

Topic: ECONOMIC IMPORTANCE, FEATURES AND TECHNOLOGY OF HEMP GROWING.

Plan

1. Historical information and economic importance.
2. Morphological and ecological features.
3. Features of growing technology
4. Recognized varieties.

1. Historical information and economic importance.

People have discovered hemp in the Stone Age – about 10,000 years ago.

The first information about hemp was found in Indian annals for 900-800 B.C. In India, hemp was first grown as a medicinal plant and then as a textile crop. In China, hemp was cultivated for 500 years B.C. In Russia, hemp growing began in the ninth century, and in the sixteenth century hemp fiber began to be exported to other countries. In foreign countries, hemp is the most common in India and China, in Europe – in Italy, France, Yugoslavia, Hungary, Poland.

It can be said that hemp grew in almost every part of the globe, except for the most extreme places – the desert and permafrost regions. The plant was unpretentious, did not need care, and brought many benefits. The first paper, made in China, was made from hemp. Later, the first German Bible was printed on hemp paper and the first American constitution with the Declaration of Independence was written on it. Hemp was an indispensable companion to the Cowboys. The first jeans (Levi Strauss) and the best cowboy shirts were sewn from its fiber. Hemp has repeatedly saved sailors as the kilometers of strong ropes, cords and sailcloth were made of it. For a long time, Americans were obsessed with hemp. From 1629 to the Civil War, this plant became extremely popular, as it brought a lot of revenue to the country's budget. It is a known fact that two famous presidents George Washington and Thomas Jefferson began their political careers from hemp cultivation.

Hemp is an ancient cure for a number of diseases – cancer, disseminated sclerosis, glaucoma, epilepsy, asthma, depression and even AIDS. It anesthetizes, relieves allergic reactions, cleanses from slag, improves sleep and even prolongs life – when adding the hemp porridge to the diet, which resembles oatmeal. It improves digestion and cardiovascular activity of human. Tasty hemp oil was made from hemp. For many centuries hemp has dressed, treated and protected people. Since 1937 the world has been overtaken by “anti-smoking hysteria”. A real war was declared on this plant. The crops declined sharply.

What's the matter? The answer is simple. For most people, hemp is a known “grass” from which marijuana and hashish are obtained, although common hemp has a low narcotic content.

Thus, hemp is on the “black list” and is considered to be a “harmful substance with no pharmacological properties”. Most doctors who prescribe hemp for medicinal purposes violate the law. And the world production of hemp fiber is only 70 thousand tons per year (for comparison: the production of cotton is 20 million tons), although the demand for hemp raw materials has long exceed the offer.

Paper for textbooks was made from hemp till the end of the XIX century. Almost all the first Bibles, maps, charts, flags were also made from hemp.

The decline of this industry is attributed in particular to the **putting of hemp on a list of narcotic plants** (United Nations Single Convention on Narcotic Drugs 1961). France was the only country in Europe which declined to act so rashly. Making a bid for breeding technical varieties with a low content of drugs, the French have created a whole industry around this culture.

And Chinese scientists have very quickly determined that with their insane heat output (in fact, at the level of coal) 2 tons of hemp bonfire (the core of the stem) is equivalent to 1 cubic meter of natural gas. **Does that mean that hemp is the golden key to energy independence?** Or is it still the number one drug as it is considered by the Ukrainian government?

For reference: alcohol ranks the 5th place, tobacco – the 9th place, and marijuana (psychoactive substance from hemp) – only the 11th place in the list of harmful drugs. Despite this, alcohol and tobacco are legalized, and hemp is mercilessly prosecuted.

In accordance with the law, marijuana is the flowers, buds and leaves of hemp, that is, any part of the plant except the central stem. Stems that do not contain a gram of narcotic substance are used to obtain fibers. Hemp is even more promising than its eternal companion, the flax. It is much higher and faster in growth, and its yields are ten times bigger, it does not require chemicals in the process of cultivation and processing.

Hemp clothing is not only durable and comfortable but also useful. It repairs the nervous system, stabilizes the immune system and saves from allergies. Fortunately, modern designers have started working with such a fiber. In Italy, for example, at the initiative of the Armani Fashion House, the first 200 hectares near Bologna have been planted, construction of a complex for the production and processing of hemp fiber into yarn and fabrics has begun, that is, “the second coming of hemp” began.

In Russia, hemp growing began in the ninth century, and in the XVI century hemp fiber began to be exported to other countries. In foreign countries, hemp is the most common in India and China, in Europe – in Italy, France, Yugoslavia, Hungary, Poland.

In Ukraine, hemp is grown in Sumy, Chernihiv, Cherkasy, Poltava, Dnipropetrovsk, Mykolaiv regions. In recent years, hemp acreage in Ukraine has declined especially intensively, from 160,000 hectares in 1956 to 11,000 hectares in 1990, and now even smaller. The yield of hemp fiber, subject to the proper technology is 10-12 c/ha.

Hemp is grown for the production of fiber and oil. Dry stems of hemp contain 18-23% of fiber. Under long stay in water, hemp fiber is quite strong and resistant to decay. Nautical ropes and cords are produced from the long fiber, ropes, reaper-binder and packing twine, as well such coarse fabrics as tarpaulin, sailcloth, canvas, sackcloth etc are made from the short fiber.

Bonfire is used for the production of paper, heat insulation boards, hemp particle boards for furniture, cellulose, plastics, for fuel.

Hemp seeds contain 30-35% of quick-drying oil (iodine number 140-165). It is used in the paint industry and the production of oils and soaps. Hemp oil is a valuable food product, used for the manufacture of canned goods and confectionery.

Hemp oil meal is a valuable concentrated feed for cattle, especially the dairy cows. It contains 7-10% of fat and 25-30% of protein. A kilogram of oil meal is equivalent to 2.9 kg of oats or 3 kg of barley, 3.1 kg of corn, 15.3 kg of potatoes by its digestible protein.

2. Morphological and ecological features

Hemp belongs to the Cannabinaceae family, which combines three separate species: common hemp (*cannabis sativa*), grown for fiber and seeds, Indian hemp (*C. indica*), which leaves are synthesized for narcotic substance (hashish) for the needs of medicine, and ruderal hemp (*C. Ruderalis* Janisch), which grows in the fields of Siberia, Central Asia, the Volga region and as weeds contaminate the hemp crops.

Common hemp is first described by Dioscorides (the 60th year).

Indian hemp is a plant of hot climate and relatively short daylight hours. Despite its name, the plant is more widely distributed not in India but in Afghanistan and Pakistan, and, moreover, the Pakistani variety, unlike the Afghan one, does not have wide leaves. Indian hemp has a high psychotropic effect and is grown to produce drugs: bhang, marijuana, hashish and their derivatives. The cultivation of Indian hemp is banned in most countries.

Wild hemp was first described in China around 2800 B.C. The plant was brought to Russia by Scythians in the 5th century. The plant was of industrial importance from the 15th to the beginning of the 20th century. The Single UN Convention of 1961 included hemp in the list of drug-containing crops, but despite the prohibited rules, the damage from the effects of smoking hemp has not yet been detected, and the sale of hemp seeds remains legal worldwide.

In Ukraine, the common hemp has the production value.

Hemp is a dioecious plant. Hemp plants with male flowers are called staminate hemp and with female plants – pistillate hemp. The staminate hemp and pistillate hemp are distinguished by their morphological structure, biological and economic features.

Hemp is a cross-pollinated crop. Pollen is carried by the wind. The flowering of female plants begins faster. Thus, in the Central Russian hemp female plants begin to flower 2-3 days earlier than the male, in the southern - 5-10 and more days. Flowering lasts 25-30 days.

Also monoecious hemp is cultivated, in which there are separate inflorescences of male and female flowers on one plant. There are plants in which male and female flowers are placed in the same inflorescence of the staminate hemp and pistillate hemp. There are also hermaphroditic forms of plants with bisexual flowers.

The most valuable economic part of hemp is their fibrous stems – an important raw material for fiber production. The fiber is formed in the core particle of the stem in the form of bast fibre bundles, which form an outer ring (primary phloem), consisting of long elastic fibers up to 35-50 mm long, firmly glued together, and the inner ring (secondary lobe), consisting of short (4-10 mm long) and slightly elastic fibers, which by treated plant fibers processing, are suitable only for pieces.

The primary phloem is usually formed in the middle part and the secondary phloem in the lower part of the stem.

The productivity of hemp depends to a large extent on the plants' supply of heat, moisture, fertilizer element etc.

For germination of hemp seeds sufficient temperature of the sowing layer of soil is **1-3 °C**, and the seedlings are able to withstand spring frosts up to minus **5-6 °C**. Therefore, hemp is often sown in the early stages, when the soil temperature warms up to **5-7 °C**, and this promotes the formation of taller plants. But the maximum yield of seeds and fibers can be obtained by sowing hemp in the soil, heated at a depth of seed covering to **8-10° C**. The most favorable temperature during the growing season of hemp is 18-20°C. Increasing the air temperature to **25°C** during the flower-bud formation promotes intensive growth and development of plants.

Hemp is a moisture-demanding plant, its transpiration factor is 600-800-1200. The southern hemp is the least demanding of moisture (ecological-geographical group).

In order to obtain the highest quality fiber, hemp cultivation must occur in conditions of sufficient moisture and supply of nutrients throughout the growing season, especially from the beginning of budding to flowering of plants (during the period of intensive formation of bast fibre bundles with long fibers). Excessive soil moisture adversely affects the growth and development of hemp. The most favorable water regime for hemp is when the soil moisture during the growing season is 70-80% HB.

The fertility of hemp soils is quite demanding, especially in the presence in the soil of a sufficient number of mobile forms of nutrients, especially nitrogen and potassium during the growing season. Studies have shown that the Central Russian hemp, with the formation of 10 dt of fiber remove from the soil 120-150 kg of nitrogen, 35-40 kg of phosphorus and 80-90 kg of potassium. Soils with neutral reaction of soil solution (pH 7.1-7.4) are the most suitable for hemp

Thus, it is recommended to grow hemp on such soils as: lowland chernozem, dark gray podzolized and dried peaty with groundwater occurrence of 75-100 cm from the surface. Sod podzolic, heavy soil and light sandy soils are not suitable for growing hemp.

Hemp is a short daylight plant. At long daylight the development of the reproductive organs is delayed.

The growing season in the early ripening varieties of dioecious hemp is 116-123 days, the mid-ripening varieties is 132-140, the late ripening varieties - 152-160 days.

3. Features of growing technology

Hemp is grown in the main hemp crop rotations under which more fertile land is taken away.

The best preceding crop for hemp are the fertilized winter crops, sugar beets, potatoes, corn, leguminous crops for grain or green fertilizer. In irrigated lands, perennial legumes are the recommended preceding crop.

Special crop rotations are 4-7-field. For example: corn on silo - hemp - potatoes - hemp (4-field) or: corn on silo - hemp - hemp - winter wheat - hemp - sugar beets or potatoes - hemp (7-field).

Land rotation cultivation. After the stubble preceding crops, the basic land rotation consists in a single peeling of stubble to a depth (6-8 cm, and in the presence of root-shoot weeds – 10-12 cm in two directions). And a deep fall plowing is (25-27cm). If the preceding crop is corn it is cultivated with a heavy disc harrow to a depth of 10-12 cm

and plowed to 27-30 cm. After potatoes and sugar beets it is limited only to cultivation with a disk harrow of 10-12 cm.

In spring they close the moisture with the coulter harrows and carry out 1-2 pre-sowing cultivations with harrowing. After manure application they plow the fall-plowed land by 14-16 cm and firm with the star-wheeled rollers.

When growing hemp on drained peatlands, the spring disking for 10-12 cm is carried out instead of fall plowing as well as simultaneous harrowing and firming with rollers.

Fertilization. Hemp yield heavily depends on organic and mineral fertilizers. Such organic fertilizers as manure and compost are applied (on poor soils, after unfertilized preceding crops and in conditions of insufficient moisture – not less than 60 t/ha, and on more fertile and after fertilized predecessors – 30-40/ha, in southern areas – 20-25 t/ha. In Polissia, when growing hemp on peaty-podzolic soils, they plow lupine as a green fertilizer. On peaty-podzolic soils the liming on hydrolytic acidity is carried out.

The rates of mineral fertilizers for hemp depend on the preceding crops and soil characteristics. After legumes on chernozem – $\underline{N_{30}P_{45-60}K_{45-60}}$, on gray, dark gray podzolized soil - $\underline{N_{60}P_{60}K_{90-120}}$.

If the predecessors are the intertilled crops (corn, potatoes, sugar beets) or winter crops, then the nitrogen rate on medium fertile soils is increased to 90-120 kg/ha at the rate of phosphorus and potassium - 60-90 kg/ha. Hemp has the ability to absorb poorly soluble phosphorus compounds, so it is advisable to apply phosphorite meal on sod-podzolic soils.

Potassium and most of the phosphorus fertilizers (P_{10-15}) are applied into the fall-plowed land, while nitrogen - under the pre-sowing cultivation and also a part of the phosphorus fertilizers are applied into the rows during sowing.

In the cultivation of hemp after non-fertilized preceding crops, especially on fertile soils, the recommended application rate is 30-40 t/ha of manure or compost and complete mineral fertilizer $\underline{N_{90}P_{60-90}K_{60-90}}$.

On the previously cultivated peat soils, the copper sulphate (20-25 t/ha) or pyritic cinders (3-5 kg/ha) is applied once every four to five years and phosphorus-potassium fertilizers with high potassium standards - $\underline{P_{60}K_{150-180}}$.

Hemp is a culture of early sowing. It is necessary to sow it after early cereals, when the soil at a depth of seed covering warms up to 8-10°C.

Seed covering depth is 3-4 cm and by insufficient humidity of the topsoil – 4-5 cm.

When growing hemp for fiber (greens) the main method of sowing is a close drilling with a row spacing of 7.5 cm and ordinary drilling with row spacing of 15 cm. The grain drills C3Y-3,6, C3-3,6, flax drills C3JI-3, 6 and other modern solid planting drills are used for sowing. **The seeding rate is 4.5–5.0 mln.pcs./ha of similar seeds, which is 80–100 kg of seeds per hectare.**

For the control of annual gramineous weeds and dicotyledonous weeds before sowing with pre-seeding treatment, or 3-4 days after sowing with pre-emergence harrowing, such herbicides as **dual (2–4 l/ha)** or **lenacil (1,2–1.5 kg/ha)** or their tank mixture (**dual 2 l/ha + lenacil 1kg/ha**) are applied.

Crop care

Depending on weather conditions, soil condition and sowing, soil care includes the following technological operations:

- soil compaction after sowing in case of insufficient humidity;
- pre-emergence harrowing with medium or light harrows, 3-4 days after sowing, which reduces weeds by 30-60%;
- use of soil spiker or rotary harrow to destroy the soil crust during the emergence of seedlings;
- post-harvest harrowing with medium or light harrows at speeds up to 3 km/h leads to a slight decrease of the plant stand density (up to 10%), which must be compensated by increasing the seeding rate;
- to eliminate weeds and improve the water-air condition of soil, two or three bursting of row spacing to a depth of 5-6 and 7-8 cm are made on wide-row sowings;
- Control of annual grass weeds and quick grass by spraying crops in the stage of two or three pairs of hemp leaves with one of the herbicides: **Pantera (1.0–1.8 l/ha)**, **Miura (0.8–1.2 l/ha)**, **Targa Super (1.5-3.0 l/ha)**. The higher doses are used against perennial weeds.
- edge or overall spraying of seedlings in the control of hop flea beetle by one of the insecticides: **Decis, 2.5% c.u. (0.3 kg/ha)**, **Bazudin, 60% c.u. (1.7 kg/ha)**, **Fozalone, 35% c.u. (1.5–2.0 kg/ha)**, **metaphos, 40% c.u. (0.6–1.0 kg/ha)**;
- edge spraying of crops with one of the above preparations with air sprayer in the period of flowering against the European corn borer.

Hemp seed growing

The most widespread hemp varieties, included in the Register of Plant Varieties of Ukraine, are: YUSO 31, Zolotoniski Monoecious 11 and Zolotoniski 15.

The elite seeds and the first reproduction of these varieties are grown by the Institute of Fiber Crops of the UAAS and its regional department in Zolotonosha. Hemp farms.

Conditions for hemp cultivation in Ukraine

Modern hemp breeding varieties listed in the Register of Plant Varieties of Ukraine contain 0.03-0.06% of the narcotic-active substance tetrahydrocannabinol (THC), with the permissible content according to the legislation of Ukraine 0.15% and according to the legislation of the EU countries - 0, 20%. However, the current legislation of Ukraine provides for the following conditions of hemp cultivation:

- the farm has the right to grow hemp only with a License issued by the Ministry of Agrarian Policy of Ukraine for a period of 3 years;
- annually the farm has to receive the approval of the Department for Combating Drug Trafficking of the Regional Directorate of the Ministry of Internal Affairs of Ukraine.
- to propagate the seeds to the second reproduction, which can be used to sow for greens or to produce commercial seeds.

Harvest. To produce fiber and seeds the monoecious, for greens, (i.e. fiber), and mono- and dioecious hemp varieties are sown. The harvesting begins when the plants reach 60-75% of seeds. Harvesting is conducted in a separable way - with the use of

reaper binders ZhKK - 2,1 and then threshing the seeds in a stationary environment or in the field with the hemp threshers MLK -4,5 in a mobile way, and the final stage of harvesting is the use of the hemp harvesting machine KKP-1,8. 5-6 days before harvesting, the **desiccation** is carried out, for this hemp is sprayed with magnesium chlorate solution up to 25 kg/ha.

They begin to harvest hemp for greens at the beginning of mass flowering of male flowers and end with their defloration. The hemp harvesters, reaper binders and hemp thresher for plants combing are used. If hemp is harvested for seeds, immediately after threshing it is necessary to thoroughly clean the seeds on grain-cleaning machines and, if necessary, dry them in a grain dryer. Humidity is adjusted to 11-13%.

Hemp, which is harvested for greens, immediately after mowing, is sorted by length, thickness and color, and then separately sent for soaking in special ponds to obtain the hemp straw. The duration of soaking depends on the water temperature. By summer soaking, when the water temperature is 18-20 °C, soaking is completed in 7-8 days, and by autumn soaking in cool water (10-12°C) it lasts 15-18 days.

At the end of wetting, the bast fibre bundles are easily separated from the bonfire. If the soaking process is delayed, it will cause the bundles to be broken down into separate fibers and a sharp deterioration of the long fiber quality.

The fiber is produced in farms or processing plants.

4. Recognized varieties in Ukraine: Glukhivski 33, Glukhivski 46, Glera, Gliana, Dniprovski monoecious 11, Zolotoniski 15, Zoriana, YUSO 14, YUSO 31.