**Appendix S1: Supplemental Information**

**Supplemental methods**

**Database cross referencing**

We also cross referenced our reduced Integrity database (n = 338) with the Northeast Organic Farmers Association of New York (NOFA-NY) directory using the integrity database “Operation Name” classification as the search term for the “Business Name” in the NOFA-NY directory. During this process we found that not all integrity databased farms were in the NOFA-NY directory (n = 41). Through inspection of the integrity database, we determined absence from the NOFA-NY directory was certifier dependent, with 41 farms certified by other for-profit, not-for-profit, and public entities. Verification of the farm location and production data for farms absent from the NOFA-NY directory was conducted via web searches (Google, Mountain View, California, USA) using the “Operation Name” as the search term.

**Survey pretesting**

For pretesting, we gathered a group of stakeholders including researchers with specializations in soil microbes and integrated pest management (n = 2), extension agents representing the geographic range of the study (to ensure practices included in the instrument were representative of those used by participants within NY) with specializations in vegetable production, agriculture, horticulture, and local food production (n = 15), government entities funding sustainable agriculture research in NY (n = 1), and vegetable farmers that were selected by extension agents to assist with pretesting and were certified organic or practiced organic methods (n = 4) (n = 22 total stakeholders). Stakeholder meetings were held on August 23, 25, 26, and 27, 2021 at 19:00, 11:00, 11:00, and 16:00 EST, respectively. Emphasis was placed on scheduling meetings around farmer stakeholder availability; thus, sessions were held over lunch, and before and after supper. Stakeholders self-selected which meeting to attend digitally (Zoom, San Jose, California, USA). Prior to the meetings, stakeholders were sent via email (Microsoft Outlook, Redmond, Washington, USA) a suite of documents encompassing the multiple mailing approach (*see* main text), including the recruitment letter, informed consent form, survey instrument, and reminder postcards, along with a meeting outline. Stakeholders were asked to review the outline and documents prior to attending the meeting. Meetings were hosted by the primary investigator, with a focus on generating stakeholders’ impressions of the questions used to assess participants. Feedback from stakeholder meetings was used to revise the survey instrument to reflect the production practices and terminology used by NY organic farmers.

**Affinity propagation and principal component analysis**

For affinity propagation, each data point (farmer) is viewed as a node within a network, and real-valued messages are recursively transmitted along network edges. These messages are updated based on formulas that search for minima of an energy function, where the magnitude of the message is the current affinity between nodes (Frey and Dueck, 2007). Unlike other cluster analyses, affinity propagation does not have a parameter for a predetermined number of clusters. Rather, clustering is mediated by the preference parameter (preference value) (Heumann et al., 2020). Affinity propagation uses the preference parameter to iteratively select groups (clusters) of similar data whilst identifying representative archetypes (exemplars) for emerging groups (clusters) (Haberman and Bennett, 2019). Typically, the preference parameter takes the median value of the input matrix, which yields a moderate number of clusters (Haberman and Bennett, 2019). However, preference values set to the minimum and maximum of the similarity matrix can yield smaller and larger numbers of clusters, respectively, and the relationship between preference value and cluster number is non-linear (Heumann et al., 2020). Iterating (permuting) across preference values allows for the selection of stable clustering solutions, whereby the number of clusters is invariant across a suite of preference values selected from the input matrix (Frey and Dueck, 2007; Dueck 2009). As compared to other clustering approaches (e.g., k-centers), affinity propagation is faster, results in lower error, and is exploratory. In other terms, there is no objectively correct answer or predetermined number of clusters required as an input parameter (Frey and Dueck, 2007).

In brief, we conducted affinity propagation on the importance each participant placed on production practices, soil properties, demographics and farm characteristics, off-farm factors (e.g., conventional pesticides applied in bordering lands), and climate factors (e.g., extreme weather events) for regulating the pest-suppressive soil microbiome on their farm (Table S1 Q1). These data, recorded by the participant on a five-point Likert scale (1 = Not at all important; 2 = Slightly important; 3 = Somewhat important; 4 = Very important; 5 = Extremely important) were characterized by 20 statements (11 production practices; 3 farm characteristics; 1 demographical characteristic of participants; and 5 off-farm and climatic factors) (Table S1 Q1). Prior to affinity propagation we used a stepwise process, including principal component analysis (4 models total) to eliminate collinearity and collapse dataset dimensionality, resulting in 85 (the number of farmer participants) two-dimensional data points (nodes).

To begin, correlations between statement responses were examined using a correlation matrix (function = cor) (R Core Team, 2021). No problematic correlations were found (problematic correlations classified as those > 0.8) (Bloom et al., 2021). We then used Bartlett’s test (function = cortest.bartlett), and examined the determinant of the matrix (function = det) to estimate the suitability of these data for principal component analysis (R Core Team, 2021). Here, the matrix is composed of pairwise Pearson correlation coefficients for the 20 statements (matrix dimensions = 20 × 20) evaluating farmer beliefs regarding the pest-suppressive soil microbiome. Neither test indicated our data violated the assumptions of principal component analysis (e.g., positive determinant of the correlation) (Field et al., 2012). Following Field et al. (2012), we then used principal component analysis to eliminate collinearity and reduce the dimensionality of our dataset. In a preliminary analysis, we used the principal function in the psych package (parameters: n factors = 20 [one for each statement]; rotation = none) (Revelle, 2021). We visualized the eigenvalues from this model using a scree plot to find the point of inflection, which indicated a three-factor solution. We then created a model with three factors and varimax rotation (as parameters) and displayed loadings above 0.6, leading to the final model where statements with loading values above the loading threshold were used. Following Haberman and Bennett (2019), we then used the component scores from the first two rotated components of the final varimax rotated principal component analysis as the two-dimensional input for our negative distance matrix used in affinity propagation (Frey and Dueck, 2007). Therefore, in our study the negative distance matrix is found from measures of microbiome beliefs (Table S2 Q1). In our preliminary analysis, we used the default settings of the apcluster function in the apcluster package which yielded a 10-cluster solution (Bodenhofer et al., 2011). To evaluate the stability of this solution, we repeated this analysis varying the q parameter (preference value) [range of q = 0 – 1] in the apcluster function, where .5 represents the median value of the negative distance matrix (which is the default setting in the apcluster function). We used 6,561 q values (the length of the negative distance matrix) sequenced from the min to max q values (0 – 1) and extracted the number of clusters found for each q parameter. These values were visualized, with the number of clusters as the response to q following Dueck (2009) to determine non-linearity and find long straight segments (indicating stability in the clustering solution). Using this approach, we found the default settings (using the median q value of 0.5) yielded a highly unstable 10-cluster solution (Fig. 2a). Thus, in our final analysis we used the most stable solution as input for the k parameter using the apcluster function.

**Adoption regressions**

To test if practice adoption was dependent on beliefs, we developed sets of simple logistic regression models where adoption was a binary dependent variable, describing whether the farmer had adopted a practicefor the field(s) they characterized in their soil survey(e.g., use of no-tillage as a binary variable). These models were grouped into model sets (16 dependent variables × 9 explanatory variables = 144 models) and used in an information theoretic approach to select top models (explanatory variables) for each of the dependent variables (practices adopted). The sixteen farming practices (dependent variables) were irrigation methods (targeted [e.g., drip]; broadcast [e.g., overhead]), diversified farming (> 1 crop within the field surveyed), cover cropping (grasses [e.g., cool season grasses]; legumes [e.g., clover]; other cover crops [e.g., buckwheat]), fertilization (animal [e.g., manures]; mineral (e.g., langbeinite); vegetative [e.g., alfalfa meal]; compost), tillage (absolutely no tillage [e.g., permanent beds]; some tillage [e.g., within row subsoiling]), mulching (synthetics [e.g., plastics]; biologicals [e.g., straw]), pre-planting practices (e.g., tarping), and soil pesticide use (e.g., hydrogen peroxide). The nine explanatory variables used to select top models for each of the dependent variables were: (1) farmer beliefs (six factor levels); (2) time in organic management (years); (3) area in certified organic production (acres); (4) total area of farm (acres); (5) farming as primary income source (yes or no); (6) formal agricultural education (yes or no); (7) age (years); (8) if the participant was a first-generation farmer (yes or no); and (9) survey effort (a binary variable [0 or 1 for one and two surveys, respectively]).

**Details on survey effort**

Farmers were allowed to submit two soil samples, and thus characterize practice adoption for up to two fields (71 farmers elected to characterize the farming practices used in two fields). Allowing farmers to submit samples for one or two fields generated a richer dataset but also caused a mismatch between our farm-level explanatory and certain field-level dependent variables. In our main analysis, we addressed this mismatch by including a binary variable in models that represents farmer soil sampling effort. We also took two additional modeling approaches to address this mismatch. In Supplemental analysis 1, we tested the robustness of our results to restricting the analysis to farmers that characterized two fields. In Supplemental analysis 2, we dropped the practices recorded from the second field, retaining all farmers in the analysis and unifying the scale at which explanatory and dependent variables were modeled. We then repeated model selection (*see* Information theoretic approach below).

**Motivations regressions**

To test if motivation to adopt a new practice was dependent on beliefs, we created a dependent motivation variable which summed Likert scale scores across 11 motivation statements by farmer (Table S3 Q11). These statements included broad categories encapsulating reduced labor, ease of integration, social interactions, environmental benefits, economic benefits, and greater awareness of practice adoption by the public (e.g., microbe friendly labeling scheme) (Table S3 Q11). We then used farmer beliefs, farm characteristics, demographics, and survey effort as the explanatory variables with a Gaussian error distribution (1 dependent variable × 9 explanatory variables = 9 models total in the model set for selection) (*see* Adoption regressions for explanatory variable descriptions).

**Information theoretic approach**

For our information theoretic approach to model selection, model sets for each dependent variable were constructed. Model sets included null models where estimates for our data were found when no explanatory variables were modeled. Seventeen model sets were constructed (one set per dependent variable) with 10 models per set (9 models with explanatory variables + 1 null model). Model sets where effort was standardized to only farmers characterizing two fields (Supplemental analysis 1) did not include the sampling effort term. Therefore, for “Supplemental analysis 1”, there were 17 model sets (one for each dependent variable) with nine (instead of ten) models, one for each explanatory variable and a null model. No changes were made to the model sets for “Supplemental analysis 2”.

Models were ranked based on AIC within each set, with top models for each dependent variable identified as those with ΔAIC < 2.0 from the best model (Burnham and Anderson, 2002; Grueber et al., 2011). We considered explanatory variables as important correlates of farming practice adoption and motivations if they appeared in top models (ΔAIC < 2.0) and the 95% confidence interval for the parameter did not overlap zero (Burnham and Anderson, 2002). In belief models (1 model per set), the cluster at the origin of the rotated components (RC1 and RC3) served as the intercept (*see* Cluster 1; Fig. 2b). Participants in this cluster, believed all variables were “somewhat important” for mediating the microbiome on their farm (Table S1 Q1). Thus, statistical estimates from our effects parameterization are for clusters found elsewhere in the coordinate plane (e.g., the positive portion of the x-axis). We also removed the cluster only represented by two participants because it was impossible to confidently estimate regression coefficients with the small sample size (*see* Cluster 6; Figure 2b). Finally, we use simple rather than multiple linear regression to prevent overfitting these data with our small sample size (Zuur et al., 2009). Models were created and residuals were checked using the glmmTMB and simulateResiduals functions, respectively (Brooks et al., 2017; Hartig, 2021); no problems were detected for top models of our main analysis.

**Supplemental results**

**Model complementarity and ranking**

We found adoption of farming practices varied with farmer beliefs of the pest-suppressive soil microbiome (Fig. 4a-f). Farming practices also varied with farmer demographics and farm characteristics (Fig. 5a-j) (Tables S7-12). Farmer beliefs, farmer demographics, and farm characteristics were not mutually exclusive, and models for some response variables ranked similarly (*see* Tables S7-S12). Models were also complementary, where explanatory variables (e.g., farmer beliefs and demographics) correlated with specific farming practices, and no competing parameters were identified (*see* Fig. 4b, c, e, f and Fig. 5a-f, h, i; Tables S7-S12). Null models indicated that none of the explanatory variables best described the adoption of animal manures (Table S11), and models for adoption of synthetic mulching should be treated with caution, as the beliefs and null model ranked similarly (Fig. 4c; Table S9).

**Sampling effort analysis**

Sampling effort was generally not indicative of adoption (Tables S7-S12) or motivations (Table S14). However, sampling effort ranked similarly with beliefs and farm characteristics in models evaluating farmer adoption of pre-planting practices (*see* Figs. 4d, 5g; Table S9). Our sensitivity analyses indicated that reducing our dataset to only farmers who submitted two samples (Supplemental analysis 1) yielded qualitatively similar results, with top models remaining similar for adoption across the full and partial dataset (Fig. 4a, c, d, e; Fig. 5a-e, h, i; Tables S7-S12). However, analysis of only the first field a farmer characterized (Supplemental analysis 2) within their farm supported the importance of farm characteristics (e.g., time in organic management) and demographics (e.g., farm as the main source of income) (Fig. 5a, b, d, e, h-j; Tables S7, S8, S10, S11), rather than beliefs, for mediating adoption of practices that support the soil microbiome. Top models for both supplemental analyses tended to fail checks of residuals, showing goodness of model fit increased with sampling effort, supporting the use of the full dataset in our present analysis. Estimates for the supplemental analyses are not included, but these estimates are available upon request (*see* Tables S7-S12 for consensus of supplemental analyses with full dataset). Our supplemental analyses assessing the impact of sampling effort on motivations yielded qualitatively similar results to the full models (Fig. 6l; Table S14).

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**Supplemental tables**

**Table S1.** Survey questions used to assess general beliefs of study participants with Wilcoxon tests. See main text for details on statistics.

Q1. To what extent do you agree with the following statements about pest-suppressive soil microbes on your farm? *Select one option for each of the following statements.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
| Even though I cannot see soil microbes, I believe they enhance pest suppression on my farm by boosting plant defenses. |  |  |  |  |  |
| The most effective way to promote soil microbes that enhance pest suppression is using farming practices that support them. |  |  |  |  |  |
| The most effective way to promote soil microbes that enhance pest suppression is using microbial inoculants (e.g., *Beauveria* sp.). |  |  |  |  |  |

Q2. To what extent do you agree or disagree with the following statements about this project? *Select one option for each of the following statements.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
| I participated in this project because I want to know more about the soil microbes on my farm. |  |  |  |  |  |
| I intend to use the practices discovered by this project to support soil microbes on my farm. |  |  |  |  |  |

**Table S2.** Survey questions used to generate explanatory variables. Q1 was used for affinity propagation to generate belief clusters. Q2 – Q8 are farming system characteristics and farmer demographics used in model selection. See main text for details.

Q1. Indicate how important you believe each of the following factors are for pest-suppressive soil microbes on your farm. *Select one option for each of the following statements.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Not at all important | Slightly important | Somewhat important | Very important | Extremely important |
| Farming practices |
|  Irrigation |  |  |  |  |  |
|  Crop diversity (# of crops grown) |  |  |  |  |  |
|  Livestock rotation |  |  |  |  |  |
|  Fertilizer inputs (N, P, K) |  |  |  |  |  |
|  Compost applications |  |  |  |  |  |
|  Reduced or no-tillage |  |  |  |  |  |
|  Cover cropping |  |  |  |  |  |
|  Mulches (e.g., plastic mulch) |  |  |  |  |  |
|  Pre-planting protocols (e.g., tarping) |  |  |  |  |  |
|  Microbial insecticides applied to soil(e.g., *Beauveria* spp.) |  |  |  |  |  |
|  Other pesticides applied to soil (e.g., Hydrogen dioxide) |  |  |  |  |  |
| Soil properties |
|  Soil type (e.g., clay, sandy) |  |  |  |  |  |
|  Soil organic matter |  |  |  |  |  |
| Farmer and farm characteristics |
|  Time in organic farming |  |  |  |  |  |
|  Formal education in farming (e.g., degree in agriculture) |  |  |  |  |  |
|  Amount of certified land in vegetable/fruit production |  |  |  |  |  |
| Factors outside of your farm |
|  Conventional pesticides applied to soil in bordering lands |  |  |  |  |  |
|  Amount of natural areas in bordering lands |  |  |  |  |  |
| Climate factors |
|  Increases in extreme weather events |  |  |  |  |  |
|  Changes in weather patterns (e.g., early and late frosts) |  |  |  |  |  |
| Optional: Use the other option to list any other factors you think influence soil microbes. |
|  Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |  |  |

Q2. What is your age? \_\_\_\_\_\_\_\_\_ years old

Q3. Are you a first-generation farmer? *First generation farmers do not have parents that were farmers.*

|  |  |
| --- | --- |
| * Yes
 | * No
 |

Q4. Do you have a degree in agriculture or a related field? *Examples of related fields include horticulture.*

|  |  |
| --- | --- |
| * Yes
 | * No
 |

Q5. Is farming your household’s main source of income? *A main source is > 50 % of your income.*

|  |  |
| --- | --- |
| * Yes
 | * No
 |

Q6. How many total acres is your farm? Both certified and non-certified acres. \_\_\_\_\_\_\_\_\_\_ acres

Q7. How many acres of certified land is in vegetable/small fruit production? \_\_\_\_\_\_\_\_\_\_ acres

Q8. How long has your farm been managed organically? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ years

**Table S3.** Survey questions used to generate response variables used in the regression analysis. During data preparation, values for Q1 – Q10 were transformed to binomial response for logistic regression and responses for Q11 were summed by participant. See main text for additional details.

Q1. Which of the following irrigation methods did you use in this field in the last year, if any? *Choose all that apply. Use the other option to list any other irrigation methods you use.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| * Drip
 | * Overhead (e.g., sprinkler)
 | * Hand watering
 | * Flood
 | * None
 | * Other:\_\_\_\_\_\_\_\_\_\_\_
 |

Q2. Which of the following crops did you grow in this field in the last year? *Choose all that apply. Use the other option to list any other crops you grew.*

|  |  |
| --- | --- |
| * Brassica crops (e.g., cabbage, kale, broccoli)
* Cucurbit crops (e.g., cucumber, watermelon, squash)
* Solanaceous crops (e.g., tomato, potato, pepper)
* Sweet corn
* Legume crops (e.g., beans, peas)
* Lamiaceous crops (e.g., basil, mint, thyme)
 | * Allium crops (e.g., garlic, onions, leeks)
* Umbel crops (e.g., carrot, parsley, dill, fennel)
* Chenopod crops (e.g., spinach, chard, beet)
* Aster crops (e.g., lettuce, endive, salsify)
* Rosaceae crops (e.g., raspberry, strawberry)
* Ericaceae crops (e.g., blueberry)
 |
| * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q3. Which of the following cover crops did you grow in this field in the last two years, if any? *Choose all that apply. Use the other option to list any other cover crops that were not listed.*

|  |  |
| --- | --- |
| * Legumes (e.g., red clover, hairy vetch, sun hemp)
* Brassicas (e.g., forage radish, purple top turnip)
* Buckwheat
 | * Cool season grasses (e.g., winter rye)
* Warm season grasses (e.g., sorghum, millet, sudangrass)
* Phacelia
 |
| * None
 | * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q4. Which of the following livestock have you rotated into this field in the last two years, if any? *Choose all that apply. Use the other option to list any other livestock that were not listed.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| * Chickens
 | * Ducks
 | * Cattle
 | * Goats
 | * Sheep
 | * Hogs
 | * None
 |
| * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q5. Which of the following fertilizers have you applied to this field in the last year, if any? *Choose all that apply. Use the other option to list any other fertilizers that you used.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * Alfalfa meal
* Blood meal
* Kelp meal
 | * Bat guano
* Cottonseed
* Greensand
 | * Feather meal
* Fish emulsion
* Langbeinite
 | * Fish meal
* Soybean meal
* Potassium sulfate
 | * Bone meal
* Rock phosphate
* Compost
 |
| * None
 | * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q6. Which of the following reduced or no-tillage practices have you used in this field in the last year, if any? *Choose all that apply. Use the other option to list any other reduced tillage methods you used.*

|  |  |
| --- | --- |
| * No-till (soil is undisturbed by any tillage equipment between plantings)
* Ridge-till (cultivator maintains permanent ridge for planting, wheel traffic in same lanes)
* Shallow tillage (tillage limited to the top 1-2 inches of soil)
 | * Zone tillage (narrow strips of tillage, bands where crops are planted)
* In-row subsoiling (soil surface residue left undisturbed, but tillage used underneath)
* Permanent beds (primary tillage is concentrated in beds, less disturbance in pathways)
 |
| * None
 | * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q7. Which of the following mulches did you use in this field in the last year, if any? *Choose all that apply. Use the other option to list any other mulches that were not listed.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| * Hay
 | * Straw
 | * Plastic mulch
 | * Weed barrier fabrics
 | * Biodegradable planting paper
 | * None
 |
| * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q8. Which of the following pre-planting practices did you use in this field in the last two years, if any? *Choose all that apply. Use the other option to list any other pre-planting practices that were not listed.*

|  |  |
| --- | --- |
| * Tarping (e.g., silage tarp or other non-transparent plastic)
 | * Solarization (e.g., clear plastic)
 |
| * None
 | * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q9. Which of the following microbial insecticides have you applied to the soil in this field in the past three years, if any? *Choose all that apply. Use the other option to list any other microbial insecticides that you used.*

|  |  |
| --- | --- |
| * *Beauveria bassiana (*e.g.,BoteCHA ES*)*
* *Chromobacterium substugae* (e.g., Grandevo)
 | * *Isaria fumosorosea* (e.g., Preferal, PFR-97)
* None
 |
| * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q10. Which of the following non-microbial pesticides have you applied to the soil in this field for insect and disease management in the past three years, if any? *Choose all that apply. Use the other option to list any other soil pesticides that you used.*

|  |  |
| --- | --- |
| * Azadiractin (e.g., AzaGuard, Neemix)
* Iron phosphate *(*e.g., *Bug-N-Sluggo)*
* Hydrogen dioxide (e.g., OxiDate 2.0)
 | * Potassium silicate (e.g., Sil-Matrix LC)
* Spinosad (e.g., *Bug-N- Sluggo, Seduce*)
* *Reynoutria sachaliensis* extract (e.g., Regalia)
 |
| * None
 | * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 |

Q11. Indicate what would motivate your decision to adopt a new practice that supports pest-suppressive soil microbes on your farm. *Select one option for each of the following statements.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Not at all motivating | Slightly motivating | Somewhat motivating | Very motivating | Extremely motivating |
| **Reduced** labor costs of controlling pests |  |  |  |  |  |
| **Easy** integration with your existing practices |  |  |  |  |  |
| Recommendation made by **extension** persons |  |  |  |  |  |
| Recommendation made by **commercial** advisor |  |  |  |  |  |
| **Conversation** with a neighbor |  |  |  |  |  |
| **Workshop** at a conference (e.g., NOFA-NY, MOSES) |  |  |  |  |  |
| **Requested** by a customer |  |  |  |  |  |
| **Benefits** to the environment (e.g., species conservation) |  |  |  |  |  |
| **Increases** in marketable yield |  |  |  |  |  |
| **Observable** reductions in insect pest damage on your farm |  |  |  |  |  |
| A microbe **friendly** farming labeling scheme for products |  |  |  |  |  |
| Optional: Use the other option to list any other motivating factors. |
| Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |  |  |

**Table S4.** Results of three factorprincipal component analysis with a statement loading threshold of 0.6 and varimax rotation. All statements before loading threshold are shown in Table S1 Q1.

|  |  |  |  |
| --- | --- | --- | --- |
| Statement options | RC1 | RC3 | RC2 |
| Changes in weather patterns (e.g., early and late frosts) | 0.88 | - | - |
| Increases in extreme weather events | 0.83 | - | - |
| Conventional pesticides applied to soil in bordering lands | 0.77 | - | - |
| Amount of natural areas in bordering lands | 0.70 | - | - |
| Soil organic matter | - | 0.80 | - |
| Reduced or no-tillage | - | 0.73 | - |
| Compost applications | - | 0.73 | - |
| Crop diversity (# of crops grown) | - | 0.66 | - |
| Time in organic farming | - | 0.61 | - |
| Other pesticides applied to soil (e.g., Hydrogen dioxide) | - | - | 0.89 |
| Microbial insecticides applied to soil(e.g., Beauveria spp.) | - | - | 0.83 |
| Pre-planting protocols (e.g., tarping) | - | - | 0.67 |
| Fertilizer inputs (N, P, K) | - | - | 0.64 |
| SS Loadings: RC1 = 2.81; RC3 = 2.77; RC2 = 2.48Proportion variance: RC1 = 0.22; RC3 = 0.21; RC2 = 0.19Cumulative variance: RC1 = 0.22; RC3 = 0.43; RC2 = 0.62Proportion explained: RC1 = 0.35; RC3 = 0.34; RC2 = 0.31Cumulative proportion: RC1 = 0.35; RC3 = 0.69; RC2 = 1.00- = No applicable |

**Table S5.** Farmer demographics by affinity propagated clusters for survey conducted on organic farms in New York, USA from 2021-2022.

|  |  |
| --- | --- |
|  | Affinity propagated cluster |
| Variables\* | 1 (N = 23) | 2 (N = 11) | 3 (N = 11) | 4 (N=10) | 5 (N = 14) | 6 (N = 2) | 7 (N = 11) |
| Farmer age [Years] |
| Mean(SD) | 60.4(16.8) | 49.3(16.0) | 47.4(16.8) | 55.3(16.9) | 54.6(15.2) | 58.5(9.19) | 48.9(10.7) |
| Median[Min, Max] | 65.0[27.0, 85.0] | 49.0[25.0, 70.0] | 43.5[26.0, 72.0] | 60.5[26.0, 70.0] | 59.5[33.0, 80.0] | 58.5[52.0, 65.0] | 48.0[30.0, 68.0] |
| Missing | 1 (4.3%) | 0 (0%) | 1 (9.1%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| First generation farmer [0/1] |
| Mean(SD) | 0.773(0.429) | 0.455(0.522) | 0.636(0.505) | 0.700(0.483) | 0.714(0.469) | 0(0) | 0.818(0.405) |
| Median[Min, Max] | 1.00[0, 1.00] | 0[0, 1.00] | 1.00[0, 1.00] | 1.00[0, 1.00] | 1.00[0, 1.00] | 0[0, 0] | 1.00[0, 1.00] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Farmer educational attainment [Multiple] |
| Mean(SD) | 3.73(0.985) | 3.18(1.94) | 3.36(1.80) | 3.80(1.14) | 4.14(0.864) | 0.500(0.707) | 3.82(1.08) |
| Median[Min, Max] | 4.00[2.00, 5.00] | 4.00[0, 5.00] | 4.00[0, 5.00] | 4.00[1.00, 5.00] | 4.00[3.00, 5.00] | 0.500[0, 1.00] | 4.00[1.00, 5.00] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Farmer agricultural education [0/1] |
| Mean(SD) | 0.273(0.456) | 0.273(0.467) | 0.273(0.467) | 0.400(0.516) | 0.286(0.469) | 0(0) | 0.182(0.405) |
| Median[Min, Max] | 0[0, 1.00] | 0[0, 1.00] | 0[0, 1.00] | 0[0, 1.00] | 0[0, 1.00] | 0[0, 0] | 0[0, 1.00] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Farm main income source [0/1] |
| Mean(SD) | 0.682(0.477) | 0.455(0.522) | 0.545(0.522) | 0.600(0.516) | 0.571(0.514) | 1.00(0) | 0.727(0.467) |
| Median[Min, Max] | 1.00[0, 1.00] | 0[0, 1.00] | 1.00[0, 1.00] | 1.00[0, 1.00] | 1.00[0, 1.00] | 1.00[1.00, 1.00] | 1.00[0, 1.00] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| \*Numerical coding for variables are given in Table 1. |

**Table S6.** Farm characteristics by affinity propagated clusters for survey conducted on organic farms in New York, USA from 2021-2022.

|  |  |
| --- | --- |
|  | Affinity propagated cluster |
| Variables\* | 1 (N = 23) | 2 (N = 11) | 3 (N = 11) | 4 (N=10) | 5 (N = 14) | 6 (N = 2) | 7 (N = 11) |
| Farm acres (certified + non-certified) [Acres] |
| Mean(SD) | 207(456) | 370(819) | 215(432) | 97.4(233) | 96.4(72.3) | 79.0(72.1) | 103(97.0) |
| Median[Min, Max] | 58.5[1.00, 2000] | 87.0[1.00, 2800] | 92.0[5.00, 1500] | 14.0[2.50, 750] | 98.0[1.00, 235] | 79.0[28.0, 130] | 75.0[2.00, 350] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Certified acres in production (current year) [Acres] |
| Mean(SD) | 22.3(53.9) | 67.6(150) | 13.7(25.1) | 4.25(4.65) | 11.2(10.3) | 0.590(0.580) | 34.8(40.5) |
| Median[Min, Max] | 3.00[1.00, 250] | 5.00[0.120, 500] | 4.00[0.750, 85.0] | 2.50[1.00, 16.0] | 9.00[1.00, 30.0] | 0.590[0.180, 1.00] | 23.0[2.00, 130] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 1 (9.1%) |
| Time in organic [Years] |
| Mean(SD) | 16.6(13.0) | 14.3(13.7) | 14.8(12.3) | 14.6(10.9) | 13.3(10.7) | 8.50(2.12) | 22.3(14.1) |
| Median[Min, Max] | 12.0[3.00, 49.0] | 6.00[3.00, 40.0] | 9.00[3.00, 42.0] | 11.5[3.00, 35.0] | 8.00[2.00, 40.0] | 8.50[7.00, 10.0] | 25.0[2.00, 50.0] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Organic status (next five years) [Multiple] |
| Mean(SD) | 1.14(0.468) | 1.18(0.405) | 1.36(0.505) | 1.44(0.527) | 1.29(0.611) | 1.50(0.707) | 1.09(0.302) |
| Median[Min, Max] | 1.00[0, 2.00] | 1.00[1.00, 2.00] | 1.00[1.00, 2.00] | 1.00[1.00, 2.00] | 1.00[0, 2.00] | 1.50[1.00, 2.00] | 1.00[1.00, 2.00] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 1 (10.0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Farm status (next 10 years) [Multiple] |
| Mean(SD) | 3.91(2.31) | 4.18(1.66) | 4.55(2.30) | 2.40(2.37) | 4.07(2.40) | 3.00(2.83) | 4.27(2.28) |
| Median[Min, Max] | 4.50[0, 6.00] | 4.00[1.00, 6.00] | 6.00[1.00, 6.00] | 1.00[0, 6.00] | 5.50[1.00, 6.00] | 3.00[1.00, 5.00] | 6.00[1.00, 6.00] |
| Missing | 1 (4.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| \*Numerical coding for variables are given in Table 1. |

**Table S7.** Parameter selection for crop diversification and cover cropping. Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | Delta AIC | Parameter Selected |
| Diversified field (> 1 crop) |
| Certified acres in production (Acres)1,2 | **-0.016** | **-0.028** | **-0.0046** | **2** | **158.64** | **0** | **Yes** |
| First generation farmer (Yes) | 1.3 | 0.49 | 2 | 2 | 163.62 | 4.98 | No |
| Effort (Two) | -20 | -22000 | 22000 | 2 | 166.07 | 7.43 | No |
| Cluster 2 | -1.7 | -2.9 | -0.49 | 6 | 167.78 | 9.14 | No |
| Cluster 3 | 0.56 | -1.1 | 2.2 | 6 | 167.78 | 9.14 | No |
| Cluster 4 | -0.97 | -2.3 | 0.31 | 6 | 167.78 | 9.14 | No |
| Cluster 5 | -0.64 | -1.8 | 0.56 | 6 | 167.78 | 9.14 | No |
| Cluster 7 | -1.4 | -2.6 | -0.12 | 6 | 167.78 | 9.14 | No |
| Farm acres (Acres) | -0.001 | -0.002 | -2.60E-05 | 2 | 168.55 | 9.91 | No |
| Time in Organic (Years) | -0.029 | -0.057 | -0.00076 | 2 | 169.94 | 11.3 | No |
| Age (Years) | -0.018 | -0.041 | 0.0055 | 2 | 171.69 | 13.05 | No |
| Null | 0.53 | 0.53 | 0.53 | 1 | 172 | 13.36 | No |
| Farmer agricultural education (Yes) | -0.33 | -1.1 | 0.47 | 2 | 173.35 | 14.71 | No |
| Farmer main income source (Yes) | 0.22 | -0.53 | 0.97 | 2 | 173.69 | 15.04 | No |
| Cover cropping (grasses) |
| Age (Years)1,2 | **-0.044** | **-0.068** | **-0.02** | **2** | **177.18** | **0** | **Yes** |
| Farmer main income source (Yes) | 1.2 | 0.44 | 1.9 | 2 | 181.48 | 4.3 | No |
| Time in Organic (Years) | -0.023 | -0.05 | 0.0041 | 2 | 188.89 | 11.72 | No |
| Null | 0.48 | 0.14 | 0.82 | 1 | 189.67 | 12.49 | No |
| First generation farmer (Yes) | 0.43 | -0.29 | 1.2 | 2 | 190.3 | 13.12 | No |
| Effort (Two) | 0.72 | -0.52 | 2 | 2 | 190.38 | 13.2 | No |
| Farmer agricultural education (Yes) | -0.37 | -1.1 | 0.39 | 2 | 190.77 | 13.59 | No |
| Farm acres (Acres) | -0.00022 | -0.0012 | 0.00073 | 2 | 191.38 | 14.21 | No |
| Certified acres in production (Acres) | -0.00097 | -0.0058 | 0.0039 | 2 | 191.52 | 14.34 | No |
| Cluster 2 | -0.057 | -1.1 | 1 | 6 | 192.24 | 15.07 | No |
| Cluster 3 | 0.68 | -0.51 | 1.9 | 6 | 192.24 | 15.07 | No |
| Cluster 4 | -0.46 | -1.6 | 0.67 | 6 | 192.24 | 15.07 | No |
| Cluster 5 | -0.1 | -1.1 | 0.9 | 6 | 192.24 | 15.07 | No |
| Cluster 7 | 1.3 | -0.12 | 2.7 | 6 | 192.24 | 15.07 | No |
| Cover cropping (legumes) |
| Farmer main income source (Yes)2 | **1.5** | **0.76** | **2.3** | **2** | **181.83** | **0** | **Yes** |
| Cluster 21 | **-1.9** | **-3.1** | **-0.73** | **6** | **183.82** | **1.99** | **Yes** |
| Cluster 3 | -1.1 | -2.3 | 0.096 | 6 | 183.82 | 1.99 | No |
| Cluster 41 | **-2.6** | **-4** | **-1.2** | **6** | **183.82** | **1.99** | **Yes** |
| Cluster 51 | **-1.7** | **-2.8** | **-0.55** | **6** | **183.82** | **1.99** | **Yes** |
| Cluster 71 | **-1.6** | **-2.8** | **-0.43** | **6** | **183.82** | **1.99** | **Yes** |
| Age (Years) | -0.026 | -0.048 | -0.0048 | 2 | 192.88 | 11.05 | No |
| First generation farmer (Yes) | 0.86 | 0.13 | 1.6 | 2 | 193.43 | 11.59 | No |
| Time in Organic (Years) | -0.027 | -0.054 | -0.00037 | 2 | 194.81 | 12.98 | No |
| Null | 0.13 | -0.2 | 0.46 | 1 | 196.89 | 15.06 | No |
| Farmer agricultural education (Yes) | -0.32 | -1.1 | 0.43 | 2 | 198.19 | 16.35 | No |
| Farm acres (Acres) | 0.00027 | -0.00068 | 0.0012 | 2 | 198.48 | 16.64 | No |
| Certified acres in production (Acres) | -0.0016 | -0.0065 | 0.0034 | 2 | 198.5 | 16.67 | No |
| Effort (Two) | 0.34 | -0.9 | 1.6 | 2 | 198.61 | 16.77 | No |
| Cover cropping (herbs) |
| Farm acres (Acres) | -0.0019 | -0.0041 | 0.00025 | 2 | 180.67 | 0 | No |
| Certified acres in production (Acres) | -0.01 | -0.023 | 0.0026 | 2 | 181.3 | 0.63 | No |
| Time in Organic (Years) | -0.024 | -0.053 | 0.0058 | 2 | 183.53 | 2.86 | No |
| Null | -0.63 | -0.98 | -0.28 | 1 | 184.14 | 3.47 | No |
| Effort (Two) | -0.49 | -1.7 | 0.75 | 2 | 185.56 | 4.89 | No |
| Farmer agricultural education (Yes) | 0.28 | -0.49 | 1 | 2 | 185.64 | 4.96 | No |
| Age (Years) | -0.0039 | -0.025 | 0.018 | 2 | 186.02 | 5.34 | No |
| Farmer main income source (Yes) | -0.085 | -0.81 | 0.64 | 2 | 186.09 | 5.42 | No |
| First generation farmer (Yes) | 0.042 | -0.71 | 0.79 | 2 | 186.13 | 5.46 | No |
| Cluster 2 | -0.4 | -1.6 | 0.8 | 6 | 191.9 | 11.23 | No |
| Cluster 3 | 0.45 | -0.67 | 1.6 | 6 | 191.9 | 11.23 | No |
| Cluster 4 | 0.41 | -0.76 | 1.6 | 6 | 191.9 | 11.23 | No |
| Cluster 5 | 0.19 | -0.86 | 1.2 | 6 | 191.9 | 11.23 | No |
| Cluster 7 | 0.32 | -0.84 | 1.5 | 6 | 191.9 | 11.23 | No |
| 1Parameter also supported by Supplemental analysis 1.2Parameter also supported by Supplemental analysis 2 |

**Table S8.** Parameter selection for no tillage and the use of some no-tillage practices. Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | DeltaAIC | ParameterSelected |
| Tillage (absolutely no-tillage) |
| Certified acres in production (Acres)1,2 | **-0.03** | **-0.053** | **-0.0064** | **2** | **180.49** | **0** | **Yes** |
| Cluster 2 | -0.26 | -1.4 | 0.89 | 6 | 183.09 | 2.6 | No |
| Cluster 3 | 0.98 | -0.14 | 2.1 | 6 | 183.09 | 2.6 | No |
| Cluster 4 | 1.5 | 0.31 | 2.8 | 6 | 183.09 | 2.6 | No |
| Cluster 5 | 0.9 | -0.12 | 1.9 | 6 | 183.09 | 2.6 | No |
| Cluster 7 | -1.4 | -3 | 0.18 | 6 | 183.09 | 2.6 | No |
| Farm acres (Acres) | -0.0023 | -0.0046 | 1.60E-05 | 2 | 188 | 7.51 | No |
| Time in Organic (Years) | -0.04 | -0.069 | -0.01 | 2 | 188.08 | 7.59 | No |
| Farmer main income source (Yes) | -0.77 | -1.5 | -0.069 | 2 | 191.01 | 10.53 | No |
| Null | -0.33 | -0.66 | 0.0054 | 1 | 193.7 | 13.21 | No |
| Effort (Two) | -0.56 | -1.8 | 0.68 | 2 | 194.92 | 14.43 | No |
| Age (Years) | -0.0082 | -0.029 | 0.013 | 2 | 195.1 | 14.61 | No |
| First generation farmer (Yes) | 0.19 | -0.53 | 0.92 | 2 | 195.43 | 14.94 | No |
| Farmer agricultural education (Yes) | 0.16 | -0.59 | 0.91 | 2 | 195.52 | 15.03 | No |
| Tillage (some no-tillage) |
| Null | -0.24 | -0.57 | 0.09 | 1 | 195.41 | 0 | No |
| Cluster 2 | **-1.4** | **-2.6** | **-0.23** | **6** | **196.24** | **0.82** | **Yes** |
| Cluster 3 | 0.073 | -1 | 1.2 | 6 | 196.24 | 0.82 | No |
| Cluster 4 | -0.36 | -1.5 | 0.77 | 6 | 196.24 | 0.82 | No |
| Cluster 5 | -0.82 | -1.8 | 0.2 | 6 | 196.24 | 0.82 | No |
| Cluster 7 | -0.94 | -2.1 | 0.22 | 6 | 196.24 | 0.82 | No |
| Certified acres in production (Acres) | 0.0025 | -0.0027 | 0.0077 | 2 | 196.42 | 1 | No |
| First generation farmer (Yes) | 0.32 | -0.41 | 1 | 2 | 196.67 | 1.26 | No |
| Age (Years) | 0.0064 | -0.014 | 0.027 | 2 | 197.05 | 1.63 | No |
| Farmer main income source (Yes) | 0.12 | -0.57 | 0.82 | 2 | 197.29 | 1.88 | No |
| Farm acres (Acres) | -0.00011 | -0.0011 | 0.00083 | 2 | 197.33 | 1.92 | No |
| Time in Organic (Years) | -0.0015 | -0.028 | 0.025 | 2 | 197.4 | 1.99 | No |
| Farmer agricultural education (Yes) | 0.042 | -0.71 | 0.79 | 2 | 197.4 | 1.99 | No |
| Effort (Two) | -0.065 | -1.3 | 1.2 | 2 | 197.4 | 1.99 | No |
| 1Parameter also supported by Supplemental analysis 12Parameter also supported by Supplemental analysis 2 |

**Table S9.** Parameter selection for mulching and preplanting (e.g., solarization). Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | Delta AIC | Parameter Selected |
| Mulching (biological) |
| Certified acres in production (Acres)1 | **-0.022** | **-0.041** | **-0.0026** | **2** | **182.98** | **0** | **Yes** |
| Cluster 2 | -0.25 | -1.4 | 0.86 | 6 | 185.24 | 2.26 | No |
| Cluster 3 | 0.55 | -0.55 | 1.6 | 6 | 185.24 | 2.26 | No |
| Cluster 4 | 0.8 | -0.35 | 2 | 6 | 185.24 | 2.26 | No |
| Cluster 5 | 0.53 | -0.48 | 1.5 | 6 | 185.24 | 2.26 | No |
| Cluster 7 | -2.4 | -4.5 | -0.27 | 6 | 185.24 | 2.26 | No |
| Age (Years) | -0.015 | -0.036 | 0.0059 | 2 | 192.26 | 9.28 | No |
| Null | -0.39 | -0.72 | -0.051 | 1 | 192.27 | 9.29 | No |
| First generation farmer (Yes) | -0.44 | -1.2 | 0.28 | 2 | 192.86 | 9.88 | No |
| Time in Organic (Years) | -0.016 | -0.044 | 0.011 | 2 | 192.91 | 9.93 | No |
| Farm acres (Acres) | -0.00043 | -0.0014 | 0.00057 | 2 | 193.38 | 10.4 | No |
| Farmer agricultural education (Yes) | 0.24 | -0.51 | 1 | 2 | 193.87 | 10.89 | No |
| Effort (Two) | 0.19 | -1.1 | 1.5 | 2 | 194.18 | 11.2 | No |
| Farmer main income source (Yes) | -0.1 | -0.8 | 0.6 | 2 | 194.19 | 11.21 | No |
| Mulching (synthetic) |
| Farmer agricultural education (Yes) | -0.66 | -1.5 | 0.17 | 2 | 187.06 | 0 | No |
| Age (Years) | -0.016 | -0.038 | 0.005 | 2 | 187.35 | 0.28 | No |
| Time in Organic (Years) | -0.021 | -0.05 | 0.0075 | 2 | 187.46 | 0.4 | No |
| Null | **-0.54** | **-0.88** | **-0.2** | **1** | **187.64** | **0.58** | **Yes** |
| First generation farmer (Yes) | -0.53 | -1.3 | 0.2 | 2 | 187.65 | 0.58 | No |
| Effort (Two) | -0.78 | -2 | 0.46 | 2 | 188.1 | 1.04 | No |
| Cluster 2 | 0.44 | -0.62 | 1.5 | 6 | 188.47 | 1.41 | No |
| Cluster 3 | -0.19 | -1.3 | 0.93 | 6 | 188.47 | 1.41 | No |
| Cluster 4 | 0.23 | -0.91 | 1.4 | 6 | 188.47 | 1.41 | No |
| Cluster 51 | **-1.3** | **-2.6** | **-0.077** | **6** | **188.47** | **1.41** | **Yes** |
| Cluster 7 | -0.61 | -1.8 | 0.59 | 6 | 188.47 | 1.41 | No |
| Farmer main income source (Yes) | -0.21 | -0.92 | 0.5 | 2 | 189.32 | 2.26 | No |
| Certified acres in production (Acres) | 0.0013 | -0.0036 | 0.0061 | 2 | 189.38 | 2.32 | No |
| Farm acres (Acres) | 3.70E-05 | -0.00091 | 0.00099 | 2 | 189.64 | 2.57 | No |
| Preplanting practices (all types) |
| Effort (Two) | **-1.5** | **-2.9** | **-0.14** | **2** | **188.11** | **0** | **Yes** |
| Time in Organic (Years) | **-0.03** | **-0.059** | **-0.00086** | **2** | **189.11** | **1** | **Yes** |
| Cluster 2 | 0.19 | -0.94 | 1.3 | 6 | 189.71 | 1.6 | No |
| Cluster 31 | **1.4** | **0.27** | **2.6** | **6** | **189.71** | **1.6** | **Yes** |
| Cluster 4 | 0.53 | -0.65 | 1.7 | 6 | 189.71 | 1.6 | No |
| Cluster 51 | **1.1** | **0.086** | **2.2** | **6** | **189.71** | **1.6** | **Yes** |
| Cluster 7 | -0.37 | -1.7 | 0.93 | 6 | 189.71 | 1.6 | No |
| Farm acres (Acres) | -0.0011 | -0.0024 | 0.00018 | 2 | 189.93 | 1.82 | No |
| First generation farmer (Yes) | 0.64 | -0.12 | 1.4 | 2 | 190.63 | 2.52 | No |
| Null | -0.42 | -0.75 | -0.08 | 1 | 191.46 | 3.35 | No |
| Certified acres in production (Acres) | -0.0024 | -0.0083 | 0.0034 | 2 | 192.69 | 4.58 | No |
| Farmer agricultural education (Yes) | -0.17 | -0.93 | 0.6 | 2 | 193.28 | 5.17 | No |
| Age (Years) | 0.0025 | -0.018 | 0.024 | 2 | 193.4 | 5.29 | No |
| Farmer main income source (Yes) | -0.018 | -0.72 | 0.69 | 2 | 193.46 | 5.34 | No |
| 1Parameter also supported by Supplemental analysis 1 |

**Table S10.** Parameter selection for irrigation. Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | Delta AIC | Parameter Selected |
| Irrigation (precision) |
| Time in Organic (Years) | -0.023 | -0.05 | 0.0033 | 2 | 193.23 | 0 | No |
| Farm acres (Acres) | -7.00E-04 | -0.0017 | 0.00029 | 2 | 193.73 | 0.5 | No |
| Cluster 2 | -0.074 | -1.2 | 1 | 6 | 193.82 | 0.59 | No |
| Cluster 3 | -0.87 | -2 | 0.24 | 6 | 193.82 | 0.59 | No |
| Cluster 4 | -0.41 | -1.6 | 0.76 | 6 | 193.82 | 0.59 | No |
| Cluster 5 | -0.77 | -1.8 | 0.27 | 6 | 193.82 | 0.59 | No |
| Cluster 71 | **-1.7** | **-2.9** | **-0.5** | **6** | **193.82** | **0.59** | **Yes** |
| Null | 0.23 | -0.1 | 0.56 | 1 | 194.25 | 1.02 | No |
| Certified acres in production (Acres) | -0.003 | -0.0084 | 0.0024 | 2 | 194.88 | 1.65 | No |
| Age (Years) | -0.01 | -0.031 | 0.011 | 2 | 195.35 | 2.12 | No |
| Effort (Two) | -0.51 | -1.8 | 0.74 | 2 | 195.6 | 2.37 | No |
| First generation farmer (Yes) | 0.2 | -0.51 | 0.92 | 2 | 195.94 | 2.71 | No |
| Farmer main income source (Yes) | 0.038 | -0.66 | 0.74 | 2 | 196.24 | 3.01 | No |
| Farmer agricultural education (Yes) | -0.025 | -0.77 | 0.72 | 2 | 196.24 | 3.02 | No |
| Irrigation (broadcast) |
| Age (Years)1,2 | **-0.043** | **-0.066** | **-0.019** | **2** | **170.46** | **0** | **Yes** |
| Time in Organic (Years) | -0.041 | -0.073 | -0.0089 | 2 | 176.91 | 6.45 | No |
| Farm acres (Acres) | -0.0018 | -0.0038 | 0.00026 | 2 | 178.99 | 8.53 | No |
| Certified acres in production (Acres) | -0.0057 | -0.015 | 0.0033 | 2 | 181.59 | 11.13 | No |
| Null | -0.65 | -1 | -0.3 | 1 | 182.02 | 11.55 | No |
| First generation farmer (Yes) | 0.47 | -0.31 | 1.3 | 2 | 182.58 | 12.12 | No |
| Farmer main income source (Yes) | 0.4 | -0.35 | 1.2 | 2 | 182.91 | 12.44 | No |
| Effort (Two) | 0.49 | -0.87 | 1.8 | 2 | 183.49 | 13.02 | No |
| Farmer agricultural education (Yes) | -0.17 | -0.96 | 0.63 | 2 | 183.84 | 13.38 | No |
| Cluster 2 | 0.84 | -0.28 | 2 | 6 | 188.17 | 17.7 | No |
| Cluster 3 | 0.81 | -0.34 | 2 | 6 | 188.17 | 17.7 | No |
| Cluster 4 | 0.77 | -0.43 | 2 | 6 | 188.17 | 17.7 | No |
| Cluster 5 | 0.24 | -0.89 | 1.4 | 6 | 188.17 | 17.7 | No |
| Cluster 7 | 0.68 | -0.51 | 1.9 | 6 | 188.17 | 17.7 | No |
| 1Parameter also supported by Supplemental analysis 12Parameter also supported by Supplemental analysis 2 |

**Table S11.** Parameter selection for fertilizers. Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | Delta AIC | Parameter Selected |
| Fertilizer use (compost) |
| Time in Organic (Years)1,2 | **-0.039** | **-0.067** | **-0.011** | **2** | **189.7** | **0** | **Yes** |
| Effort (Two) | -1.4 | -3 | 0.19 | 2 | 194.16 | 4.46 | No |
| Cluster 2 | 0.35 | -0.75 | 1.4 | 6 | 194.79 | 5.09 | No |
| Cluster 3 | 0.43 | -0.72 | 1.6 | 6 | 194.79 | 5.09 | No |
| Cluster 4 | 0.012 | -1.1 | 1.2 | 6 | 194.79 | 5.09 | No |
| Cluster 5 | -0.26 | -1.3 | 0.74 | 6 | 194.79 | 5.09 | No |
| Cluster 7 | -1.6 | -2.9 | -0.32 | 6 | 194.79 | 5.09 | No |
| Farmer main income source (Yes) | 0.58 | -0.11 | 1.3 | 2 | 195.15 | 5.45 | No |
| Null | 0.21 | -0.12 | 0.55 | 1 | 195.87 | 6.17 | No |
| Farmer agricultural education (Yes) | -0.44 | -1.2 | 0.31 | 2 | 196.54 | 6.84 | No |
| Farm acres (Acres) | 0.00038 | -0.00059 | 0.0013 | 2 | 197.09 | 7.39 | No |
| Certified acres in production (Acres) | -0.0016 | -0.0066 | 0.0033 | 2 | 197.43 | 7.72 | No |
| Age (Years) | -0.0059 | -0.027 | 0.015 | 2 | 197.55 | 7.85 | No |
| First generation farmer (Yes) | 0.18 | -0.54 | 0.89 | 2 | 197.63 | 7.93 | No |
| Fertilizer use (animal manure) |
| Farmer agricultural education (Yes) | 0.87 | -0.048 | 1.8 | 2 | 173.62 | 0 | No |
| Null | **0.82** | **0.47** | **1.2** | **1** | **175.43** | **1.81** | **Yes** |
| Age (Years) | -0.015 | -0.038 | 0.0079 | 2 | 175.75 | 2.13 | No |
| Farm acres (Acres) | 0.00056 | -0.00054 | 0.0017 | 2 | 176.33 | 2.72 | No |
| Certified acres in production (Acres) | 0.0024 | -0.0042 | 0.009 | 2 | 176.82 | 3.2 | No |
| Farmer main income source (Yes) | 0.25 | -0.49 | 0.99 | 2 | 176.99 | 3.37 | No |
| First generation farmer (Yes) | 0.24 | -0.52 | 1 | 2 | 177.05 | 3.43 | No |
| Effort (Two) | 0.29 | -1 | 1.6 | 2 | 177.25 | 3.63 | No |
| Time in Organic (Years) | -0.002 | -0.03 | 0.026 | 2 | 177.41 | 3.79 | No |
| Cluster 2 | -0.28 | -1.4 | 0.82 | 6 | 183.03 | 9.41 | No |
| Cluster 3 | -0.23 | -1.4 | 0.91 | 6 | 183.03 | 9.41 | No |
| Cluster 4 | 0.11 | -1.1 | 1.3 | 6 | 183.03 | 9.41 | No |
| Cluster 5 | 0.62 | -0.56 | 1.8 | 6 | 183.03 | 9.41 | No |
| Cluster 7 | 0.19 | -1 | 1.4 | 6 | 183.03 | 9.41 | No |
| Fertilizer use (mineral) |
| Time in Organic (Years)1 | **-0.058** | **-0.1** | **-0.017** | **2** | **147.65** | **0** | **Yes** |
| Age (Years) | **-0.037** | **-0.063** | **-0.012** | **2** | **148.77** | **1.11** | **Yes** |
| Null | -1.2 | -1.6 | -0.8 | 1 | 155.44 | 7.79 | No |
| Cluster 2 | 0.84 | -0.28 | 2 | 6 | 156.85 | 9.19 | No |
| Cluster 3 | 0.1 | -1.1 | 1.3 | 6 | 156.85 | 9.19 | No |
| Cluster 4 | -0.047 | -1.4 | 1.3 | 6 | 156.85 | 9.19 | No |
| Cluster 5 | -1.3 | -2.9 | 0.3 | 6 | 156.85 | 9.19 | No |
| Cluster 7 | -0.48 | -1.9 | 0.95 | 6 | 156.85 | 9.19 | No |
| Farmer main income source (Yes) | 0.3 | -0.54 | 1.1 | 2 | 156.93 | 9.28 | No |
| Certified acres in production (Acres) | 0.0014 | -0.0038 | 0.0065 | 2 | 157.18 | 9.53 | No |
| Farm acres (Acres) | 0.00022 | -0.00076 | 0.0012 | 2 | 157.2 | 9.55 | No |
| Effort (Two) | 0.34 | -1.2 | 1.9 | 2 | 157.25 | 9.59 | No |
| First generation farmer (Yes) | -0.13 | -0.96 | 0.7 | 2 | 157.35 | 9.7 | No |
| Farmer agricultural education (Yes) | 0.021 | -0.86 | 0.9 | 2 | 157.44 | 9.78 | No |
| Fertilizer use (plant based) |
| Effort (Two) | 20 | -24000 | 24000 | 2 | 155.45 | 0 | No |
| Certified acres in production (Acres) | 0.0038 | -0.0013 | 0.0088 | 2 | 159.86 | 4.41 | No |
| Null | -1.1 | -1.5 | -0.73 | 1 | 160.03 | 4.58 | No |
| Age (Years) | -0.017 | -0.041 | 0.0069 | 2 | 160.06 | 4.61 | No |
| Farm acres (Acres) | -0.00064 | -0.0018 | 0.00057 | 2 | 160.93 | 5.48 | No |
| Farmer main income source (Yes) | 0.42 | -0.42 | 1.2 | 2 | 161.04 | 5.59 | No |
| Time in Organic (Years) | -0.0095 | -0.041 | 0.022 | 2 | 161.67 | 6.22 | No |
| First generation farmer (Yes) | 0.17 | -0.67 | 1 | 2 | 161.87 | 6.43 | No |
| Farmer agricultural education (Yes) | 0.11 | -0.74 | 0.96 | 2 | 161.97 | 6.52 | No |
| Cluster 2 | 0.5 | -0.72 | 1.7 | 6 | 165.93 | 10.48 | No |
| Cluster 3 | -0.26 | -1.7 | 1.2 | 6 | 165.93 | 10.48 | No |
| Cluster 4 | 1.1 | -0.18 | 2.3 | 6 | 165.93 | 10.48 | No |
| Cluster 5 | 0.47 | -0.69 | 1.6 | 6 | 165.93 | 10.48 | No |
| Cluster 7 | 0.16 | -1.2 | 1.5 | 6 | 165.93 | 10.48 | No |
| 1Parameter also supported by Supplemental analysis 12Parameter also supported by Supplemental analysis 2 |

**Table S12.** Parameter selection for pesticide use. Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | Delta AIC | Parameter Selected |
| Pesticides (all types) |
| Cluster 2 | 0.26 | -0.88 | 1.4 | 6 | 157.63 | 0 | No |
| Cluster 3 | 0.66 | -0.49 | 1.8 | 6 | 157.63 | 0 | No |
| Cluster 4 | -0.66 | -2.1 | 0.76 | 6 | 157.63 | 0 | No |
| Cluster 5 | **-2.3** | **-4.4** | **-0.14** | **6** | **157.63** | **0** | **Yes** |
| Cluster 7 | -0.073 | -1.3 | 1.2 | 6 | 157.63 | 0 | No |
| Null | -1 | -1.4 | -0.66 | 1 | 160.41 | 2.79 | No |
| Certified acres in production (Acres) | 0.0035 | -0.0016 | 0.0085 | 2 | 160.53 | 2.9 | No |
| Age (Years) | -0.014 | -0.038 | 0.0093 | 2 | 160.99 | 3.36 | No |
| Effort (Two) | 0.82 | -0.73 | 2.4 | 2 | 161.15 | 3.53 | No |
| Farmer agricultural education (Yes) | 0.25 | -0.59 | 1.1 | 2 | 162.07 | 4.44 | No |
| First generation farmer (Yes) | -0.18 | -1 | 0.63 | 2 | 162.22 | 4.59 | No |
| Farmer main income source (Yes) | 0.13 | -0.67 | 0.93 | 2 | 162.31 | 4.68 | No |
| Time in Organic (Years) | -0.0038 | -0.035 | 0.027 | 2 | 162.36 | 4.73 | No |
| Farm acres (Acres) | 1.70E-05 | -0.00097 | 0.001 | 2 | 162.41 | 4.78 | No |

**Table S13.** P-value statistics for pairwise Wilcoxon rank sum test examining differences between 11 statements for motivating adoption of practices supporting the pest-suppressive microbiome within organic farms. Full statements are shown in Table S3 Q11; abbreviations are in bold.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Motivation | Reduced | Easy | Extension | Commercial | Conversation | Workshop | Request | Benefits | Increases | Observable |
| Easy | 0.208635 | - | - | - | - | - | - | - | - | - |
| Extension | 0.001108 | 2.84E-06 | - | - | - | - | - | - | - | - |
| Commercial | 2.37E-15 | 4.17E-19 | 5.53E-09 | - | - | - | - | - | - | - |
| Conversation | 3.03E-11 | 2.56E-15 | 6.12E-05 | 0.014861 | - | - | - | - | - | - |
| Workshop | 0.003369 | 8.78E-06 | 0.620959 | 1.07E-10 | 2.64E-06 | - | - | - | - | - |
| Request | 4.87E-17 | 1.27E-20 | 7.60E-11 | 0.342986 | 0.000817 | 1.23E-12 | - | - | - | - |
| Benefits | 0.017768 | 0.169898 | 7.49E-08 | 9.14E-19 | 1.71E-15 | 2.13E-07 | 4.38E-20 | - | - | - |
| Increases | 0.002108 | 0.045707 | 2.39E-10 | 2.91E-22 | 2.36E-19 | 5.37E-10 | 2.04E-23 | 0.684345 | - | - |
| Observable | 4.53E-06 | 0.000302 | 4.97E-15 | 6.44E-26 | 5.29E-24 | 5.70E-15 | 1.07E-26 | 0.075971 | 0.126233 | - |
| Friendly | 4.06E-12 | 4.19E-15 | 7.53E-07 | 0.883672 | 0.052565 | 5.19E-08 | 0.326855 | 1.75E-15 | 4.49E-18 | 2.74E-21 |
| “-” Only lower triangle of p-values for pairwise Wilcoxon tests are shown to avoid redundancy. |

**Table S14.** Parameter selection for motivations mediation adoption. Estimates and AIC values given at two significant figures and the second decimal place, respectively. Bold are parameters selected based on AIC value (< 2 from top model) and the 95% confidence interval (did not cross zero).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Estimate | 2.50% | 97.50% | df | AIC | Delta AIC | Parameter Selected |
| Motivations (sum) |
| Cluster 2 | -0.23 | -3.3 | 2.8 | 7 | 449.04 | 0 | No |
| Cluster 3 | 1.3 | -1.9 | 4.4 | 7 | 449.04 | 0 | No |
| Cluster 41,2 | **3.5** | **0.23** | **6.8** | **7** | **449.04** | **0** | **Yes** |
| Cluster 51,2 | **5.5** | **2.7** | **8.4** | **7** | **449.04** | **0** | **Yes** |
| Cluster 7 | 0.65 | -2.5 | 3.8 | 7 | 449.04 | 0 | No |
| Farmer agricultural education (Yes) | 2 | -0.35 | 4.3 | 3 | 455.75 | 6.71 | No |
| Null | 39 | 38 | 40 | 2 | 456.49 | 7.45 | No |
| Age (Years) | 0.042 | -0.024 | 0.11 | 3 | 456.94 | 7.9 | No |
| Time in Organic (Years) | 0.035 | -0.05 | 0.12 | 3 | 457.84 | 8.8 | No |
| Farm acres (Acres) | -0.00046 | -0.0031 | 0.0022 | 3 | 458.37 | 9.33 | No |
| First generation farmer (Yes) | -0.37 | -2.7 | 2 | 3 | 458.39 | 9.35 | No |
| Farmer main income source (Yes) | -0.2 | -2.4 | 2 | 3 | 458.45 | 9.42 | No |
| Certified acres in production (Acres) | -0.0013 | -0.017 | 0.015 | 3 | 458.46 | 9.42 | No |
| Effort (Two) | 0.071 | -3 | 3.1 | 3 | 458.48 | 9.45 | No |
| 1Parameter also supported by Supplemental analysis 12Parameter also supported by Supplemental analysis 2 |

**Supplemental figures**

**SECTION D: YOUR PRECEPTIONS OF SOIL MICROBES**



This is the final section. We start by standardizing your knowledge of microbes. Then we evaluate your perceptions and factors influencing your adoption of practices that support the microbiome. This section will take 20 minutes to complete.

**Our research shows organic farms promote soil microbes that enhance plant defenses and**

**reduce pest populations. This process is displayed in the arrow diagram below.**

****

SOIL MICROBE AND PLANT DEFENSE FACTS

* Soil microbes can be both fungi and bacteria
* Soil microbes interact with plant roots
* Plants have chemical defenses (hormones) that turn off and on
* Soil microbes can turn on plant chemical defenses
* Plant chemical defenses naturally reduce pest pressures

**Figure S1.** Information participants wereprovisioned on the pest-suppressive microbiome to standardize their knowledge of the study system. This information includes a visual conceptual diagram of microbiome mediated pest-suppression and text detailing the diagram.

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**Figure S2.** Geographic distribution of clusters by county and statistics indicating spatial autocorrelations. (a) Points show approximate location of respondent and colors identify cluster membership. Stars are exemplars for clusters. Pie plots show distribution of cluster membership within counties with submissions. (b) Bins used for spatial autocorrelation analysis and the resulting Moran’s I statistics.