Growing Hemp Grain/Seed between 16°-42° Latitude

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BEFORE YOU BEGIN

There are two types of Seed and/or Grain. Grain is the term used for production intended to go to food, meal and oil markets. Grain types are grown for their seed yield capacity and also there oil/seed profile. Seed types alternatively, are grown for re-propagation and re- use as planting seed stock. High yielding bio-mass fibre types are often low yielding in seed. This Hemp Seed Growers Guide does NOT consider the growing requirements for Hemp Fibre Production, as they are VERY different.

Growers thinking of Hemp grain/seed production should consider whether their enterprise is adequately suited to a late summer seed production crop, including having ready access to broad acre seed production equipment and handling systems. Access to suitable post harvest pre-cleaning, seed drying, cleaning and grading facility in the local area is also an important consideration.

It is a hardy, dioecious annual bast fibre plant. This means there are about 50:50% of either male or female only plants. It is also a spring/ summer /autumn growing crop, grown for fibre, seed, grain and oil in many countries around the world. There are over 2,000 landraces and varieties of hemp internationally, with European fibre varieties being the most commonly grown. Industrial hemp has low THC and is not marijuana. Fibre growing requires a mill to process the stems nearby, whereas hemp for seed and grain can literally be grown anywhere that is suitable.

HEMP Grain & Seed Production

Compared to hemp fibre crop production, the growing of hemp grain/seed is more similar to other oilseed crops. The crop grows for a longer time (approx 150 days), pest monitoring and control if necessary is important, time of maturity is critical to harvest and the key yield is in cleaned bagged grain.

Overall it is a hardy crop, and can be planted in spring, right through to Autumn, all depending on the variety and latitude it is being grown at. Usually it would need irrigation and is harvested from the end of summer, through into winter, again depending on variety and latitude it is grown at. This is very critical to get both these factors right.

SOILS

Hemp is tolerant of a wide variety of soil types, but grows best in well aerated, deep free draining soils, with a pH of 6 or greater, along with good moisture and nutrient holding capacity. **Hemp is extremely sensitive to flooding, water logging and soil compaction, therefore poorly drained or badly structured soils are not recommended**, as excess surface water and heavy rains can result in damage to the hemp crop.

LAND PREPRATION

A fine, firm, well-prepared flat seedbed is required for fast, uniform germination of hemp seed. Conventional seedbed preparation for small grain cropping situations is considered ideal. Zero-till and minimum till situations may be suitable for hemp grain as well, in certain soil types, where compaction is not a problem or where it is managed with controlled traffic farming systems.

PLANTING DATE WINDOWS

Planting time for hemp cropping requires careful consideration of variety used, local latitude and climatic conditions and crop purpose. Hemp is considered a summer-growing crop, and a "short day sensitive" plant, meaning flowering is initiated by the onset of shorter days in late summer to autumn. It does have the ability to be planted early in spring, with soil temperatures as low as 10 degrees Celsius. It therefore does have some frost tolerance as well, coming out of winter, for early plantings and going into autumn, with late flowering crops

Seed crop production of late maturing Fibre varieties only, are usually planted late, otherwise the crop grows too tall to harvest effectively for seed. For seed crops of subtropical varieties, usually mid-to-late summer plantings for 35°-25° and late planting in late summer-autumn for 25°-15° making the crop more conducive/shorter for ease of harvesting. Alternatively, seed grain varieties from 40°+, early-to-mid summer plantings are normally recommended. Seed crops planted in summer are ready to harvest 130 – 150 days after sowing, depending on climate, latitude, variety, planting date and distinct varietal, day length responsive flowering dates.

SOWING

The seed is medium sized and round, similar to a sorghum grain (35-55,000 seeds/kg) and should be planted through conventional seeders or air seeders, that enable the following sowing rates. Seed should be placed at 10 – 25 mm depth, with good seed - soil contact for best results. Seedlings will not emerge uniformly if the seed is placed at a depth greater than 30mm. The use of a roller/press wheel is recommended to ensure maximum seed -soil contact.. With adequate soil temperature (above 15^0 C.) and moisture, seedlings should emerge evenly within 4 – 7 days.

For grain and seed crops sowing rates are 25 – 35 kg per ha (all depending on sowing date, germination rate, establishment and seed size, of between 35-55,000 seeds per kg). The configuration of rows may be as close as 150mm (6") apart, or as wide as 800mm (32"), unlike fibre crops. Crop plant populations, are usually required between 60-80 plants/m2. Remember, that only 50% will be seed bearing female plants at harvest time.

There are a number of factors that make up the decision as to the number of plants per meter and row spacings. If the prepared land is relatively weed free, than wider spacings are possible, otherwise it is better to have a higher/closer density, to insure early canopy closure, which will restrict weed establishment and competition. Alternatively inter row cultivation can be used as a weed control tool, in wider row situations. It is best to seek the advice of a local Agronomist. Remember Hemp does not tiller very much, but can branch out later on only, at flowering time

MALES AND FEMALES

Seed planted can produce either male or female plants (there will be approximately 40-60% males to females in an even dioecious crop). Males flower first and continue flowering after the onset of female flowering (generally a few weeks after male flowering initiation). Thorough pollination (wind pollinated) is important for seed and grain production and provided there is good and even plant establishment, it would be adequate under natural conditions. Late sown crops, with potential cold weather problems during flowering, sometimes may need additional later sown seeds, to provide additional male pollen to late female flowering plants

Picture 2: Male flowers

Picture 1: Female flowers

CROP NUTRITION

Hemp grows best in a nutrient-rich, well-drained, well-structured, sandy, silty or clay loam soils, with good organic matter. Hemp is nitrophilic (loves nitrogen!) and can place high nutrient demands upon the soil. This is cheaply provided following rotations such as lucerne, pasture or legume crops. Organic based soil amendments such as Biosolids and animal manures are also worth consideration. Fibre crops that grow over 3m tall, in 3 months and produce over 10t/ha dry matter, require high N, (120-160kg/ha), P (50-70kg/ha) and K (60-80kg/ha), which has to be supplemented by fertilizer, if the soil tests do not match these crop requirements. Then in descending order: Ca, Mg, Si Bo, Zn and micronutrients.

Seed/grain crops, compared to fibre crops, extract less N, but more P and K from the soil. Therefore seed/grain crops should be fertilised with higher levels of P than fibre crops (70 - 80 kg/ha) and K (90-110 kg/ha), if soil tests suggest so. The nitrogen uptake is most intensive in the first four to eight weeks, while potassium and in particular phosphorous are needed more during flowering and seed formation. A soil test is recommended to assess nutrient levels and achieve optimum results. Much of the nutrients applied to crops are returned to the soil through residual leaf matter as shown in the following chart.

Table: Nutrient demand of a hemp 1 t/ha seed crop

Crop	**N (Kg/ha)**	**P_2O_5 (Kg/ha)**	**K_2O (Kg/ha)**
Hemp	100	70	110

IRRIGATION

It has been estimated, that up to four mega litres (4 ML) or 400mm of rain/soil moisture is required over the crop growth period (of about 110 days for seed/grain crops). 75% of this water is required in the first 90 days. This will vary according to soil type and depth, initial soil moisture content, soil water holding capacity, irrigation systems, temperatures reached and Evapo-transpiration rates. Hemp seedlings are susceptible to flood irrigation (**flood irrigation is not recommended for hemp cropping, only down furrows on raised beds or row crop**). Overhead spray irrigation (or high reliability rainfall areas) are the best method for application. Water or irrigation is critical in the first one to six weeks of growth, to enable even plant stands and growth for optimum vegetative growth. Final yield will be determined by calculating the last irrigation to allow maximum seed flowering and grain fill.

WEED CONTROL

In most cropping systems, hemp fibre production does not require any herbicides for weed control, due to their high populations and tall growth, shading and competing out most weeds. Seed production on the other hand, are thinner and shorter for grain harvest and do not provide the same natural tall weed control canopy, as fibre crops do. Field history and soil weed bank populations should be considered when planting seed crops. Limited chemical weed control options are available in hemp at present.
Ecofibre has some APVMA permits pending or under consideration for use presently. Pre-emergent residual weed control may be beneficial to crop establishment, especially in extreme weed burden circumstances and to reduce weed seeds in harvest sample. There are also some limited and potentially phototoxic post emergent weed control chemicals potentially available, but detailed knowledge is required for their specific use in hemp crop!

PEST CONTROL

Hemp enjoys a reputation as a pest-free "organic" crop. In reality, hemp is pest-tolerant and pests rarely cause economic damage in fibre crops that do not go to seed. However, hemp crops for seed, can be attacked, by a wide variety of insect pests, fungi and diseases, and careful crop monitoring is required throughout the crop growth cycle, especially towards grain fill and crop maturity.

Grain and seed crops are susceptible to a wide range of common broadacre pests and control may be required to maintain yield. **Insects** noted in hemp seed/grain crops to date include *Nezaria viridula* (Green veggie bug), *Helicoverpa spp.* (Heliothis) and, in some places, *Sminthuris viridis* (Lucerne Flea). Many insects that have been identified in irrigated and broad acre cropping systems can cause variable damage to hemp production. Careful monitoring of hemp pests is required now and in the future, especially in seed and grain production. Good crop rotations are also a precursor, to reduce such incidence of pest, fungi and disease attack.
Weed control is usually best achieved by early canopy closure in the crop stand. In seed and grain crops, insect populations can build up to levels of economic damage, especially in the flowering heads. These are best controlled by implementing a range of both IPM (Intergrated Pest Mgt) and specifically targeted chemical control strategies.

Diseases that have been identified in hemp crops to date include: *Fusarium spp.*, *Alternaria sp. Sclerotium rolfsii* and *Scerotinia sclerotiorum*, but none of these have been sufficient to warrant control programs. *Botrytis cinerea* and Powdery Mildew has been recorded as a significant disease of hemp a number of locations in the world.

Some pests and diseases recorded for hemp are listed in the table below.

Insect pests	Diseases
Nezaria viridula (Green veggie bug)	*Fusarium spp.*
Helicoverpa spp. (Heliothis)	*Alternaria spp*.
Sminthuris viridis (Lucerne flea) – reported in southern states only	*Sclerotium rolfsii* *Sclerotinia sclerotiorum*
	Botrytis cinerea (reported in seed crops in New Zealand)
	Meloidogyne spp. (Root knot nematode)
	Septoria cannabis (Yellow Leaf Spot)

Of the pests and diseases listed, only Heliothis in seed crops has caused damage requiring control.

Generally crops grown in late summer have less pest considerations as they bare seed during winter when the insect load is much lower than summer.

HARVESTING

Harvesting hemp crops is dependent on crop type and fibre end market.

Seed/Grain Cropping

Seed or grain industrial hemp matures usually four to six to eight weeks after the peak of male flowering as nitrogen and moisture reserves are depleting. Seed heads mature from the bottom up and the seed is mature once the seed coat has hardened and the surrounding bract has dried. It is advisable to monitor seed head maturing to the point where maturation has reached 60-70% and then the use of a desiccant.

Desiccating the crop will allow the remaining seeds to reach full maturity as well to assist with the drying away of green leaf material from the seed head and to assist with stalk drying. This process will result in ease of harvest and improve end seed sample, thus reducing potential damage to header parts, allowing even maturation, a clean stalk cut, reduced grading costs and allow ease of handling.

An early frost can also help by burning off the leaf. Generally the seed is well formed by this time and no frost damage is done to the seed/grain. The seed moisture content is critical at harvest time. 9% moisture content is recommended. Also a dry mild harvest day will also help cut the stalk. If harvest time can't be delayed for the prime conditions and the seed is slightly high in moisture the grower should organise to dry the seed immediately upon harvest. The immediate need for this can't be stressed enough. Leaving the grain in a bin overnight will do damage to the seed germination and viability.

To effectively harvest grain hemp, the use of modern natural flow rotary headers or those conventional headers with a Draper front conveyer system is highly recommended. The stalk flow is extremely important in relation to the entangling of the head and stalk material through the machine.

The use of conventional headers with a standard auger front system should be avoided as the flow of stalk material will be very uneven and will cause entangling before it reaches the feeder housing thus creating a balling effect when it reaches the drum. This creates the potential for the fibre to wrap around the drum creating tension on drives and will ultimately cause down time or terminal damage. The use of straw choppers should be avoided as additional moving parts only allows fibre to wrap around this mechanism and may cause terminal damage to the bearings and ultimately to the chopper itself.

Machine Set-up

Fan Speeds*:* To assist with a clean seed sample, fan speeds should be set on the minimum speed. The only way to gain a clear perspective is to adjust in-field and monitor the amount of foreign material (hurd / pith) material in the sample as well as the amount of grain going through the harvester and out onto the on the ground, and adjust accordingly.

Sieves: Sieves should be closed slightly more than that of harvesting conventional grain crops such as wheat, barley or sorghum, but open enough to ensure seed in the stalk material would be captured

whilst allowing broken hurd / pith material transferred out. Once again in-field set-up and monitoring of this process is very important in relation to end sample and un-recoverable grain. Different positions should be trialled and assessed to ensure maximum retained grain.

Drum and Concaves*:* Hemp seeds when fully mature thresh easily. The desired clearance between drum and concaves should almost be fully open, or around the 50mm range, by opening the concaves almost right open will also allow a good even flow of seed head stalk material through the machine. If the various settings are allowing too much seed to pass through onto the post harvested stalk/ground or the seed heads are not being threshed well enough then trial closing of the concaves may be an option or the adjustment of drum speed revised. Drum speed should be set around the 300-450rpm (slow), or as close as possible. Once again this in-field trial of opening and closing the distance between concaves and drum and drum speeds be in reflection of end sample and other machine set-up procedures.

Ground Speed*:* Ground speed is another important consideration in relation to the amount of material the header will thresh without entangling or wrapping. Ground speed should be adjusted accordingly to each crop, varieties harvested and evenness of maturity. Generally seed/grain crops require ground speeds around the 1-4km / hour, this again will be better established with in-field set-up and trial to gain best possible yield of grain.