

Project Title: Verticillium efforts on spinach
CLGRB Progress Report
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Project Summary

Efforts continue to examine the genetic and phenotypic diversity of *Verticillium* and *Verticillium*-like species on spinach. Greenhouse inoculation assays are being optimized to evaluate the pathogenicity and virulence of isolates under controlled conditions. Lime treatments to soil under greenhouse conditions appear to increase *Verticillium* wilt disease severity (Table 1). All isolates of *V. dahliae* that originated from spinach or spinach seed were confirmed to be pathogenic on spinach, whereas some isolates that originated from other hosts were not pathogenic on spinach or weakly virulent (Table 1). Isolates of *V. tricorpus* and *G. nigrescens*, recovered from spinach, and *V. albo-atrum*, and *L. fungicola* were not pathogenic on spinach (Table 1). These results indicate that *Verticillium* and related species associated with spinach display substantial variability in parasitic ability, virulence, and pathogenicity.

Table 1. Mean disease incidence and severity of spinach line AC1 inoculated with a wildtype and a “marker” *nit* mutant strain of *Verticillium dahliae* treated with lime recorded 22 days after inoculation^a

| Isolate | Species | Host | Origin | Treatments | | | |
|---------------------|------------------|---------|--------|-------------------------------|----------------------|--------------------------------|----------------------|
| | | | | Disease Severity ^b | | Disease Incidence ^c | |
| | | | | Lime ^d | No-Lime ^e | Lime ^d | No-Lime ^e |
| VD4 | <i>V.dahliae</i> | Spinach | USA | 1.9 | 1.2 | 73.3 | 73.3 |
| VD4/54 ^f | <i>V.dahliae</i> | Spinach | USA | 3.3 | 2.2 | 80.0 | 53.3 |
| Control | | | | 0 | 0 | 0 | 0 |

^a Inoculated on 1/28/10.

^b Mean disease severity rating (scale 0-6) of 3 plants per pot and 5 pots per treatment (in greenhouse) 22 days after inoculation.

^c Mean disease incidence per treatment on day 22 after inoculation

^d Lime treatment (5 g/L) applied once per week.

^e No lime treatment applied.

^f Nitrate non-utilizing mutant of VD4 isolate of *Verticillium dahliae*.

Table 1. Disease incidence, severity and plant dry weight of spinach line AC1 inoculated with different isolates of *Verticillium* recorded 54 days after inoculation.^a

| Isolate Name | Species ^b | Host | Origin | VCG ^c | Disease severity ^d | Disease incidence ^e | Dry weight (g) ^f |
|-----------------|----------------------|--------------|-------------|------------------|-------------------------------|--------------------------------|-----------------------------|
| Control | --- | --- | --- | --- | 0.0 | 0.0 | 1.23 |
| LD9 | <i>V. albo-atrum</i> | Alfalfa | USA | n.d. | 0.0 | 0.0 | 1.41 |
| LD10 | <i>G. nigrescens</i> | Spinach seed | USA | n.d. | 0.0 | 0.0 | 1.48 |
| USDA 95 | <i>G. nigrescens</i> | Spinach seed | USA | n.d. | 0.0 | 0.0 | 1.38 |
| LD8 | <i>V. tricorpus</i> | Peppermint | USA | n.d. | 0.0 | 0.0 | 1.50 |
| USDA 11 | <i>V. tricorpus</i> | Spinach seed | USA | n.d. | 0.0 | 0.0 | 1.21 |
| USDA 29 | <i>V. tricorpus</i> | Spinach seed | USA | n.d. | 0.0 | 0.0 | 1.61 |
| <i>L. fung.</i> | <i>L. fungicola</i> | Mushroom | USA | n.d. | 0.0 | 0.0 | 1.44 |
| LD1 | <i>V. dahliae</i> | Peppermint | USA | 2B | 0.0 | 0.0 | 1.57 |
| VD4 | <i>V. dahliae</i> | Spinach | USA | 4B | 0.4 | 16.7 | 1.53 |
| WSU 541 | <i>V. dahliae</i> | Spinach | Netherlands | 2B | 1.1 | 16.7 | 1.51 |
| WSU 107 | <i>V. dahliae</i> | Spinach | Denmark | 2B | 1.4 | 41.2 | 1.69 |
| WSU 523 | <i>V. dahliae</i> | Spinach | Netherlands | 2B | 1.4 | 50.0 | 1.30 |
| JD4 | <i>V. dahliae</i> | Spinach | USA | n.d. | 1.4 | 33.3 | 0.95 |
| RV1 | <i>V. dahliae</i> | Radish | USA | 4B | 1.6 | 58.8 | 1.82 |
| WSU 509 | <i>V. dahliae</i> | Spinach | Netherlands | 4B | 1.7 | 70.6 | 0.99 |
| USDA 25 | <i>V. dahliae</i> | Spinach seed | USA | n.d. | 1.9 | 76.5 | 1.25 |
| WSU 139 | <i>V. dahliae</i> | Spinach | USA | 4B | 2.1 | 64.7 | 1.56 |
| VD1 | <i>V. dahliae</i> | Spinach | USA | 2B | 2.2 | 55.6 | 1.16 |
| WSU 268 | <i>V. dahliae</i> | Spinach | USA | 2B | 2.3 | 82.4 | 1.32 |
| JD1 | <i>V. dahliae</i> | Potato | USA | 2B | 2.5 | 50.0 | 1.29 |
| WSU 311 | <i>V. dahliae</i> | Spinach | Denmark | 4B | 2.5 | 82.4 | 0.93 |
| WSU 49 | <i>V. dahliae</i> | Spinach | USA | 4B | 2.8 | 88.9 | 1.09 |
| JD6 | <i>V. dahliae</i> | Spinach | USA | n.d. | 2.8 | 100.0 | 1.14 |
| WSU 384 | <i>V. dahliae</i> | Spinach | USA | 2B | 2.9 | 88.9 | 1.29 |
| WSU 210 | <i>V. dahliae</i> | Spinach | Denmark | 2B | 3.1 | 77.8 | 0.90 |
| LD2 | <i>V. dahliae</i> | Mint | USA | 2B | 3.4 | 77.8 | 0.87 |
| JD4 ss4 | <i>V. dahliae</i> | Spinach | USA | n.d. | 3.4 | 94.4 | 0.82 |
| WSU 359 | <i>V. dahliae</i> | Spinach | Denmark | 4B | 3.5 | 94.4 | 0.78 |
| JD2 | <i>V. dahliae</i> | Potato | USA | 4B | 3.5 | 83.3 | 0.76 |
| WSU 511 | <i>V. dahliae</i> | Spinach | Netherlands | 4B | 3.9 | 82.4 | 0.54 |
| JD4 ss2 | <i>V. dahliae</i> | Spinach | USA | n.d. | 4.1 | 94.4 | 0.45 |

^a Inoculated on 12/17/09. Planting on trays on 11/18/09. Transplanting: 12/09/09.

^b *Verticillium* species designation based on ITS.

^c Vegetative compatibility group; n.d. = not determined.

^d Mean disease severity rating (scale 0-6) of 3 plants per pot and 6 pots per treatment (in greenhouse) 54 days after inoculation.

^e Disease incidence per treatment on day 54 after inoculation.

^f Mean dry weight of three replications (each replication with three plants) per treatment. Plants within replication weighed individually.