NORTHWEST CROPS & SOILS PROGRAM

2020 On-Farm New England Hemp Pest & Disease Scouting Report

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A survey of arthropod pests and disease was conducted on farms throughout New England and New York during the 2020 field season in order to qualify the species composition of arthropod and disease pest on industrial hemp. Hemp is a non-psychoactive variety of *cannabis sativa L*. The crop is one of historical importance in the U.S. and reemerging in worldwide importance as manufacturers seek hemp as a renewable and sustainable resource for a wide variety of consumer and industrial products. Today, industrial hemp is re-emerging as a locally grown product in the U.S. There is little data on pest and diseases of industrial hemp in New England and New York, and this survey was intended to help identify common pests that growers may encounter. Eighteen industrial hemp farms participated in the scouting program, which allowed growers to develop scouting schedules and become effective in disease and arthropod identification and management leading to higher quality crops.

Methods:

Ten industrial hemp farms in Vermont, three farms in Maine, two farms in Connecticut, two farms in Massachusetts, and one farm in New York were scouted. Vermont locations included the towns of Craftsbury, Pittsfield, Alburgh, Putney, Williston, Colchester, Berlin, Addison, and Morristown. Maine locations included Union, Unity, and Machias, Connecticut locations included Vernon and Scotland, Massachusetts locations included Southwick and New Braintree, and the New York site was in the town of Hudson (Figure 1). Unknown disease and insect samples were taken and identified with assistance from the University of Vermont Plant Diagnostic Laboratory (Burlington, Vermont).

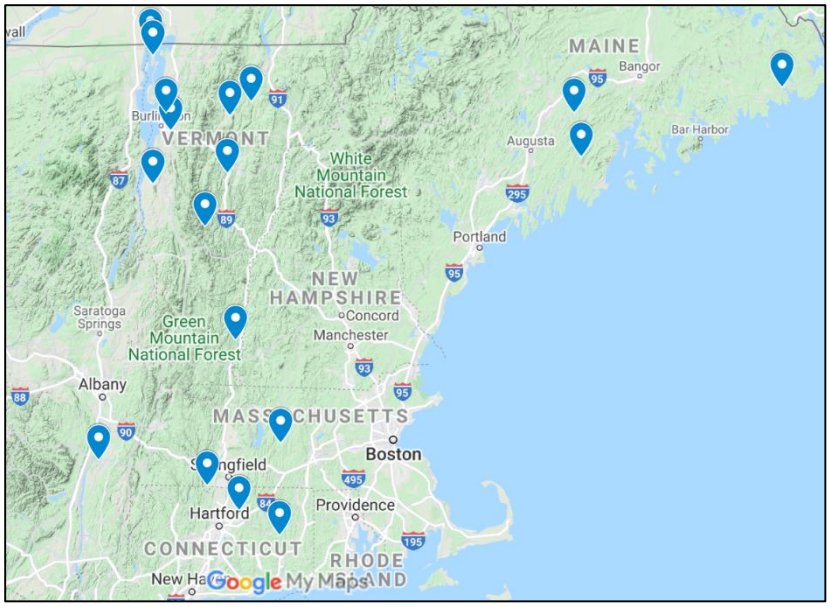

Figure 1. Locations of farm scouting sites, 2020. Google Maps, 2021.

Since the type of diseases and pests will change over the course of the season, farms were scouted at two critical periods during the growing season: at flower development stage (mid-August) and just before harvest (mid-September). Three adjacent plants were scouted at five locations within each field in a W-shaped pattern to ensure all quadrants of the field were assessed. Five leaves were randomly selected including top, mid and lower sections of the plants, as well as the terminal and 4 axillary cola buds, and evaluated for incidence (number of leaves affected) and severity (% total leaf damage) for each of the diseases and arthropod pests listed in the scouting form. Incidence results refer to the leaves scouted, except for botrytis, which includes the cola buds. See Figure 2 for an example of total leaf damage. Stems, crown, and root issues were also noted if present, and the presence of other diseases, pests, or disorders was noted.

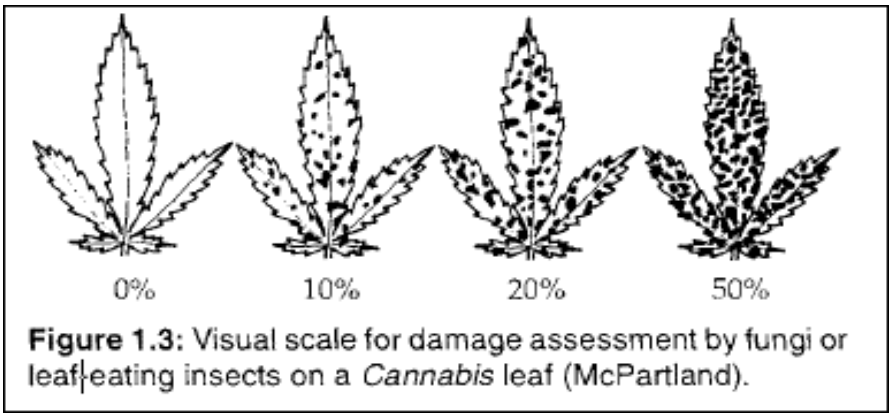

Figure 2. Leaf assessment scale from Hemp Diseases and Pests, McPartland, 2000.

Common Diseases in Industrial Hemp

Sclerotinia sclerotiorum, or white mold, spreads by spores that are carried by wind and insects. Spores infect the stem and flower in hemp. The resting bodies of the fungus, sclerotia, can overwinter in the soil and remain viable for over 5 years. Moist conditions, high humidity, and warm temperatures encourage spore survival and growth. Seedlings may rot or become stunted,

Figure 3. Sclerotinia (white mold)

leading to poor establishment and lower yields. Alternative hosts include many broadleaf crops and weeds, so good weed control and proper rotations are key to its management.

Figure 4. Botrytis (grey mold)

Botrytis cinerea, or grey mold, is a necrotrophic fungus that can cause brown, damp lesions on the plant. Infected leaves and flowers become necrotic and produce grey spores, and stalks may break. When tissue decays, it produces black rounded pieces of sclerotia, which are overwintering vessels, that look like rodent scat. *Botrytis* can cause damping off early in the season especially in wet years.

Figure 5. Powdery mildew

Leaf Spots can include several species of pathogens, and one specific to hemp is *Septoria cannabis*. Like most foliar diseases, it requires moist conditions to germinate, and begins at the ground in the bottom leaves, working its way up the plant. Common signs are yellow spots, and discoloration (browning and yellowing).

Powdery mildew appears as patches of white spores on the surface of leaves. If the infection progresses, and entire leaves, petioles, and flowers become covered, that can lead to reduced flower quality. Even though powdery mildew can be found in hops, a close relative of hemp, it is not known if the same race of the pathogen attacks both plant hosts.

Common Arthropod Pests in Industrial Hemp

Cannabis aphids winged and wingless forms are found on leaves and stems, change color later in season (cream/light green to pale pink to light brown), and feed on fluid in phloem (often little to no leaf symptoms). Populations slowly grow as the season progresses, high populations cause reduce plant vigor, slow growth, wilting and leaf yellowing.

Two spotted spider mites are very small straw color to green mites (adults have a pair of large, dark spots on each side of body) often found on leaf undersides along with cast skins and eggs. Leaf stippling is a common symptom seen on leaves, as well as extensive webbing when infestation is severe. Populations can explode during hot and dry conditions, or after pesticide applications.

Figures 6 & 7. Cannabis aphid *(left)* and two spotted spider mites *(right)*

European cornborer do not prefer hemp, but if a preferred host is not available during one of the two flights, the adult moths will lay eggs on hemp. The peak 1st flight, late June to early July in VT, will result in damage to stalks and stems causing them to break. In most of our region, enough degree-day accumulation occurs for a 2nd flight in August that can lead to damaged buds.

Figure 8. European corn borer

Flea beetles are tiny black beetles (different species may be present) whose larvae feed on plant roots, though the larval damage is not significant. The adults, however, cause small "shot hole" wounds on leaves. There are two adult generations, in June/early July and late August/September, but generally only the large populations when plants are young affect plant growth because feeding can damage growing points.

Potato leafhoppers adults are small wedge-shaped insects blown in on weather currents early in June. The winged adults will readily jump and fly when disturbed, however the wingless nymphs will simply scuttle around on the underside of the leaves. They can have several generations that build throughout the season, leading to the characteristic "hopperburn" damage, as sign of cell death, and reduced photosynthesis.

Figure 9. Potato leafhoppers on hops

Diseases Identified On-Farm:

The warm and dry growing conditions throughout much of the season resulted in relatively low levels of foliar and root disease. *Sclerotinia* white mold was not observed at any of the locations on either scouting date. Leaf spots were seen in every state, and at every farm site except for two farms in Vermont. Botrytis was also common across farms. The plant diseases identified during the 2020 growing season are listed by state in Table 1, and leaf spot and botrytis incidence are mapped in Figures 10 and 11. Data by scouting date and farm is shown in Tables 2 and 3.

Table 1. Disease presence by state, 2020.

State	Leaf Spots	Powdery Mildew	Botrytis	Other
Connecticut	X	X	X	
Maine	X	X	X	
Massachusetts	X		X	X
New York	X			
Vermont	X	X	X	X

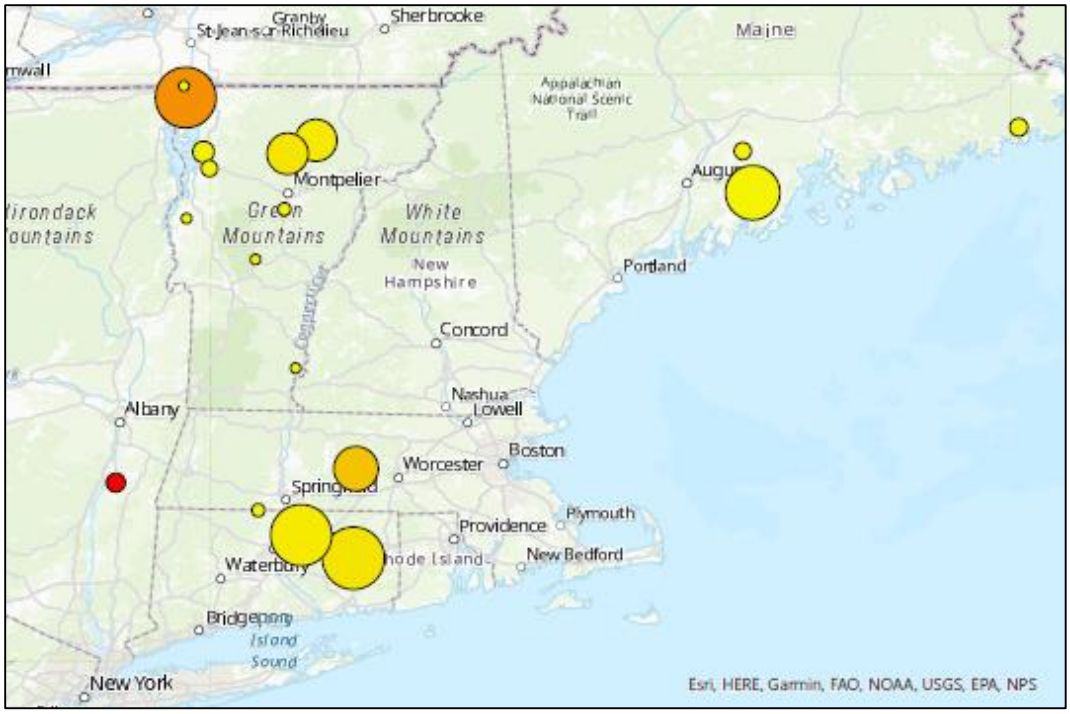

Figure 10. Leaf spot incidence, 2020. Average leaf spot incidence is represented by the size of the dot, which marks the farm location. The total incidence of all disease scouted is represented by the color of the marker *(Legend below Figure 11).*

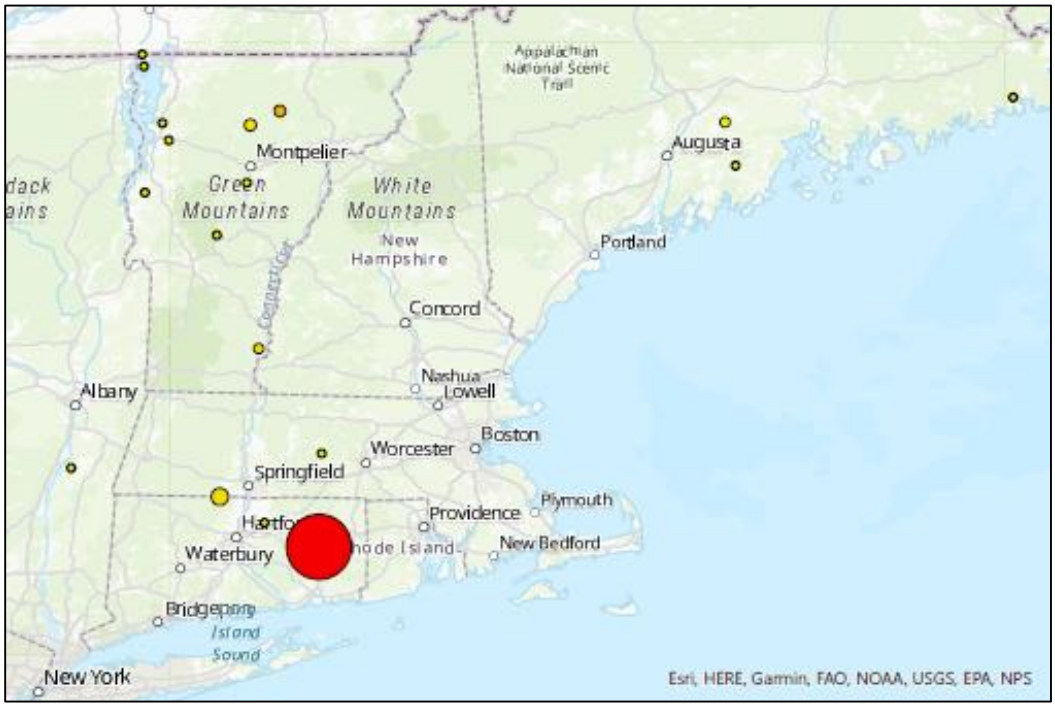

Figure 11. Botrytis incidence, 2020. Average botrytis incidence is represented by the size of the dot, which marks the farm location. The total incidence of all disease scouted is represented by the color of the marker.

Table 2. The average incidence and severity of diseases on hemp at flowering and pre-harvest in Connecticut, Maine, Massachusetts, and New York, 2020. Incidence and severity are for 5 leaves per plant on 15 plants per field.

			Flowering				Pre-harvest					
			Leaf spots		Powdery Mildew		Leaf spots		Powdery Mildew		Botrytis	
State	Town	Varieties	Inc (%)	Sev (%)	Inc (%)	Sev (%)	Inc (%)	Sev (%)	Inc (%)	Sev (%)	Inc (%)	Sev (%)
Connecticut	Vernon	Abacus	33.0	0.9	0	0	46.7	2.9	49.3	9.6	0	0
	Scotland	Boax, Cherry Wine, T1	33.3	0.9	0	0	48.0	5.1	0	0	53.3	12.5
Maine	Machias	Pasture Suvah Haze, White, Lifter, Electra	11.0	0.1	0	0	0.7	0	6.7	0.6	0	0
	Union	Stem Cell, Special Sauce, Pink Mistress, Von Baren	69.0	0	0	0	0	0	0	0	0	0
	Unity	Suva Haze, Lifter, Space Candy, Special Sauce, White, Abacus	9.3	0.2	0	0	1.1	0.1	5.6	1.8	1.3	0.1
Massachusetts	Southwick	CBG, Very Berry Cherry, hybrid	0	0	0	0	4.0	0.2	0	0	8.0	1.3
	New Braintree	Boax (Strawberry, Cherry)	0	0	0	0	53.3	17.3	0	0	0	0
New York	Hudson	Boax	0	0	0	0	0.1	0.9	0	0	0	0

Table 3. The average incidence and severity of diseases on hemp at flowering and pre-harvest in Vermont, 2020. Incidence and severity are for 5 leaves per plant on 15 plants per field.

		Flowering				Pre-harvest					
Vermont		Leaf spots		Powdery Mildew		Leaf spots		Powdery Mildew		Botrytis	
Location	Varieties	Inc (%)	Sev (%)	Inc (%)	Sev (%)	Inc (%)	Sev (%)	Inc (%)	Sev (%)	Inc (%)	Sev (%)
Addison	Cat's Meow	0	0	0	0	0	0	0	0	0	0
Alburgh-1	Boax	0	0	53.3	20.6	0	0	52.0	16.3	0	0
Alburgh-2	White CBG	1.3	12.9	0	0	77.3	22.8	45.3	9.7	0	0
Berlin	Honolulu Haze, Suver Haze, Green Mountain Cherry	0	0	40.0	10.3	4.0	0.5	26.7	4.0	0	0
Colchester	White	17.3	1.7	0	0	0	0	0	0	0	0
Craftsbury	Lifter	29.3	0	0	0	20.0	3.9	2.7	0.3	2.7	3.6
Morrisville	Suvar Haze	25.3	2.7	0	0	23.0	2.9	0	0	3.0	0.8
Pittsfield	Lifter	0	0	0	0	0	0	0	0	0	0
Putney	Lifter, Electra, CBG, Suver Haze	0	0	0	0	0	0	21.3	2.1	1.3	1.3
Williston	Suver Haze, Special Sauce, White CBG	9.3	0.2	0	0	0	0	0	0	0	0

Arthropod Pests Identified On-Farm

Spider mites and thrips were not observed at the scouting locations at either scouting date. Corn borers were only scouted in Connecticut and Maine. Aphids were the primary insect pests and were identified in every state (Table 4). Scouting data by date, farm, and species are shown in Tables 5 and 6, and aphid and leaf hopper incidences are mapped in Figures 12 and 13.

Table 4. Arthropod presence by state, 2020.

State	Aphids	Corn Borer	Flea Beetles	Leaf Hoppers	Other
Connecticut	X	X	X	X	X
Maine	X	X		X	X
Massachusetts	X				X
New York	X		X		X
Vermont	X		X	X	X

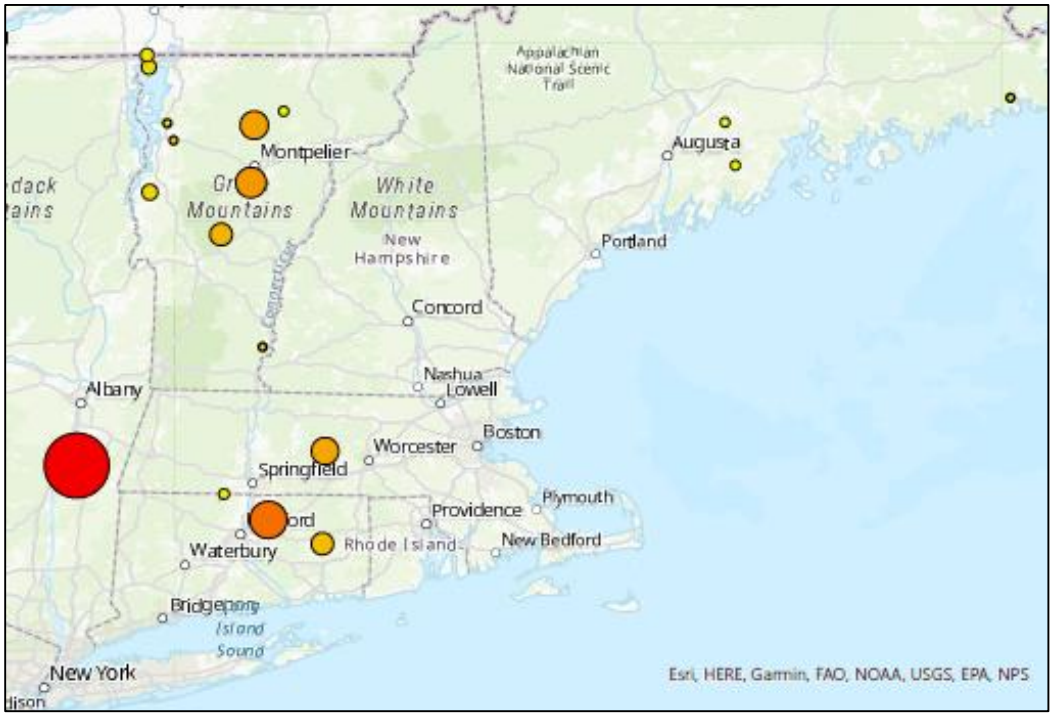

Figure 12. Aphid incidence, 2020. Average aphid incidence is represented by the size of the dot, which marks the farm location. The total incidence of all insects scouted is represented by the color of the marker.

Low total (all insect) incidence — High total (all insect) incidence

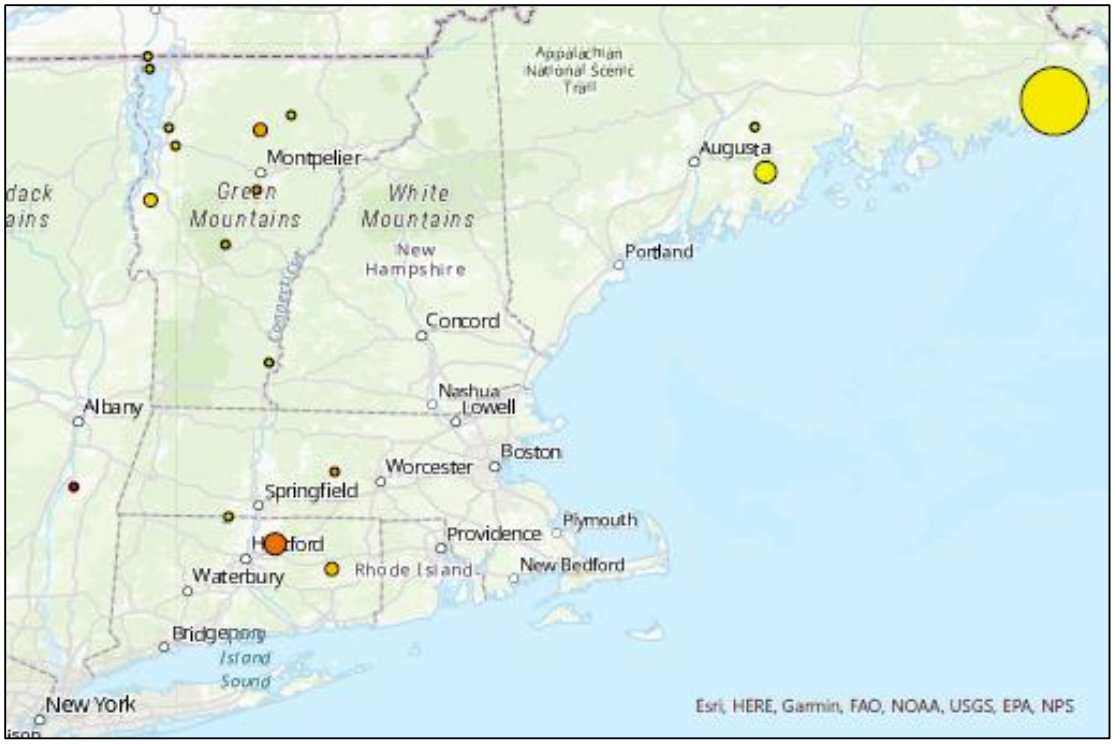

Figure 13. Leaf hopper incidence, 2020. Average leaf hopper incidence is represented by the size of the dot, which marks the farm location. The total incidence of all insects scouted is represented by the color of the marker.

Low total (all insect) incidence — High total (all insect) incidence

Table 5. Average number of arthropods per leaf, Connecticut, Maine, Massachusetts, & New York, 2020. Incidence and severity are for 5 leaves per plant on 15 plants per field.

			Flowering				Pre-harvest			
State	Town	Varieties	**Aphids**	**ECB**	**Flea Beetles**	**Leafhoppers**	**Aphids**	**ECB**	**Flea Beetles**	**Leafhoppers**
Connecticut	Vernon	Abacus	0.21	0	0.13	0.05	2.33	0.03	0.05	0
	Scotland	Boax, Cherry Wine, T1	0.49	0	0	0	0.71	0.01	0	0.01
Maine	Machias	Pasture Suvah Haze, White, Lifter, Electra	0	0	0	0	0.00	0	0	0.29
	Union	Stem Cell, Special Sauce, Pink Mistress, Von Baren	0.08	0.09	0	0.06	0	0	0	0
	Unity	Suva Haze, Lifter, Space Candy, Special Sauce, White, Abacus	0	0	0	0	0.07	0.01	0	0
Massachusetts	Southwick	CBG, Very Berry Cherry, hybrid	0	0	0	0	0.13	0	0	0
	New Braintree	Boax (Strawberry, Cherry)	0.24	0	0	0	1.41	0	0	0
New York	Hudson	Boax	0.01	0	0.01	0	5.00	0	0	0

Table 6. Average number of arthropods per leaf during two scouting periods , Vermont, 2020. Incidence and severity are for 5 leaves per plant on 15 plants per field.

Vermont		Flowering			Pre-harvest		
Location	Varieties	**Aphids**	**Flea Beetles**	**Leafhoppers**	**Aphids**	**Flea Beetles**	**Potato Leafhoppers**
Addison	Cat's Meow	0.03	0.03	0.01	0.59	0.00	0.00
Alburgh-1	Boax	0.00	0.00	0.00	0.40	0.01	0.00
Alburgh-2	White CBG	0.37	0.09	0.00	0.16	0.00	0.00
Berlin	Honolulu Haze, Suver Haze, Green Mountain Cherry	0.03	0.00	0.00	1.91	0.00	0.00
Colchester	White	0.00	0.09	0.00	0.00	0.00	0.00
Craftsbury	Lifter	0.00	0.00	0.00	0.09	0.00	0.00
Morrisville	Suvar Haze	0.03	0.00	0.01	1.72	0.00	0.00
Pittsfield	Lifter	0.15	0.19	0.00	1.07	0.00	0.00
Putney	Lifter, Electra, CBG, Suver Haze	0.00	0.29	0.00	0.00	0.00	0.00
Williston	Suver Haze, Special Sauce, White CBG	0.00	0.60	0.00	0.00	0.00	0.00

IPM (Integrated Pest Management)

A good IPM program starts with proper scouting and identification aligned with integrated approach to management to keep pest populations from causing significant yield and quality loss.

Regular scouting of hemp is a way to monitor pest populations and potential problems that may arise. Generally, scouting the underside of three leaves/plant in each variety is recommended weekly. Releasing non-invasive beneficial insects/natural enemies like ladybugs can be done to control pests. Trichogramma wasps, which can help control European corn borer populations, can be purchased as cards or eggs at an insectary or online, such as at arbico-organics.com and groworganic.com. Trichogramma wasps are parasites that lay their eggs inside European corn borer eggs, preventing them from hatching. They should be released when the moths are beginning to lay eggs, within a week of the start of the moth flight. Naturally occurring predators can also be promoted by planting adjacent flowering plants.

There are several cultural practices that can help to manage diseases including growing varieties with known tolerance or resistance to disease, proper crop rotation, adequate crop spacing to maximize airflow, and proper nutrient management. We also highly recommend buying “certified” seed when possible. Certified seed guarantees that the seed meets or exceeds a strict set of quality control standards. Weed management is especially important to improve airflow and assist with keeping the canopy as dry as possible. Weeds can also harbor diseases that may also impact the hemp crop. Trimming the lower branches of large hemp plants can also help with airflow and slow the spread of disease. Spores from many of the fungal diseases can survive in the soil for 3 to 5 years waiting for their host plant and/or ideal conditions. Crop rotation away from host crops and healthy soil are critical to minimizing diseases.

If you determine that a chemical control is necessary, currently there are few EPA-registered pesticide products labeled for use on hemp. Read and follow pesticide labels carefully. Be very aware that broad-spectrum insecticides kill natural predators and often lead to secondary outbreaks of other pests.

The most recent information about EPA approved pesticides for hemp can be found at: https://www.epa.gov/pesticide-registration/pesticide-products-registered-use-hemp

Policies from the Vermont Hemp Rules, including pesticide polices for the state, can be found at: https://agriculture.vermont.gov/public-health-agricultural-resource-management-division/hemp-program/hemp-resources-and-guidance

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