A Joint Project to Study the Effects of Ecological Farming Practices on the Quality, Production and Ecological Health of *Cannabis sativa* Grown for Marijuana Products

RESEARCH FRAMEWORK, METHODOLOGY AND DESIGN

Sub-Goal: Establish Research Framework and Preliminary Set-up (Sub-Goal 3.a.)

Research Topics (Sub-Goal 3.a.i.)

Ecological Agriculture. The project will investigate several general relationships between these strategic patterns and expected outcomes in terms of soil fertility and plant production.

1. The effects of polyculture patterns (interplanting and block planting) on plant production and development in field soil and in container soil.

2. The effects of polyculture strategies (interplanting and block planting) on cannabinoid and volatile organic compound (VOC) production.

3. The effects of soil fertility measures on plant production and development of cannabis plants.

4. The effects of soil fertility measures on production of cannabinoids and volatile organic compounds.

5. The labor and materials costs associated with each management practice.

Integrated Pest Management. The project will investigate the effectiveness of an IPM program on experimental blocks using opportunistic infestations as a case study, should an infestation occur.

1. The success of monitoring in anticipating and preventing infestations above critical levels.

2. The success in containing infestations using IPM responses.

3. The practicality of implementing the IPM program including data-tracking.

4. The labor and materials costs associated with each management practice.

Geographical Information Systems. The project will investigate the efficacy of using GIS in ecological agriculture cannabis farm planning, management, and research.

1. Its utility and practicality in the design process.

2. Its utility and practicality in project administration (accounting and planning).

3. Its utility in implementing the IPM program (for example, in determining the area of responses).

4. Its utility in tracking plant and ecology dynamics for research and development.

5. The labor and materials costs associated with using GIS in this context.

This project will employ two general research frameworks. The primary research framework will employ standard hypothesis testing, while the secondary framework will gain practical information on the topic of applying geographical information systems (with relational database capability) to cannabis production.

Research Topic for Initial Experiment.

See “Research Topics,” attached file.

Sub-Goal Framework for Research: Hypothesis Testing. (Sub-Goal 3.a.ii.)

We will apply hypothesis testing to questions concerning specific relationships (posed as dependencies) directly relevant to applying ecological agriculture to *Cannabis sativa* production for marijuana products. The project will focus on answering specific questions that are directly relevant to and actionable in commercial production.

The project will take a **two-tiered approach** to hypothesis testing. Research in the **first tier** will yield sufficient data to indicate the efficacy of the hypotheses for further study, and it will yield useful data for cautious application to cultivation. However, research on this tier will use small samples covering limited areas and will not yield statistically-significant data. Furthermore, as research on this tier will not use destructive sampling, soil and rhizosphere morphology data will not be obtainable. However, using smaller plots and sample sizes will allow us to conduct preliminary tests on many more questions. hile minimizing area use, resources, labor costs and foregone opportunity cost from destructive sampling. dedicated to any one hypothesis. Further, making this approach more cost-effective.

Research in the **second tier** will involve samples large enough to assure statistical significance and in some cases will involve destructive sampling. Large samples are important if the research will underlay large investments – for example the farm-wide adaptation of a strategy but they are expensive and must demonstrate a net benefit. Also, statistical significance may be necessary for publishing or fulfilling a grant requirement, justifying the cost. Likewise, destructive sampling requires the same cost-benefit analysis. While the studies they make possible would be immensely valuable – for instance studies on growth and development of root systems and dynamics of rhizosphere conditions -- destructive sampling involves destroying plants.

Preliminary Hypotheses. (Sub-Goal 3.a.iii.)

Framework for Research: Case Study in Integrated Pest Management.

The project will manage all plots with a transparent, well-documented IPM program, maintaining documentation and data on pest levels, damage, and control measures. The IPM will vigorously suppress pest-population build-ups using a sequence of controls that preserve beneficial parasites and parasatoids.

Framework for Research: Case Study in GIS.