Guidelines for Pedigreed Seed Production of Hybrid Industrial Hemp and Feminized Hemp Seed Varieties

Definitions

Dioecious type: with male and female flowers on separate plants (natural state for hemp).

Monoecious type: with male and female flowers on the same plant (varieties developed with different ratios of male and female flowers on the same plant).

Feminized hemp seed (FHS) type: with only female plants and flowers (genetically female plants carrying only the XX chromosome where varieties are developed by the fertilization of flowers on a dioecious female plant with pollen from the same plant or another dioecious female plant that has been induced to produce pollen).

Hybrid: the first generation of a cross between two specified parent lines with different genotypes with one being the seed parent and the other the pollen parent.

Unisexual Female: a monoecious plant type with mainly female flowers and a severely reduced number of male flowers, used as a seed parent line.

Unisexual Hybrid: a monoecious "Hybrid" plant with mainly female flowers and a reduced number of male flowers.

Approved Cultivar: any variety of Industrial Hemp set out in the *List of Approved Cultivars*, published by the Government of Canada on its website, as amended from time to time, for administration of the Industrial Hemp Regulations (IHR). All production of Industrial Hemp crops in Canada is subject to license application approval by Health Canada.

Industrial Hemp: a cannabis plant – or any part of that plant – in which the concentration of THC is 0.3% or less in the flowering heads and leaves (as defined by the *Industrial Hemp Regulations* in Canada).

THC (delta-nine (Δ9) tetrahydrocannabinol): The chemical compound that is primarily responsible for the intoxicating effects of cannabis.

Hybrid Industrial Hemp

Hybrid hemp varieties can be generated by crossing two different parent lines with one being the seed parent and the other the pollen parent.

Seed Classes and Generations

The following classes and generations are utilized in the certification of hybrid hemp and parent lines.

Breeder:

- Produced in plots by or under supervision of a CSGA-Recognized Plant Breeder

Foundation:

- Produced in plots by or under the supervision of a CSGA-Recognized Plant Breeder or by a CSGA-Accredited Plot Grower

Certified class hybrid seed:

- Produced from Breeder or Foundation parents
- One generation sold to commercial producers and not eligible for further certification

Types of Parental Germplasm and Propagation Methods

There are several types of hybrid varieties, depending on the parental material used. **The F1 hybrid will be dioecious or monoecious depending on the pollen parent.**

Seed parent material may be:

1. FHS with only female plants and only female flowers.
2. Dioecious line where the male plants are rogued before the female plants flower.
3. Monoecious line with mainly female flowers and a severely reduced number of male flowers.

Pollen parent material may be:

1. Masculinized dioecious female.
2. Dioecious male line
3. Monecious line.

Parent material may be:

1. Clonal parental genotypes (clones) that are maintained through vegetative propagation. The plant breeder is responsible for the maintenance of this germplasm and must provide adequate information to positively identify each genotype.
2. Seed-derived parent material
3. Feminized hemp seed parent material

Eligibility for Certification

An application for determination of variety certification eligibility shall be made to the CSGA. It shall include a description of the hybrid and of its parent material. Distinguishing morphological, physiological, cytological, chemical, or other characteristics that establish the identity of the variety shall be provided. Supplemental molecular data supporting the identity of the variety may be submitted.

There shall be a comprehensive description of the protocols for maintaining the parent material and ensuring its stability.

FHS produced from a dioecious variety is not considered seed of the parental variety.

A sample of 200 seeds of both parents and 500 seeds of the hybrid shall be sent to the CFIA for variety verification purposes.

Land/Growth Facility Requirements

All types of hybrids can be produced in a contained growth facility (growth chamber or room, greenhouse, polyhouse) or in the field.

1. **Growth facility**
   Each room or chamber in a growth facility must only contain plants used in the production of Certified seed of the variety. Indoor seed crops of hybrid varieties must be protected from all potential sources of contaminating *Cannabis sativa* pollen from previous production within the same room or chamber. This may be achieved through an adequate time interval between successive crops, or by implementing alternative measures that effectively prevent residual pollen contamination. All protocols used must be thoroughly documented and available to CSGA or an authorized inspector upon request.

2. **Field production**
   Seed crops of hybrid varieties must not be planted on land which in the previous two years grew a crop of *Cannabis sativa*.

Crop Inspection

Seed parent and pollen parent plants need to be clearly identified.

It is the seed grower's responsibility to ensure that the seed crop is inspected twice by an authorized inspector, once just prior to any pollen release, and once when the pollination period is complete (all male flowers have shed their pollen).

Crop Standards

Isolation

All types of hybrid varieties, whether produced inside a growth facility or in a field, must maintain a minimum isolation distance from any sources of contaminating pollen as described below.

1. **Growth Facility**

   Indoor seed crops of hybrid varieties must be protected from all potential sources of contaminating *Cannabis sativa* pollen, including adjacent chambers, rooms, other growth facilities, and outdoor production. This may be achieved through adequate isolation or by implementing alternative measures that effectively prevent pollen contamination. All protocols used must be thoroughly documented and available to CSGA or an authorized inspector upon request.

2. **Field Production**

   All field production of a Certified hybrid must have an isolation distance of at least 1600 meters from contaminating *Cannabis sativa* pollen sources.

Maximum Impurity Standards

Plants not conforming to the norm of the variety may be considered off-types.

1. In the seed parent rows, no more than 10 pollen-shedding off-types and no more than 25 non–pollen-shedding off-types are permitted in 10,000 plants.
2. In the pollen parent rows, no more than 15 pollen-shedding off-types are permitted in 10,000 plants.
3. There is insufficient information currently available to determine with any certainty the appropriate levels of varietal purity for hybrid hemp varieties. Until adequate experience with this crop type is obtained, a crop certificate may be issued on the condition that the hybridity requirement is satisfied and that the number of off-types does not exceed 1.5 times the established maximum impurity standard (e.g., not more than 15 off-types/other varieties shedding pollen in the seed parent rows).

Hybridity Requirements

The percent hybrid seed shall be determined by a method developed by the plant breeder for the hybrid variety and approved by the CFIA.

1. Percent hybrid seed shall not be less than 80% for Hybrid Hemp. The balance of the seed should be parent line derivatives, resulting from incomplete hybridization in the seed field.
2. A declaration stating the actual percent hybrid seed of a representative sample of the Hybrid Hemp seed crop, and the method of determining the percent hybrid seed, must be submitted to the CSGA prior to a crop certificate being issued.

Additional Requirements

Applicants must declare that the parent material for the hybrid variety was produced within a CSGA-Recognized Plant Breeder's documented Quality Management System (QMS). The QMS protocols must address all elements related to maintaining the varietal purity of the parent material for hybrid production and be available to CSGA upon request.

Feminized Hemp Seed Varieties (including hybrid FHS)

Feminized hemp seeds (FHS) produce only female plants. They are generated by the fertilization of flowers on a dioecious female plant with pollen from the same plant or another female plant that has been induced to produce pollen ("masculinized").

Seed Classes and Generations

Only one class of pedigreed seed production, Certified, is recognized for FHS variety production.

Types of Parental Germplasm and Propagation Methods

There are several types of FHS varieties, depending on the parental material used.

Parent material may be (1) vegetative propagating material (cloned plants), (2) seed-derived dioecious female parent plants or (3) seed-derived feminized plants. In the case of non-FHS hybrids, male dioecious plants may serve as the pollen parent. Seed production protocols include maintenance of the parental germplasm and the procedures used to generate the Certified seed.

1. **Clonal parental genotypes**

   Clonal parental genotypes (clones) are maintained through vegetative propagation. The plant breeder is responsible for the maintenance of this germplasm and must provide adequate information to positively identify each genotype.

   Three mating designs are recognized:

   a. **Feminized single genotype**

      A single genotype is vegetatively propagated, some nodes are masculinized and the pollen from these flowers is used to fertilize the female flowers.

   b. **Feminized polycross**

      A number of genotypes are vegetatively propagated and then incorporated into a polycross, with an equal number of each parental genotype allowed to intercross with all other genotypes. A few nodes on each plant are masculinized. An equal quantity of seed from each parental genotype is bulked to ensure genetic stability. FHS varieties produced in this manner will be considered synthetic varieties.

   c. **Feminized hybrid**

      A parental genotype is vegetatively propagated, and one or more plants are masculinized. This genotype will be identified as the (male) pollen parent. Clones of a different, untreated genotype will be designated as the (female) seed parents. Seed is harvested from the clones of the non-masculinized (female only) genotype. An equal amount of seed from each seed parent is bulked to form the seed lot.

2. **Seed-derived parent material**

   Dioecious hemp varieties can be used as parent seed material for FHS varieties/hybrids. All males and any monoecious off-types must be removed prior to flowering. In the case of FHS varieties, a specified number of female plants of the same or another variety must be masculinized. In the case of a hybrid variety, male plants of another variety can be used as the pollen parent.

   The protocol for selecting plants to be used as pollen parents for FHS varieties must be stated in the variety description and adhered to in each seed production cycle to maintain

varietal stability. Protocols could include treating a defined portion of randomly selected plants (e.g. every tenth plant) or having separate rows of pollen and seed parents.

Parent material can be commercial hemp varieties or material used exclusively for FHS/hybrid production approved by the CSGA.

Only Breeder and Foundation seed can be used to produce FHS varieties/hybrids.

3. **Feminized parent material**

   Feminized seed can be used as parent reproductive material (pollen parent, where masculinized, and/or seed parent) for one generation if the first generation was certified by the CSGA as meeting Breeder or Foundation seed crop certification standards.

   The plant breeder must ensure that plants designated as pollen parents are chosen randomly and that no artificial selection is imposed when masculinizing those plants.

Eligibility for Certification

An application for determination of variety certification eligibility shall be made to the CSGA. It shall include a description of the FHS variety/hybrid and of its parent material. Distinguishing morphological, physiological, cytological, chemical, or other characteristics that establish the identity of the variety shall be provided. Supplemental molecular data supporting the identity of the variety may be submitted.

There shall be a comprehensive description of the protocols for maintaining the parent material and ensuring its stability.

FHS produced from a dioecious variety is not considered seed of the parental variety.

A sample of 500 seeds of the FHS variety/hybrid shall be sent to the CFIA for variety verification purposes.

Land/Growth Facility Requirements

All types of FHS varieties/hybrids can be produced in a contained growth facility (growth chamber or room, greenhouse, polyhouse) or in the field.

1. **Growth facility**
   Each room or chamber in a growth facility must only contain plants used in the production of Certified seed of the variety. Indoor seed crops of FHS varieties must be protected from all potential sources of contaminating *Cannabis sativa* pollen from previous production within the same room or chamber. This may be achieved through an adequate time interval between successive crops, or by implementing alternative measures that effectively prevent residual pollen contamination. All protocols used must be thoroughly documented and available to CSGA or an authorized inspector upon request.

2. **Field production**
   Seed crops of FHS varieties/hybrids must not be planted on land which in the previous three years grew a crop of *Cannabis sativa*.

Crop Inspection

For all types of FHS/hybrid production, it is the seed grower's responsibility to ensure that the crop is inspected twice by an authorized inspector, once just prior to any pollen release, and once when the pollination period is complete (all male flowers have shed their pollen).

Crop Standards

1. **Presence of male and monoecious plants**

   All true male (XY chromosomes) and monoecious plants must be removed from the parent material prior to the first inspection (prior to any pollen shed) for all FHS varieties. Monoecious or male dioecious plants may be pollen parents for a hybrid variety.

2. **Abnormal vegetative reproductive material**

   Any vegetative reproductive material which differs significantly in appearance from the average of the parental reproductive material, is likely a somaclonal variant ('sport') and must be removed prior to the first inspection (prior to any pollen shed).

3. **Off-types in seed derived parental material**

   Plants not conforming to the norm of the variety may be considered off-types. The maximum number of off-types permitted is 1 in 100 plants of the seed parent.

4. **Growth facility production**

   Indoor seed crops of FHS varieties must be protected from all potential sources of contaminating *Cannabis sativa* pollen, including adjacent chambers, rooms, other growth facilities, and outdoor production. This may be achieved through adequate isolation or by implementing alternative measures that effectively prevent pollen contamination. All protocols used must be thoroughly documented and available to CSGA or an authorized inspector upon request.

5. **Field production**

   All field production of Certified FHS/hybrids must have an isolation distance of at least 4800 m from any contaminating *Cannabis sativa* pollen sources.

Additional Requirements

1. **Quality Management System (QMS)**

   A CSGA-Recognized Plant Breeder's documented QMS is required for production of Certified seed of FHS varieties/hybrids. The QMS seed production protocols must address all the

certification requirements for FHS/hybrid production, be approved by the CSGA and audited by an independent third-party.

2. **Description of Variety**

   The variety description of any FHS variety is of the Certified generation.

   Plants of each candidate variety must be grown at three different locations or facilities for confirmation that the variety conforms to the variety description and is distinguishable, relatively uniform and stable. Results from these trials, conducted under the supervision of the plant breeder, must be submitted as part of the application for variety certification eligibility.

   a. The total potential THC (THC + THCA) level must be below 0.3% when plants of the FHS variety/hybrid are sampled three weeks prior to harvest. Refer to Health Canada's "Policy for the Management of Industrial Hemp Varieties on the List of Approved Cultivars" for growing, sampling, and testing requirements.

   b. Cannabinoid profiles and other chemo-typing may be submitted in support of the description of the FHS variety/hybrid.

3. **Seed Varietal Purity Standards**

   There is insufficient information currently available to determine with any certainty the appropriate levels of varietal purity for FHS and hybrid varieties. As FHS varieties are intended to be grown in the absence of pollen, any male plants are particularly undesirable. It may, however, be practically impossible to produce seed lots with no males and/or no monoecious plants. Until there is more detailed information the following will serve as guidelines:

   a. The maximum number of male (XY) individuals in a Certified seed lot of an FHS variety is 3/10,000 plants.

   b. The maximum number of monoecious (XX) individuals in a Certified seed lot of an FHS variety is 5/10,000 plants.

   c. The minimum varietal purity of a Certified seed lot of a hybrid variety is 97 percent.