Harvesting, Retting, and Fiber Separation

Harvesting and fiber processing differ depending on whether the crop is grown for high-quality textile fiber, for seed, or for fiber and seed. The Oregon study, *Feasibility of Industrial Hemp Production in the United States Pacific Northwest*, summarizes current information and research on hemp harvesting, retting, and fiber separation when the crop is grown for fiber (Ehrensing).

Harvesting

When grown for textile fiber, the crop is harvested when the fiber is at its highest quality. During World War II, tractor-drawn harvester-spreaders were used to cut hemp stems and lay them in windrows for field retting. After retting, a second machine was used to gather and tie the stems into bundles for pickup and delivery to the mill. A similar harvest system is still used in Europe, but with more modern, specialized equipment. Because these systems are designed to maintain the parallel alignment of hemp stems throughout harvest and processing in order to maximize the recovery of long textile fibers, the equipment has limited throughput capacity.

For seed, hemp is harvested when the seed is mature and ready for combining. When produced as a dual-purpose crop in countries such as France and Hungary, the seed is harvested near maturity with combines modified to cut high off the ground, and then the stems are harvested. The fiber from a dual-purpose crop is usually of lower quality and is often used in low-value applications such as pulp and paper. The 1998 crop in Canada was for dual production, and farmers found that the length and strength of hemp fibers were very rough on equipment during harvest (Gardner and White; Vantreese, 1998; Scheifele, 1999). In 1999, some Canadian farmers planted early flowering cultivars, which are shorter than traditional varieties and easier to combine (Baxter and Scheifele). The first Canadian-bred seed strain, which will be available next year in limited quantities, is also short (Hanks, Fall 1999).

Retting

If hemp or flax (linen) fibers are to be used in textiles and other high-quality applications, the bast fibers must be separated from the rest of the stalk. Retting is a microbial process that breaks the chemical bonds that hold the stem together and allows separation of the bast fibers from the woody core. The two traditional types of retting are field and water retting.

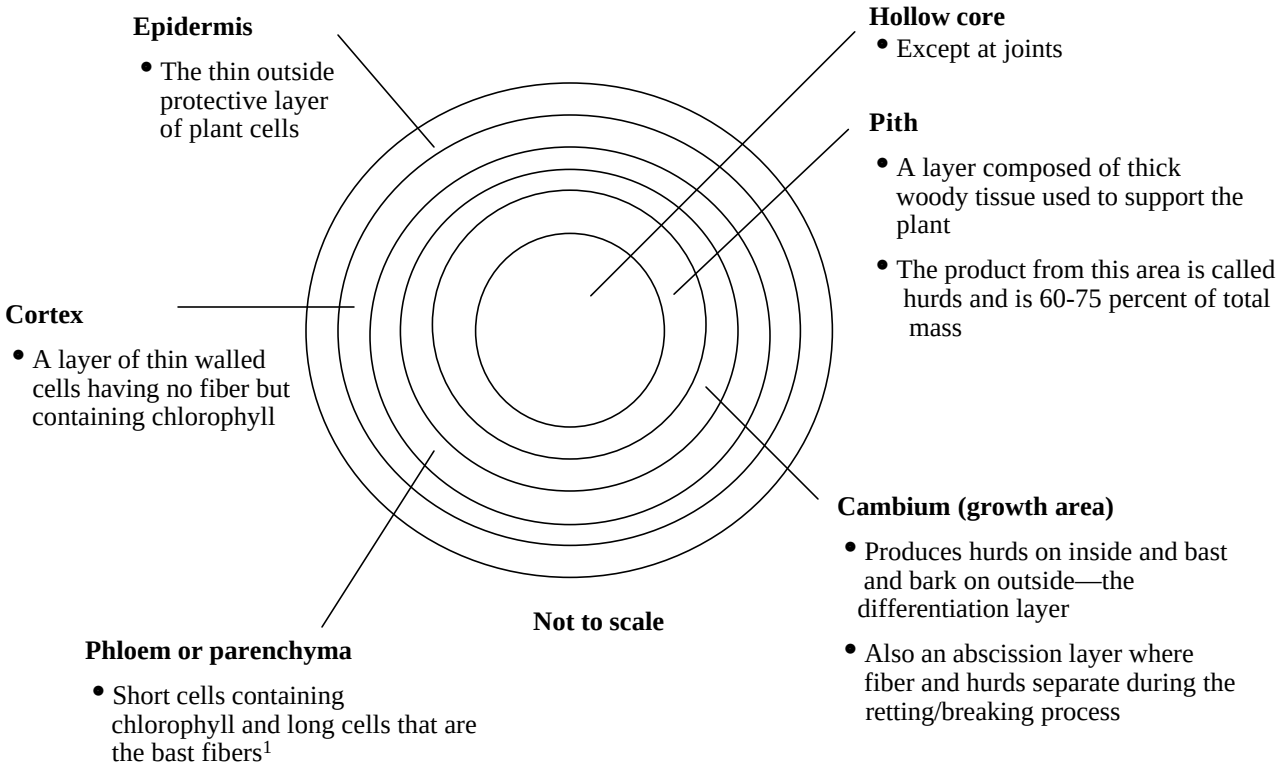
With field or dew retting, plant stems are cut or pulled up and left in the field to rot. Farmers monitor the process closely to ensure that the bast fibers separate from the inner core without much deterioration in quality. Moisture is needed for the microbial breakdown to occur, but then the weather must be dry enough for the stalks to dry for bailing. Although varying weather conditions affect the quality of fiber, field retting has been used extensively for hemp because it is inexpensive, mechanized, and does not use water.

Water retting produces more uniform and high-quality fiber, but the process is very labor- and capital-intensive. Stems are immersed in water (rivers, ponds, or tanks) and monitored frequently. Not only is this labor-intensive, farmers and/or workers must be knowledgeable about fiber quality. Also, the process uses large volumes of clean water that must be treated before being discharged. Water retting has been largely abandoned in countries where labor is expensive or environmental regulations exist. Most hemp fiber currently used in textiles is water retted in China or Hungary. Scientists speculate that improved microorganisms or direct use of enzymes may allow countries in Europe and North America to produce textile-quality bast fibers.

Fiber Separation

Once the stalks are retted, dried, and baled, they are brought to a central location for processing. With mechanical separation, in a process called breaking, stalks are passed between fluted rollers to crush and break the woody core into short pieces (called hurds), separating some of it from the bast fiber. The remaining hurds and fiber are separated in a process called scutching. Fiber bundles are gripped between rubber belts or chains and carried past revolving drums with projecting bars that beat the fiber bundles, separating the hurds and broken or short fibers (called tow) from the remaining long fiber (called line fiber). Fiber and hurds also can be separated with one machine called a decorticator (Kerr, 1998). Figure 3 presents a generalized schematic of plant and fiber yields, when grown

Figure 1. Cross section of a hemp stem



[1] Bast fibers are composed of primary bast fibers, which are long and low in lignin, and secondary bast fibers, which are intermediate in length and higher in lignin.

Source: Oliver and Joynt, p. 3.

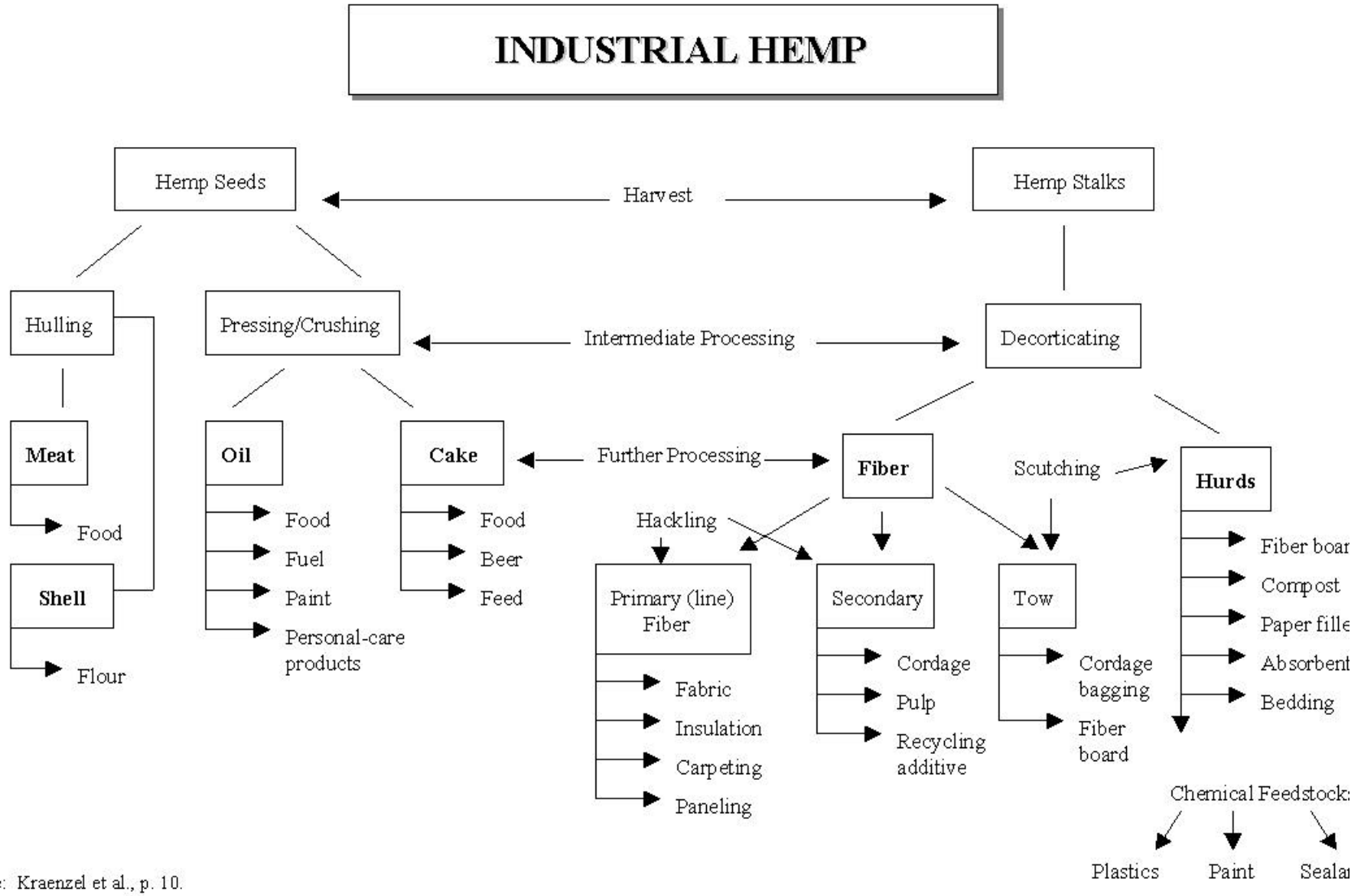
for high-quality textile fiber, from harvest through to fiber separation.

Although partially mechanized, these procedures are functionally identical to traditional hand methods of preparing hemp line fiber and tow for twisting into twine or rope or for spinning into yarn. Not only are these methods time consuming, they require skilled workers and considerable investment in capital equipment.

It is also possible to mechanically convert virtually all of the bast fiber directly into tow using flax breaking and tow processing machinery. This eliminates traditional scutching and allows processing of randomly oriented baled straw. Compared with scutching machinery, tow-processing equipment usually has higher throughput, requires fewer and less skilled workers, and costs less. However, a tow processing system cuts all of the bast fiber into short lengths, making it appropriate only for lower value uses, such as pulp and paper, instead of textiles.

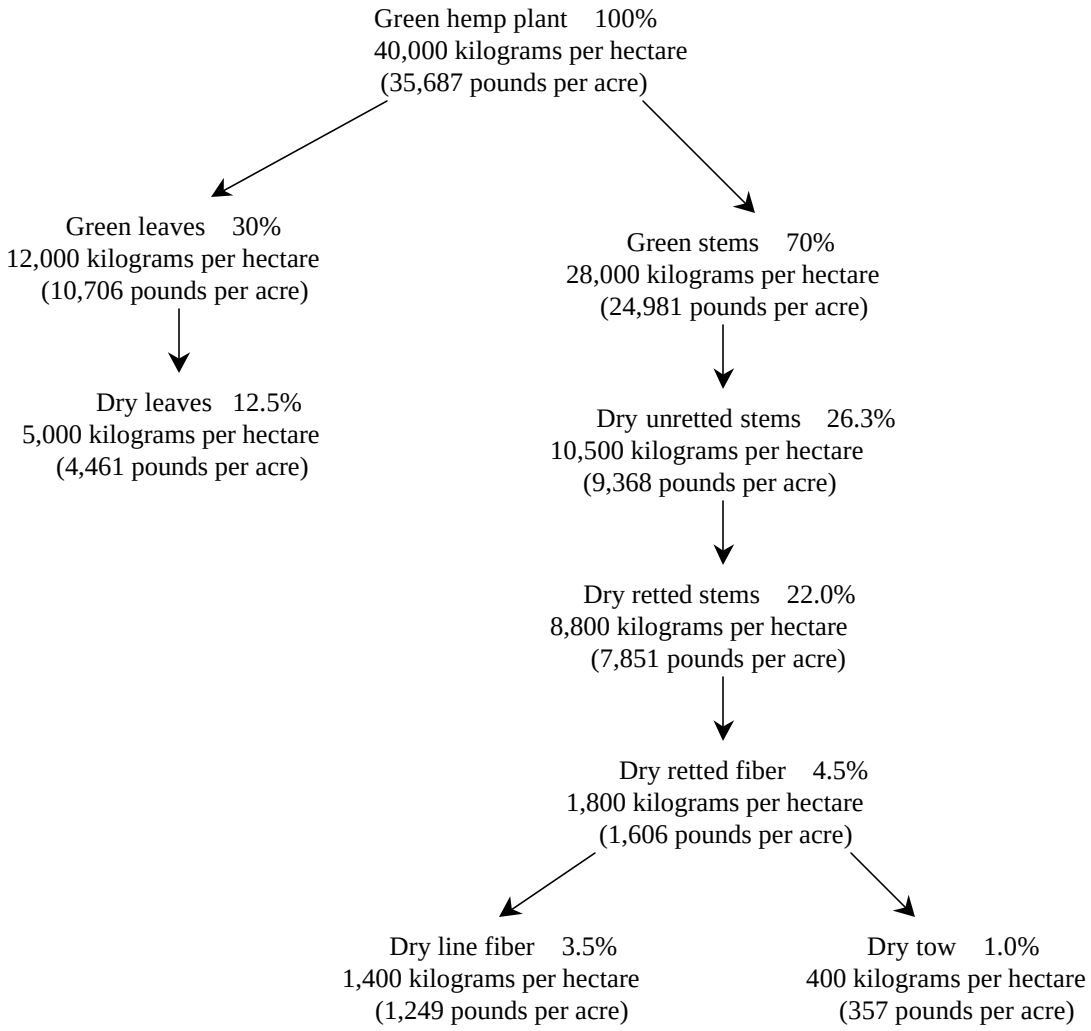
Research in Europe has sought methods for separating the bast fiber that bypass traditional retting and scutching. Steam explosion and ultrasound are under investigation in Germany, but the processes produce only short fiber. Neither technology has moved beyond laboratory or pilot scale trials. For hemp to be a viable fiber crop in the United States, modern hemp harvesting and processing methods would need to be developed.

Figure 2. Hemp products flowchart



Source: Kraenzel et al., p. 10.

Figure 3. A typical breakdown of the green- and dry-plant components of hemp grown for fiber



Note: Although these stem and fiber yields are from 1970, they illustrate how bast fibers are only a small portion of total crop yields.

Source: Dempsey, p. 82.