

## **UF/IFAS Industrial Hemp Pilot Project: Variety Selection, Cropping System Development, and Invasion Risk Assessment**

### **Overview**

Industrial hemp (*Cannabis sativa*) has been identified as a potentially valuable and impactful alternative crop for Florida. To support the future viability and sustainability of a hemp industry, preliminary assessment of the crop and cropping systems must be established prior to commercialization. An industrial hemp pilot research project was approved by the Florida legislature (F.S. 1004.4473) in response to 7 U.S.C. s. 5940, with regulation of the pilot project established through the Florida Department of Agriculture and Consumer Services (FDACS) 5B-57.013. The purpose of the UF Industrial Hemp Pilot Project is to identify hemp germplasm appropriate for Florida's diverse environmental and agronomic conditions, to develop cropping systems that serve a diverse range of hemp industries, and to assess and mitigate hemp invasion risk. Given the potential opportunities and challenges, a preliminary assessment by the UF Industrial Hemp Pilot Project will be conducted to support the future commercialization of industrial hemp. To ensure a profitable and sustainable hemp industry in Florida, the pilot project will address the following overarching questions:

- How will hemp grow and reproduce on farms and in natural areas of Florida?
- What are the best hemp varieties for Florida?
- How can existing farming equipment and operations be adapted to hemp production?
- What are the economic impacts of the pilot project?

### **Goals and Objectives**

The preliminary assessment is organized as a multi-site collaborative experiment at various UF/IFAS research stations, guided by a UF Agronomy faculty team and strategic research and industry partners. The overall goal of the UF/IFAS research team is to help develop and support a profitable and sustainable hemp industry in Florida by addressing critical agronomic challenges. This proposal lays out short-term goals for the two-year pilot period, which is intended to motivate and inform future research programs, on-farm trials, and integration with the prospective processing industry. Following the pilot project, UF is mandated to provide a report to the Florida legislature that describes the best available information for cultivation, harvesting, processing, and economic impact of industrial hemp generated by the pilot project. As such, the proposed project broadly aims to address these aspects of hemp production for a fair assessment of industrial hemp agronomic, economic, and environmental feasibility. The expected short-term outcomes of the project are to identify hemp varieties suitable for Florida, develop potential hemp cropping systems for commercial production, and assess hemp invasion risk. The specific objectives for each proposed outcome are as follows:

*1. Identify hemp varieties suitable for planting in Florida's various environments*

Hemp varieties will be assessed for plant growth, health, and production with a focus on resilience to potential environmental, ecological, and economic threats. Variety trials will be established to identify a viable germplasm and to test planting date.

*2. Develop hemp management practices and cropping systems suitable for Florida*

Hemp cropping systems will be designed for raw material production suitable to current farming and anticipated processing industries. The best available varieties will be integrated with continually updated cropping system recommendations to meet the needs of the prospective processing and market goals. Cropping system trails will test management practices and evaluate the economic break-even point.

*3. Assess hemp invasion risk in Florida's natural and built environments*

Hemp invasion risk will be assessed for the various regions and environmental conditions anticipated for hemp production. The invasion risk assessment will be integrated with variety identification and cropping system development to mitigate the risk of hemp production.

## **Field Sites and Personnel**

UF/IFAS-managed field locations:

- Agronomy Forage Research Unit (AFRU), Hague
- Bivens Arm, Gainesville
- North Florida Research and Education Center-Quincy (NFREC), Quincy
- Tropical Research and Education Center (TREC), Homestead

UF/IFAS faculty and staff:

- Zachary Brym, Agronomy, Assistant Professor, TREC & State Research Coordinator
- Michael Mulvaney, Agronomy, Assistant Professor, NFREC Site Coordinator
- John Erickson, Agronomy, Associate Professor, AFRU Site Coordinator
- S. Luke Flory, Agronomy, Associate Professor, Bivens Arm Site Coordinator
- Edward Evans, Food and Resource Economics, Professor, TREC, Economic Analyst
- Rob Gilbert, Professor and Chair of Agronomy, Project Oversight and Administration
- Jerry Fankhauser, UF/IFAS Office of Research Administration

## **Statement of Compliance**

Key faculty and staff within UF/IFAS will be formally identified as qualified program personnel and will undertake agronomic field studies with certified industrial hemp varieties. UF/IFAS faculty and staff will comply with all applicable federal and state laws related to permitted research efforts. Such research efforts will not involve any psychotropic investigations with seed and study-derived plant materials. All industrial varieties used in field trials will be certified (i.e. concentration of tetrahydrocannabinols will not exceed 0.3 percent on a dry weight basis). All industry involvement with this project will require qualification by UF/IFAS and FDACS.

**Activities and Methodology**

*Timeline*

A timeline of the proposed industrial hemp pilot project activities is shown in Table 1. The timeline is broken down by trials that address each of the specific program objectives. Responsibility for meeting the timeline will be spread among sites and project personnel.

*Objective 1. Identify hemp varieties suitable for planting in Florida’s various environments*

Three research sites (AFRU, NFREC, TREC) will be used for the variety and planting date trials. Experiments will be prepared and monitored consistently at each site to allow for comparison of trial results among sites.

Multiple certified hemp varieties have been identified for consideration in variety trials (Table 2). Variety trials will be conducted each spring during the two-year pilot project. Variety trials will be planted in a randomized complete block design with five replicates per variety. Data will be collected on germination, flowering time/set, height, biomass, yield, and disease incidence. Each variety will be evaluated for THC levels to meet the regulatory threshold (0.3% THC) and for CBD to establish candidates for oil production. THC and CBD analysis will be conducted by Dr. Bonnie Avery at the UF Translational Drug Development Core.

Best candidates from the first-year variety trial will be used in the planting date trial to determine effect of temperature and day length on growth, development, and reproduction of hemp. Each site will plant the trial in quarter two of the second year, with an option for an additional quarter four planting. Planting dates will be spaced approximately monthly throughout the spring. The optional winter season plantings would also be staggered roughly monthly. Each trial will be planted in a randomized split-block design with five replicates per variety and planting date. Each plot will be assessed for germination, flowering time/set, height, biomass, yield, and disease incidence.

*Objective 2. Develop hemp management practices and cropping systems suitable for Florida*

Each of the three research sites (AFRU, NFREC, TREC) will design at least one cropping system most suited to the existing farming industries in their region and the goals of their prospective hemp industry. For instance, NFREC represents a region with many large row crop growers with commercial grain harvesting equipment, while TREC represents a region with small horticultural growers and harvesting equipment that complements manual labor. Each cropping system will address a common set of objectives and be evaluated by a common set of metrics for systems-level comparison. Each system will be evaluated for plant growth and reproduction and undergo an economic assessment of the cost of producing raw materials. The economic assessment will result in the determination of the break-even price for sale of raw materials.

Two specific trials will be conducted at each site, a spacing trial and a fertilizer trial. The trials will begin in quarter two each year. The spacing trial will generate data for optimization of row spacing and seeding rates with available planting equipment and standard site preparation. The fertilizer trial will generate data for the optimization of fertilizer rate and cultivation methods. The spacing and fertilizer trials will be sampled for seedling establishment, biomass, and yield.

*Objective 3. Assess hemp invasion risk in Florida's natural and built environments*

The invasion risk assessment will occur primarily at the Bivens Arm research site located near UF main campus in Gainesville.

To establish the conditions and habitats where hemp might establish and spread, plant physiology will be evaluated in response to variable environmental conditions in a greenhouse trial at the site. Soil composition, water availability, light availability, and temperature will be varied in order to represent the range of agricultural and natural environments found in Florida. Hemp treatment responses will be monitored continuously through the duration of the project for germination, growth, and reproduction. Early results will direct the replication and modification of further treatments to ensure a thorough understanding of hemp's environmental tolerance.

A field trial will be conducted twice (year one, quarter four; year two, quarter two) to further evaluate the environmental tolerance of seedlings under field conditions. Seedlings will be established in the greenhouse and transplanted into controlled environments such as disturbed and undisturbed forest and open field plots. Transplanted seedlings will be monitored for growth and reproduction with special attention and control measures to minimize risk of escape. All plants will be harvested prior to reproductive maturity to prevent seed dispersal.

The results of the greenhouse and field trial will be combined in a modeling and simulation exercise to assess invasion risk across Florida. Using the best available information, the model and simulation will provide a region-specific assessment of invasion risk and potential agricultural control methods. During this stage of the project, information from the variety and cropping system trials will be integrated into the invasion risk assessment to recommend management practices that may be available to mitigate invasion risk.

Table 1. University of Florida Industrial Hemp Pilot Project timeline

	Year 1				Year 2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>Identify best varieties</b>								
Variety trials	Site prep	Planting	Monitor	Harvest & Evaluation	Site prep	Planting	Monitor	Harvest & Evaluation
Planting date trials					Site prep	Planting	Monitor	Harvest & Evaluation
<b>Develop cropping systems</b>								
Spacing trial	Site prep	Planting	Monitor	Harvest & Evaluation	Site prep	Planting	Monitor	Harvest & Evaluation
Fertilizer trial	Site prep	Planting	Monitor	Harvest & Evaluation	Site prep	Planting	Monitor	Harvest & Evaluation
Economic assessment	Prep costs	Planting costs		Total cost evaluation	Prep costs	Planting costs		Total cost evaluation
<b>Assess invasion risk</b>								
Greenhouse trial	Site prep & planting	Monitor		Evaluation				Evaluation
Field trial			Establish seedlings	Transplant & Monitor		Transplant & Monitor		Evaluation
Modeling & simulation					Establish model	Calibrate model	Evaluate simulation	Analysis & Evaluation

Table 2. List of identified hemp varieties for University of Florida Industrial Hemp Pilot Project, pending approval by the State of Florida and the federal government for seed import. Approval will require documentation from the distribution source for variety certification and THC testing.

Variety	Flower	Use	Origin	Source
Fibranova	dioecious	fiber	Italy	Schiavi Seeds
Carmagnola	dioecious	dual	Italy	Schiavi Seeds
Carmagnola Selezionata	dioecious	dual	Italy	Schiavi Seeds
Eletta Campana	dioecious	fiber	Italy	Schiavi Seeds
Carmaleonte	monoecious	fiber	Italy	Schiavi Seeds
Beniko	monoecious	fiber	Poland	Schiavi Seeds
Tygra	monoecious	dual	Poland	Schiavi Seeds
Wojko	monoecious	dual	Poland	Schiavi Seeds
Helena	monoecious	dual	Serbia	Schiavi Seeds
Otto 2		grain	Colorado	Centennial Seeds
Otto 4		grain	Colorado	Centennial Seeds
Yuma	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Bama	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Si-1	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Han FN-Q	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Han FN-H	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Han NE	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Han NW	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Yuma-2	dioecious	dual	China	CN Kenaf & Hemp Seed Farm
Puma-3	dioecious	fiber	China	CN Kenaf & Hemp Seed Farm
Puma-4	dioecious	fiber	China	CN Kenaf & Hemp Seed Farm
CHG MS	dioecious	fiber	Australia	United Life Science/Ecofibre
CHG	dioecious	fiber	Australia	United Life Science/Ecofibre
CHA	dioecious	fiber	Australia	United Life Science/Ecofibre
CHY	dioecious	grain	Australia	United Life Science/Ecofibre
Canda	monoecious	dual	Canada	Parkland Industrial Hemp Growers
Joey	monoecious	dual	Canada	Parkland Industrial Hemp Growers
CFX-1		grain	Canada	Hemp Genetics International
CFX-2		grain	Canada	Hemp Genetics International
CRS-1		grain	Canada	Hemp Genetics International
X59	dioecious	grain	Canada	Terramax Holdings
Anonymous 1				Anonymous