks Glory; W.F. = White Friendship; S.S. = Spic and Span; and T. = Traveler.

temperature during the growth and development of diseased plants. Four Beverly Ann corms were planted in each of 36 pots containing soil infested with *S. gladioli*, and in each of 16 pots of fumigated soil. Pots were maintained at 24 C for 14 days, at which time the first leaves had emerged (5-8 cm). Pots were then maintained at 16 C for an additional 14 days, plants were removed from half of the pots containing infested soil, and root rot severity was estimated to be 2.5 for all plants. Roots were washed gently under running tap water, and plants were repotted into fumigated soil. Four pots each of (i) repotted plants; (ii) plants growing in infested soil; and (iii) plants growing in fumigated soil were maintained at 16, 20, 24, and 28 C. Pots were watered daily to maintain moisture at 80% SC. Disease severity was estimated 5 weeks after placing pots at the differential temperatures.

When *Stromatinia*-infected Beverly Ann gladioli were removed from infested soil at 24 C and transplanted into fumigated soil and maintained at 16 C, root rot was equal to that observed on plants grown continuously in infested soil at 16 C (Fig. 3). While disease severity doubled on plants continuously exposed to infested soil at 20 C during the 5-week incubation, repotted gladioli maintained at 20 C showed only a slight increase in disease above that observed at time of repotting. Repotted plants maintained at 24 or 28 C essentially recovered from disease symptoms, whereas plants growing continuously in infested soil at 24 C showed a slight increase in disease, and plants at 28 C exhibited no more root rot than was evident at time of repotting. No stunting was evident in gladioli maintained in soil at 28 C whether repotted or not, or in the repotted gladioli maintained at 24 C when compared with healthy control plants.

Cultivar susceptibility.—Plants were grown in *S. gladioli*-infested soil at 55% SC and 20 C. Although all 12 cultivars tested were susceptible to Stromatinia root rot (average disease index = 6.1), several cultivars showed some resistance to disease (Fig. 4). Peter Pears was the most resistant cultivar, with a disease index of 3.3. Hopman's Glory, Orange Gold, and Valeria had disease indices of 4.6, 5.1, and 5.5, respectively. Friendship, the most widely grown commercial cultivar in southeastern North Carolina, was severely diseased, with an index value of 6.3. The remaining seven cultivars did not differ from Friendship in susceptibility to Stromatinia root rot.

DISCUSSION.—Analyses of soil moisture and temperature as factors determining the severity of Stromatinia root rot of gladioli indicate that although moisture is important, temperature is the most critical factor in determining disease severity. Inoculum concentration, within the range and soil temperature studied, acted independently on disease development. Whereas all three factors appear to be additive in their effects, soil temperature is the final and limiting influence in determining the product of their collective effect on disease severity.

Although infected gladioli recovered and grew vigorously when soil temperature was increased to 28 C, these data do not preclude the possibility that under more complex field conditions, mortality may be hastened. These results do, however, support a previous observation that recovery of infected plants in North Carolina can occur with increasing soil temperatures (4).

Current disease control measures, e.g., broadcast fumigation with a broad-spectrum fumigant, are expensive but effective and economically justifiable. Increased resistance of gladioli to soil-borne pathogens would permit the recommendation of alternative, integrated control practices which would be less costly. The fact that there are several currently acceptable commercial cultivars with moderate resistance to *S. gladioli* suggests that this resistance could be utilized in current breeding programs.

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