



Fusarium species Recovered from Postharvest Hemp Materials from Kentucky Fields

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Fusarium diseases are rapidly becoming a concern for the reemerging hemp and marijuana industries. At least four *Fusarium* spp. have been reported to cause Fusarium head blight (FHB) in field hemp (FIGURE 1) in both flower and grain cultivars. Reported causal species include *F. avenaceum*, *F. graminearum*, *F. sporotrichioides*, and members of the *F. incarnatum-equiseti* species complex. Fusarium wilt caused by *F. oxysporum*, as well as *F. armeniacum* and *F. incarnatum-equiseti* species complex, have been reported in both fields and indoor facilities. Other reported diseases caused by *Fusarium* spp. include crown rot, damping off, pith necrosis, root rot, and tip blight.



FIGURE 1. FUSARIUM HEAD BLIGHT HAS BEEN REPORTED IN FLOWER AND GRAIN CULTIVARS OF HEMP GROWN IN KENTUCKY.

Some *Fusarium* spp. reported to cause diseases on cannabis are known producers of mycotoxins in other crops (Gwinn et al. 2022). *Fusarium graminearum* and *F. sporotrichioides* are major producers of trichothecenes, such as deoxynivalenol (DON) and T2. *Fusarium avenaceum* commonly produces the toxin moniliformin. Species contained within *F. incarnatum-equiseti* species complex (FIESC) have the potential to produce diverse toxins, such as apicidin, beauvericin, butenolide, enniatins, equisetin, trichothecenes, fusarochromanone, and zearalenone. Many of these toxins are regulated in cereal grains at levels as low as parts per million or parts per billion, but currently there are no thresholds or toxin limits established for cannabis or cannabis products.

As consumption of cannabis products increases, it is important to understand whether *Fusarium* spp. are present in post-harvest materials. There is limited information on whether or how much *Fusarium* is present in stored materials. In particular, risk for mycotoxins is a concern for post-harvest products, and presence of toxin-producing species can be important for the health and safety of end users. The aim of this project was to determine the potential for *Fusarium* contamination of post-harvest hemp materials.

Sources of Samples

For this survey, stored hemp materials from the 2020 growing season were solicited in Spring 2021, approximately 6 months after harvest (FIGURES 1A & 1B). Seven growers from 6 counties in Kentucky submitted a total of 13 samples; one grower submitted samples from both 2019 and 2020 growing seasons. No visible fungal growth was observed in any of the samples. All submitted tissue was dried; blighting and necrosis were undetectable.

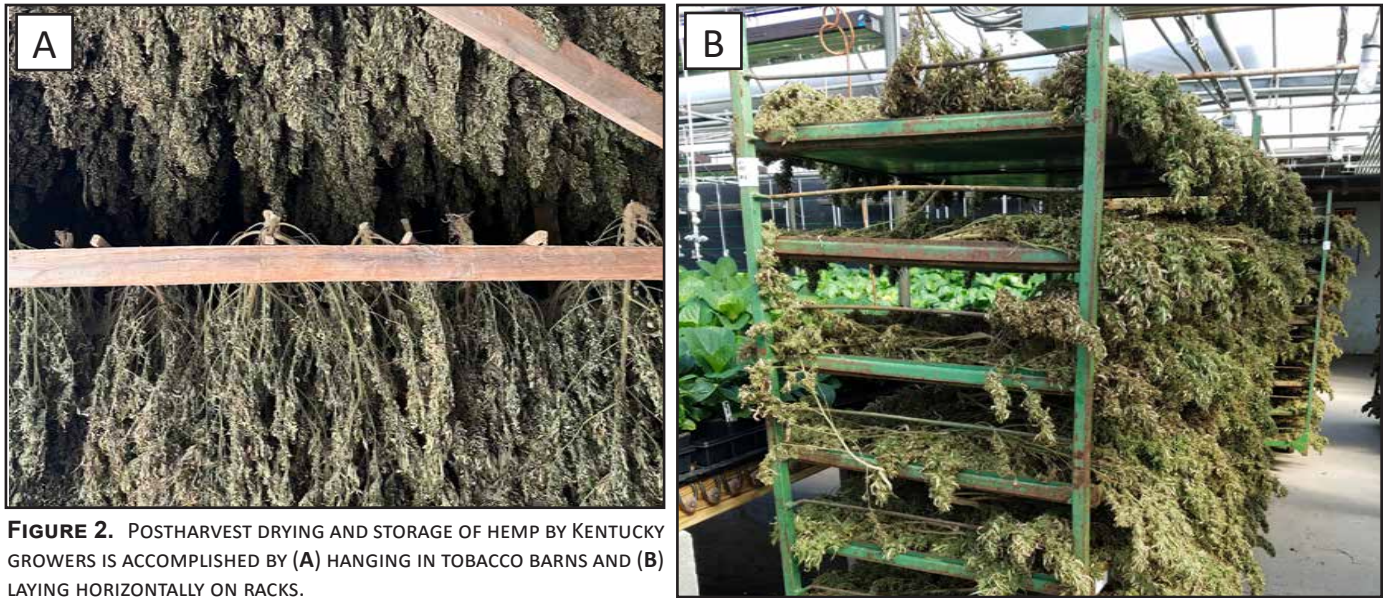


FIGURE 2. POSTHARVEST DRYING AND STORAGE OF HEMP BY KENTUCKY GROWERS IS ACCOMPLISHED BY (A) HANGING IN TOBACCO BARNs AND (B) LAYING HORIZONTALLY ON RACKS.

Isolates Identified

A total of 123 *Fusarium* spp. isolates were recovered from the 13 field sample submissions (TABLE 1, FIGURE 3). *Fusarium* spp. were isolated from 12 of the submitted samples; one sample yielded no *Fusarium* spp. Numbers of isolates varied widely from sample to sample. A grower who submitted 3 samples had as many as 21 isolates from one field and only 5 isolates from a nearby field. Another grower, who submitted 2 samples, had 18 isolates from each field. And yet another grower who submitted one sample each from 2019 and 2020 from the same field had 3 isolates in the first year but none in the second year.

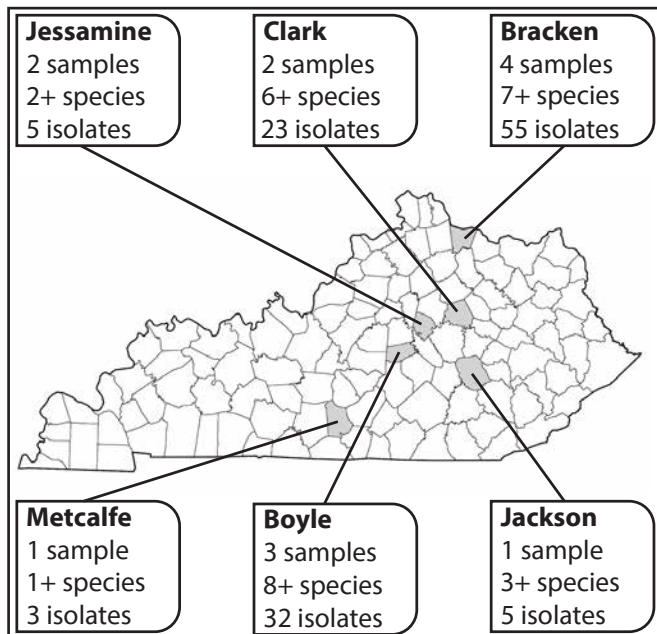


FIGURE 3. COUNTIES OF ORIGIN OF POSTHARVEST HEMP SUBMISSIONS AND SUMMARY OF *FUSARIUM* SPP. ISOLATED FROM SAMPLES.

Distribution of the species was varied, and no geographical patterns emerged. The most prevalent species were from FIESC (93 isolates) with the Equiseti clade (clade = relatedness group) making up 69 of those isolates; it was confirmed in all grower farms. Twenty isolates from the *Fusarium sambucinum* complex (FSAMSC) were recovered from 4 of the 6 counties, with 17 of the isolates being *F. graminearum*.

Based on phylogenetic analysis, a total of 12 *Fusarium* species were identified in 5 different species complexes

- Fujikuroi complex included *F. fujikuroi*.
- Oxysporum complex included *F. oxysporum*.
- Sambucinum complex included *F. armeniacum*, *F. graminearum*, and *F. sporotrichioides*.
- Solani complex included *F. solani*.
- Incarnatum-equiseti complex contained two clades, equiseti and incarnatum.
 - Equiseti clade included *F. arcuatisporum*, *F. compactum*, and *F. ipomoeae*.
 - Incarnatum clade included *F. hainanense* and *F. luffae*.

Postharvest materials contaminated by *Fusarium* spp. pose risks to end users. Today, hemp is used for food and feed, smoked and vaped, and concentrated into therapeutic products. Mycotoxins produced by many of the species identified in this study can be harmful to humans and animals. They also can put this emerging industry at risk when negative reports emerge.

TABLE 1. SPECIES OF *FUSARIUM* ISOLATED FROM STORED HEMP AND THE COUNTIES IN WHICH THEY WERE FOUND.

<i>Fusarium</i> spp.	County / Counties
<i>F. arcuatisporum</i>	Boyle
<i>F. armeniacum</i>	Boyle
<i>F. compactum</i>	Boyle, Bracken
<i>F. laceratum</i>	Boyle, Bracken
<i>F. fujikuroi</i>	Boyle, Clark
<i>F. graminearum</i>	Boyle, Bracken, Clark
<i>F. hainanense</i>	Bracken
<i>F. ipomoeae</i>	Boyle, Bracken, Clark, Jackson, Mecalfe
<i>F. luffae</i>	Boyle, Clark
<i>F. oxysporum</i>	Boyle
<i>F. solani</i>	Bracken
<i>F. sporotrichioides</i>	Boyle, Jackson

Recommendations to Growers

Growers should work with their county Extension agents during the growing season. Identification of FHB and confirmation of disease by submitting samples to the University of Kentucky Plant Disease Diagnostic Laboratory is the first step in developing a management plan. Detection of *Fusarium* spp. in stored hemp is possible, but mycotoxin testing protocols are under development.

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Complete research study can be found at

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