|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Supplementary Table 1.** Disease compatibility of specific combinations of race-specific secreted effectors (Ave1 and V2) on resistant cultivars of tomatoes containing different combinations of the race 1 (Ve1) and race 2 (V2) resistance phenotypes. | | | | | |
|  |  | **Resistance combination** | | | |
| Race (isolates) | Race Gene | Ve1-/V2- | Ve1+/V2+ | Ve1+/V2- | Ve1-/V2+ |
| Race 1/2 (Le1087, JR2) | Ave1+/Av2+ | Disease | Resistant | Resistant | Resistant |
| Race 2 (To22, Ca36) | Ave1-/Av2+ | Disease | Resistant | Disease | Resistant |
| Race 3 (HoMCF, KJ14a) | Ave1-/Av2- | Disease | Disease | Disease | Disease |
| Race 1/3 (Vdp4) | Ave1+/Av2- | Disease | Resistant | Resistant | Disease |

**Supplementary Table 2**. Biocontrol agents (BCAs) and biologicals with biocontrol activity against *Verticillium dahliae*.

| Biocontrol Organism | Source | Mechanism of action /Efficacy | Reference |
| --- | --- | --- | --- |
| *Acinetobacter calcoaceticus* FS339 | Root (Tomato) | Reduced mycelial growth, reduced disease index, increased chitinase, siderophores, protease activity | [245] |
| *Bacillus axarquiensis* TUBP1 protein | Rhizosphere (Cotton) | Anomalies in fungal hyphae and conidia, reduced spore germination, targeted plasma membrane of *V. dahliae* | [246] |
| *Bacillus sp*. | Composted ginned cotton residue | Reduce disease severity and wilt symptoms, antibiosis | [160] |
| *Bacillus thuringiensis* | Rhizosphere (Tomato) | Mycolitic chitinases, polypeptide synthetases, bacillibactin | [247] |
| *Bacillus velezensis* AL7 | Soil (Cotton) | Synthesize antifungal antibiotics | [152] |
| *Bacillus velezensis* C2 | Endophyte (Tomato) | Reduced disease incidence, antifungal activities (synthesis of lipopeptides, presence of volatile metabolites, produce lytic enzymes | [248] |
| *Bacillus velezensis OEE1* | Endophyte (Olive) | Reduced fungal growth (92%), disease severity index, percentage of dead plants, and microsclerotia density | [158] |
| *Burkholderia gladioli* pv*. agaricicola* | - | Reduced mycelial growth and disease incidence | [249] |
| Cell free mix of *Sphingobacterium* A1 and *Bacillus tequilensis* C-9 (1:9) | Rhizosphere (A1 from *Resina ferulae* and C-9 from cotton) | Reduced spore production (97.8%), germination (100%) and virulence protein of *V. dahliae* | [154] |
| *Chaetomium globosum* CEF-082 | Endophyte (Cotton) | Biocontrol effect 59%, Regulate multiple metabolic pathways, induce defense responses | [250] |
| *Crystoseria myriophylloides, Laminaria digitate, Fucus spiralis* | Algal extracts | Reduced disease severity, Increase defense response in tomato due to polyphenol oxidases, peroxidases | [251] |
| An essential oil from *Thymus* sp. | Thyme | Inhibition of mycelia and microsclerotia; disease reduction | [156] |
| *Fusarium solani* CEF559 | Endophyte (cotton) | Reduced colony growth (75%) and sporulation (80), PR genes and genes in lignin metabolism pathway upregulated, greenhouse control efficacy (60%) and field efficacy (30-56%) | [159] |
| *Metarhizium brinneum* | - | Reduce germination of microsclerotia, inhibited the hyphal formation | [252] |
| *Paenibacillus polymyxa* ShX301 | Rhizosphere (Cotton) | Reduced disease incidence and disease severity | [253] |
| *Pseudomonas fuorescence* FS167 | Root endophyte (Tomato) | Reduced mycelial growth, reduced disease index, chitinase, siderophores, protease | [245] |
| *Pseudomonas mosselli* FS67 | Root endophyte (Tomato) | Reduced mycelial growth, reduced disease index, siderophores | [245] |
| *Pseudomonas sp.* | Rhizosphere (Olive) | Reduced disease onset and development, disease incidence, plant mortality, phytase, and catalase activities | [254] |
| *Purpureocillium lilacinum* QLP12 | Soil (Eggplant) | Reduce disease index in greenhouse and field | [255] |
| *Stenotrophomonas maltophilia* FS300 | Root endophyte (Tomato) | Reduced mycelial growth, reduced disease index, chitinase, siderophores, protease | [245] |
| *Terichoderma atroviride* |  | Antifungal activity | [153] |
| *Trichoderma harzianum* | Rhizosphere (Pistachio) | Reduced mycelial growth and disease severity, mycoparasitism | [256] |
| Triterpene derivatives  (at 10µg/ml) | Latex, Euphorbia | Reduced disease severity, stunting, and vascular discoloration; enhanced peroxidase and polyphenol oxidase activities in tomato | [157] |

**Supplementary Table 3**. Some examples of organic amendments (OAs) with suppressiveness against *Verticillium dahliae*

| Organic Amendments | Test crop/Source | Mechanism of action | References |
| --- | --- | --- | --- |
| Solid olive oil waste compost | Olive | Reduce mycelial growth; and microsclerotia viability (52%-76%) | [257] |
| Olive mill compost | Cotton | Low β-glucosidase activity; high oligotrophic actinomycete populations,  Mycelial growth inhibition,  Reduced disease severity, lower microsclerotial concentrations | [258] |
| Broccoli residue | Rotation with eggplant | Reduced disease incidence by 53%, reduced *V. dahliae* DNA in soil | [259] |
| Compost tea | Corn straw | Reduced mycelial growth and conidial germination by 91% and 78% respectively in strawberry; control efficacy of 42% in greenhouse | [260] |
| Grape marc compost | Olive | Reduced microsclerotia density; disease incidence; | [155,261] |
| Plant compost (grape pomace compost; olive pomace/dairy manure compost; mixed crop residue compost) | Bell pepper | reduced pathogen population in fields (29%-42%) up to 14 weeks post-application; Compost extracts reduced *V. dahliae* growth by 25-50% in Petri dish assay | [162] |
| Fresh manure (4 kg m-2 sheep manure + 1 kg m-2 composted poultry litter) covered with transparent plastic | Bell pepper | Reduced disease incidence to less than 1% | [166] |
| 4% Dried spearmint or oregano | Tomato | Reduced disease to visually no symptoms | [262] |
| Composts with various compositions | Eggplant | Reduced disease indicated by disease suppression index | [263] |
| Tomato waste compost | Eggplant | Reduced disease severity and fungal colonization | [264] |
| Turkey litter compost | Eggplant | Reduced disease severity | [264] |
| Various compositions of steam-explosion liquid waste, Agro-industrial residues/waste, and plant green waste composts | Eggplant | Reduced disease indicated by disease suppression index (43%-65%), showed richness in potential biocontrol agents | [165] |
| Mustard | Tomato | Suppressed verticillium wilt with “biofumigant” properties | [163] |
| Sudangrass | Tomato | Suppressed verticillium wilt with “biofumigant” properties | [163] |
| Plant-based compost | Tomato | Reduced disease intensity, showed richness in culturable biocontrol agents | [161] |
| Compost of winery residues including grape stalks and grape pomace | Eggplant | Reduced disease incidence, severity and plant mortality, high total phenol content | [265] |
| Compost of tomato pulp with sawdust and chipping wood as bulking agents with a ratio of 2:1:1 v/v/v | Eggplant | Reduced disease incidence, severity and plant mortality, high total phenol content | [265] |
| Compost of organic fraction of municipal solid waste | Eggplant | Reduced disease incidence, severity and plant mortality, high total phenol content | [265] |
| Compost consisted of 73% olive mill extracted press cake, 24% wastewater and 3% olive leaves | Eggplant | Reduced disease incidence, severity and plant mortality, high total phenol content | [265] |

**Supplementary Table 4.** Examples of sources of carbon from recent studies for anaerobic soil disinfestation of soil-borne pathogens including *Verticillium dahliae.*

| Carbon source for ASD | Host plant | Targeted pathogen | References |
| --- | --- | --- | --- |
| Alfalfa | Cucumber | *Rhizoctonia solani* | [173,266] |
| Bean dregs | - | *Fusarium oxysporum* | [136] |
| Broccoli + Rice bran | Strawberry | *Fusarium oxysporum* f. sp*. fragariae; Verticillium dahliae* | [267] |
| Corn straw | - | - | [173] |
| Ethanol | Tomato; Cucumber; Strawberry | *Fusarium oxysporum* f. sp. *lycopersici; Fusarium oxysporum; Verticillium dahliae; Pyrenpchaeta lycopersici; Colletotrichum coccodes; Rhizoctonia solani Meloidogyne spp.* | [136,139,266,268,269] |
| FL-104 rye + Rice bran | Strawberry | *Fusarium oxysporum* f. sp. *fragariae* | [267] |
| Grape pomace | Strawberry | *Verticillium dahliae* | [139,174,270] |
| Italian rye + Rice bran | Strawberry | *Fusarium oxysporum* f. sp*. fragariae* | [267] |
| Molasses | Tomato Lettuce; Mustard green | *Plasmodiophora brassicae; Meloidogyne spp.*  *Verticillium dahliae; Pyrenpchaeta lycopersici; Colletotrichum coccodes* | [168,269,271] |
| Molasses + composted poultry litter (CPL) | Tomato | *Meloidogyne* sp*.* | [272] |
| Mustard + Rice bran | Strawberry | *Fusarium oxysporum* f. sp*. fragariae* | [267] |
| Mustard seed meal | Strawberry | *Verticillium dahliae* | [139,168] |
| Onion waste | Strawberry | *Verticillium dahliae* | [139] |
| Rice bran | Strawberry | *Verticillium dahliae; Fusarium oxysporum* f. sp. *fragariae* | [139,168,267] |
| Sudan grass + Rice bran | Strawberry | *Fusarium oxysporum* f. sp. *fragariae* | [267] |
| Sugarcane bagasse | - | *Fusarium oxysporum* | [136] |
| Tomato pomace | - | - | [168,174,270] |
| Triticale + Rice bran | Strawberry | *Fusarium oxysporum* f. sp. *fragariae* | [267] |
| Wheat bran | Tomato; Strawberry | *Plasmodiophora brassicae*; Meloidogyne spp.  *Verticillium dahliae*; *Pyrenpchaeta lycopersici*; *Colletotrichum coccodes*; Meloidogyne spp. | [139,269,271] |
| Wheat bran + Molasses | Lettuce; Mustard green | *Plasmodiophora brassicae*; Meloidogyne spp. | [271] |