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|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NRCS soil series | Cultivar | Latitude | Longitude | County | Years org or conv mgt | Observations |
| Morocco-Newton complex | Jersey | 42.4 | -86.0 | Allegan | 30 | Herbicide strip. Roots concentrated near surface. Some soil mottling at shallow depth. |
| Morocco complex | Bluecrop | 41.7 | -86.1 | St. Joseph, IN | 20 | Sod maintained at 1-10 cm height. |
| Granby loamy sand | Bluecrop | 42.2 | -86.3 | Ottawa | 20 | Herbicide strip. Dense mat of roots at 0−5 cm soil depth. |
| Granby loamy sand | Duke | 42.9 | -86.1 | Ottawa | 6 | Soil cultivated at 0−20 cm depth 1-2 times per year. Few roots in upper 20 cm of soil. |
| Pipestone-Kingsville complex | Elliott | 42.4 | -86.3 | Van Buren | 20 | Herbicide strip and wood mulch. Roots concentrated at surface. Accumulation of 2-4 cm surface leaf litter. |
| Pipestone sand | Elliott | 42.2 | -86.3 | Berrien | 6 | Wood mulch. Roots concentrated at surface. Rodent tunnels in mulch and soil. |
| Granby loamy sand | Elliott | 43.0 | -86.3 | Ottawa | 10 | Herbicide strip, planting rows alternate between mulch and no mulch. |
| Granby loamy fine sand | Elliott | 42.2 | -86.2 | Berrien | 6 | Wood mulch and white clover. Anoxic soil at 5−30 cm depth on some sampling dates. |
| Granby loamy sand | Bluecrop | 42.8 | -86.1 | Ottawa | 25 | Herbicide strip. Roots concentrated at surface |
| Granby loamy sand | Bluecrop | 43.0 | -86.2 | Ottawa | 7 | Cultivated soil. Few roots in upper 20 cm of soil. |
| Gilford sandy loam | Elliott | 42.3 | -86.0 | Van Buren | 10 | Herbicide strip and wood mulch. |
| Gilford sandy loam | Bluecrop | 41.7 | -86.1 | St. Joseph, IN | 20 | Sod maintained at 1−6 cm height within rows. Blueberry roots mainly at > 5 cm soil depth, below dense sod roots. |
| Houghton muck | Rubel | 42.6 | -86.1 | Allegan | 25 | Herbicide strip. Anoxic soil at 5−30 cm depth. |
| Houghton muck | Rubel | 42.6 | -86.1 | Allegan | 25 | Sod mowed once per year. Few roots in upper 20 cm of soil. Anoxic soil at 5−30 cm depth. |
| Houghton muck | Rubel/ Jersey | 42.4 | -86.0 | Van Buren | 25 | Bare soil. Up to 3 cm accumulation of leaves and stems. Anoxic soil at 5−30 cm depth on some sampling dates. |
| Houghton muck | Jersey | 43.0 | -83.0 | St. Clair | 12 | Grass clippings beneath bushes. Patchy sod and bare soil within rows. |

**Table 1.** Site descriptions of matched pairs of organic and conventional blueberry farms. Gray shading designates conventional farms.

**Table 2.** Variables measured in a comparison of organic and conventional Michigan blueberry farms in 2008.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Description |  | Unit |
| Anth | Anthracnose fruit rot |  | Incidence (%) |  |
| Alt | Alternaria fruit rot |  | Incidence (%) |  |
| Leaf N | Leaf nitrogen concentration |  | % |  |
| Leaf P | Leaf phosphorus concentration |  | % |  |
| Leaf Ca | Leaf calcium concentration |  | % |  |
| Leaf Mg | Leaf magnesium concentration |  | ppm |  |
| Leaf Fe | Leaf iron concentration |  | ppm |  |
| SOM | Soil organic matter content |  | % |  |
| Ca, K, Mg | Extractable K, Mg, K |  | mg kg soil-1 |  |
| Bray P | Bray-extractable P |  | mg kg soil-1 |  |
| Nmin | 14-day potential N mineralization |  | NH4+-N + NO3--N kg soil-1 d-1 |
| Nitr | 14- day net nitrification |  | mg NO3--N kg soil-1 d-1 |
| Rnitr | Relative nitrification |  | Nitr Nmin-1 |
| LF-SOM | Light fraction soil organic matter |  | mg g soil-1 |  |
| CO2 | Average CO2 respiration rate in 100-day soil incubationz |  | µg CO2 g soil-1d-1 |  |
| BG | β-1,4-glucosidase |  | nmol h-1 g soil-1 |  |
| CBH | β-D-1,4-cellobiosidase |  | nmol h-1 g soil-1 |  |
| NAG | β-1,4-*N*-acetylglucosiminadase |  | nmol h-1 g soil-1 |  |
| PHOS | Acid phosphatase |  | nmol h-1 g soil-1 |  |
| POX | Phenol oxidase |  | nmol h-1 g soil-1 |  |
| Bact | Cultivable bacteria |  | CFU y g soil-1 |  |
| Fungi | Cultivable fungi |  | CFUg soil-1 |  |
| Trich | *Trichoderma* spp. |  | CFU g soil-1 |  |
| ERM | Ericoid mycorrhizae colonization |  | Hair root epidermal cells containing hyphal coils (%) |  |
| DSE | Dark septate endophyte colonization |  | Hair root epidermal cells containing microsclerotia (%) |  |

zSoil incubated at 25°C and 60% soil water holding capacity (WHC)

y=Colony forming units

**Table 3**. Effects of organic and conventional management on plant health and soil properties in organic and conventional blueberries assessed in 2008. Biological soil measurements (Nmin, Nitr, Rnirt, LF-SOM, CO2, BG, NAG, PHOS, Bact, Fungi, Trich) reflect values on sandy soil types at 0-5 cm soil depth (muck soils were omitted from the analysis). Remaining soil measurements and ERM and DSE colonization are at 0-30 cm soil depth. Variable abbreviations and measurement units are shown in Table 2. Bold-face font indicates a significant difference at *P* < 0.05. Values for POX (phenol oxidase) are not shown because zero-values were recorded for both organic and conventionally managed soils.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Anth | Alt | Leaf N | Leaf P | Leaf Ca | Leaf Mg | Leaf Fe | SOM | pH | Ca | Mg | K | Bray P | Nmin | Nitr | Rnitr | LF- SOM | CO2 | BG | CBH | NAG | PHOS | Bact | Fungi | Trich | ERM | DSE |
| Org | 51 | 9 | 1.5 | 0.89 | 0.64 | 0.19 | 100 | 2.6 | 5.6 | 442 | 68.3 | 56.0 | 98.7 | 1.1 | 1.14 | 88 | 25.7 | 12.5 | 96.0 | 61.0 | 89.9 | 198.0 | 4.8 x 106 | 1.8 x 105 | 1.2 x 104 | 23.6 | 5.5 |
| Conv | 9 | 18 | 1.5 | 0.77 | 0.45 | 0.19 | 42.3 | 3.1 | 4.8 | 258 | 67.5 | 56.8 | 67.5 | 0.72 | 0.48 | 69 | 11.6 | 8.1 | 73.1 | 51.6 | 41.3 | 241.9 | 1.6 x 106 | 1.4 x 105 | 1.3 x 104 | 17.1 | 3.0 |
| ANOVA p-value | **0.04** | **0.02** | 0.39 | **0.02** | **0.01** | 0.95 | 0.14 | 0.12 | **0.02** | **<0.01** | 0.94 | 0.93 | 0.25 | 0.10 | **<0.01** | 0.16 | 0.10 | **0.03** | 0.40 | 0.52 | 0.09 | 0.55 | **0.03** | 0.69 | 0.19 | 0.12 | 0.43 |

**Table 4.** Correlations among variables measured on sandy soils collected at 0−30 cm depth from organic and conventional blueberry farms (n=12) in late September and early October 2008 (muck soils were omitted from the analysis). Variable abbreviations are defined in Table 2. Bold-face font indicates a significant relationship at *P* < 0.05.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | SOM | H2O | pH | Ca | Mg | K | Bray P | Nmin | Nitr | Rnitr | LF- SOM | CO2 | BG | CBH | NAG | PHOS | Bact | Fungi | Trich | ERM |
| H2O | 0.5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| pH | 0.1 | 0.3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ca | -0.1 | 0.2 | **0.7** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mg | 0.1 | **0.6** | **0.7** | **0.6** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| K | 0.1 | 0.3 | 0.4 | 0.4 | 0.4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bray P | -0.2 | **-0.6** | -0.2 | 0.1 | -0.2 | -0.1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Nmin | -0.1 | -0.5 | 0.1 | -0.1 | -0.4 | -0.1 | 0.3 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Nitri | -0.3 | **-0.6** | 0.2 | 0.2 | -0.2 | 0.1 | **0.6** | **0.8** |  |  |  |  |  |  |  |  |  |  |  |  |
| Rnitr | -0.5 | -0.2 | 0.1 | 0.2 | 0.4 | 0.3 | 0.3 | -0.4 | 0.2 |  |  |  |  |  |  |  |  |  |  |  |
| LF-SOM | **0.7** | 0.1 | -0.3 | -0.3 | -0.2 | -0.5 | 0.0 | -0.2 | -0.3 | -0.4 |  |  |  |  |  |  |  |  |  |  |
| CO2 | -0.1 | **0.7** | 0.5 | **0.7** | **0.7** | 0.2 | -0.2 | -0.5 | -0.3 | 0.1 | -0.2 |  |  |  |  |  |  |  |  |  |
| BG | -0.1 | 0.4 | 0.3 | 0.5 | 0.3 | 0.2 | -0.2 | -0.4 | -0.2 | 0.1 | 0.0 | **0.7** |  |  |  |  |  |  |  |  |
| CBH | 0.4 | 0.5 | 0.1 | 0.4 | 0.1 | 0.5 | -0.4 | -0.1 | -0.2 | -0.4 | 0.1 | 0.4 | 0.5 |  |  |  |  |  |  |  |
| NAG | 0.0 | 0.4 | 0.2 | 0.5 | 0.2 | 0.0 | -0.2 | -0.3 | -0.3 | -0.3 | 0.1 | 0.7 | **0.8** | 0.5 |  |  |  |  |  |  |
| PHOS | 0.3 | 0.3 | -0.2 | 0.0 | -0.1 | 0.5 | -0.4 | -0.3 | -0.4 | -0.2 | 0.1 | 0.1 | 0.3 | **0.8** | 0.2 |  |  |  |  |  |
| Bact | -0.2 | 0.4 | 0.5 | **0.6** | 0.4 | 0.3 | -0.3 | -0.2 | -0.1 | 0.1 | -0.2 | **0.7** | **0.9** | 0.4 | **0.7** | 0.2 |  |  |  |  |
| Fungi | 0.0 | 0.2 | 0.1 | 0.4 | 0.2 | -0.2 | 0.0 | -0.4 | -0.2 | -0.1 | 0.3 | 0.6 | **0.6** | 0.2 | **0.7** | 0.2 | **0.7** |  |  |  |
| Trich | -0.2 | 0.5 | 0.3 | 0.4 | 0.4 | -0.1 | -0.3 | -0.3 | -0.4 | -0.2 | -0.1 | **0.8** | 0.7 | 0.2 | **0.8** | -0.1 | **0.7** | **0.7** |  |  |
| ERM | 0.0 | 0.3 | **0.6** | 0.4 | 0.4 | 0.4 | -0.4 | -0.3 | -0.4 | 0.0 | -0.4 | 0.4 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 | 0.0 | 0.4 |  |
| DSE | -0.4 | **-0.7** | -0.2 | 0.1 | -0.3 | 0.1 | 0.4 | 0.3 | **0.6** | 0.3 | -0.1 | -0.4 | 0.1 | -0.1 | -0.2 | 0.2 | 0.1 | 0.2 | -0.4 | -0.5 |