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Research Plan

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Use of Mycorrhizal Fungi to Improve Soil Conditions for Agricultural Use

A. Rational

A study will be conducted to determine the potential of fungal mycelia to convert non-arable soil into fertile soil. Intact mycelial networks have the capability to increase soil fertility by increasing water and nutrient absorption capacity of plants, if the land is left untilled. The use of mycelium could aid in global expansion of farmland, to feed the world's growing population. Fungi are very successful inhabitants of soil, due to their high plasticity and their capacity to adopt various forms in response to adverse or unfavorable conditions (Frac, 2018). Fungicides that kill harmful fungi are also toxic to "beneficial" mycorrhizal fungi. Therefore, in addition to tillage, fungicides are inhibiting mycelial growth (Taskeen-Un-Nisa, 2011). When tillage isn't used higher fungal populations as well as higher concentrations of acid-hydrolysable carbohydrates and increased contribution of microbial (Beare 1997). Tilling soil can disrupt the colonization of mycelium, which in turn can dictate the inoculum potential as well as decrease the nutrient absorption capacity independent of the degree of colonization (Evans 1989).It has been studied that when tillage isn't used higher fungal populations as well as higher concentrations of acid-hydrolysable carbohydrates and increased contribution of microbial (Beare 1997). Therefore, when soil isn't tilled mycelium can more easily colonize and aid plants in nutrient absorption and concentration.

B. Hypothesis

It is hypothesized that by using fungal mycelia it is possible to convert depleted soils into fertile soils, in order to more successfully cultivate world food crops and other plants, as well as benefit the soil's inhabitant's health.

C. Procedure

The mycelial groups, that will be used are soil inoculants commercially sold MycoGrow® purchased from Fungi Perfecti. Since, these soil inoculants are commercially available it is exempt from SRC review.

There will be three experimental groups and one control group. Group A will consist of 11 species of endo and ectomycorrhizal fungi (**Endomycorrhizal fungi:** *Glomus intraradices, Glomus mosseae, Glomus aggregatum, Glomus etunicatum.* **Ectomycorrhizal fungi:** *Rhizopogon villosullus, Rhizopogon luteolus, Rhizopogon amylopogon, Rhizopogon fulvigleba, Pisolithus tinctorius, Scleroderma cepa, Scleroderma citrinum.*) Experimental Group B will consist of 19 species of endo and ectomycorrhizal fungi, beneficial bacteria, soluble kelp, humic acids and vitamin B1 (**Endomycorrhizal fungi**: *Glomus intraradices, Glomus mosseae, Glomus aggregatum, Glomus etunicatum, Glomus deserticola, Glomus monosporum, Glomus clarum, Paraglomus brasilianum, Gigaspora margarita.* **Ectomycorrhizal fungi:** *Rhizopogon villosulus, Rhizopogon luteolus, Rhizopogon amylopogon, Rhizopogon fulvigleba, Pisolithus tinctorius, Suillus granulatus, Laccaria bicolor, Laccaria laccata, Scleroderma cepa, Scleroderma citrinum.* **Disease Suppression Organisms:** *Trichoderma koningii, Trichoderma harzianum.* **Beneficial Bacteria :** *Bacillus licheniformis, Bacillus azotoformans, Bacillus megaterium, Bacillus coagulans, Bacillus pumilus, Bacillus thuringiensis, Paenibacillus polymyxa, Paenibacillus durum, Azobacter*

chroococcum, Pseudomonas aureofaciens, Pseudomonas fluorescens, Saccharomyces cerevisiae.) Experimental Group C will consist of a mixture of *Glomus* mycelia (**Endomycorrhizal fungi:** *Glomus intraradices, Glomus mosseae, Glomus aggregatum, Glomus etunicatum.*) Group D will be the control group using no inoculants.

Eisenia fetida (Compost Worms) Experiment:

In this part of the study, mixtures of 50 mL autoclave sterilized compost, 50 mL of sterilized sand will be mixed (autoclave sterilization will be conducted by instructor) with 1.0 cc mycelial mixtures A, B, and C individually, and the control (D) of sterile water. The soil mixture of each sample will then be put into separate divisions in a behavioral chamber. 20 mL of H_2O will be sprayed into each quadrant in order to keep the worms and soil moist. The *Eisenia fetida* will then be placed into the middle of the behavioral chamber. After 24 hours the number of worms per group will be counted in each quadrant of behavioral chamber.

Triticum aestivum (Wheat):

This experiment will be comprised of mixtures of 20 mL sterilized sand and 10 mL sterilized compost, mixed with 0.6 cc mycelial mixture for each of the groups A, B, C, and D the control will be sterile water. Four quadrants each with 30 mL soil mixtures will be made per group, and 8 mL of sterile water will be added to each of the quadrants. The *T. aestivum* seeds will be planted 4 days later to allow mycelial networks to form. Growth will be measured every few days and plants will be watered for 1 week then left unwatered for 2 weeks to test drought resistance.

Brassica rapa (Wisconsin Fast Plant®):

In this experiment, of 10 mL sterilized sand, 20 mL sterilized compost, will be mixed with 0.6 cc each mycelial inoculant, A, B, and C, individually, and just sterile water for the control (D). Four quadrants each with 30 mL soil mixtures will be made per group, and 8 mL of sterile water will be added to each of the quadrants.b The *B. rapa* seeds will then be planted 4 days later to allow mycelial networks to form. Growth will be measured every few days and plants will be consistently watered.

D. Bibliography

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