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CONSIDERATIONS ON HEMP CULTIVATION TECHNOLOGY

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Abstract: The paper presents some aspects regarding the technology of hemp cultivation (or *Canabis Sativa* as its specialty designation), this plant having the greatest capacity of industrialization among all the technical plants: nothing is thrown away, everything is capitalized and the products obtained are of an outstanding variety, starting from the ordinary rope until the medicinal or cosmetic substances, vehicles or construction materials.
Keywords: technology, hemp, fiber, seed

INTRODUCTION

Hemp (*Cannabis sativa*) is an annual herbaceous plant belonging to Cannabaceae family; it is of 2–3 m tall being able to reach up 5 m, exceptionally. Its stem is unbranched and it has long lanceolate leaves with toothed edges and dense, semi compact inflorescences. (Figure1).

Figure 1 – Hemp for spinning [5]

Hemp cultivation history is very old, being remembered since early neolithic (12,000 years ago) as a source of obtaining textile fibers, oil, food, but also as the environment where ancestral religious practices were developed or as medicinal herb. Each part of hemp has a different use and is processed according to it.

Term of cannabis, from which the Romanian word "cânepă" comes, has its origins in a Scythian or Thracian word. Greeks imported it first and afterwards Romanians and, thus it was known by Occidental civilizations. The word is very old having Indo–European roots. Ancient Oriental people (Acadiens, Babylonians and Assyrians) also knew the word as qunnabu. The original meaning was the smoky, demonstrating the ancestral habit of using the plant in recreational and practical goals.

Traditionally, the hemp was the raw material for obtaining oil, wax, resin, rope and cord, textile fibers for clothing and rough fibers for sacks and knitting, animal foddering and vegetal fuel (Figure 2). At those above, the industrial processing ads the cellulose, from which paper, chipboards for furniture industry, artificial silk, insulating down for plasterboards, can be obtained.

Figure 2 – Hemp traditional harvesting [6], [8]

Hemp is one of the oldest plants cultivated in Romania (over 2000 years), being mainly used for fibers designed to clothes. Hemp stems coming from local growing and wild hemp contain 10–12% fibers, and improved varieties– 26–32%. Fiber content within stems is influenced by each variety, technological and soil and climate conditions. Fibers have a series of valuable characteristics related to resistance (to traction, torsion, friction, rotting process), extension capacity (elastic and plastic), spining capacity, bigger length than fibers of sisal, jute, manila or cotton, that make them useful in various domains: textile industry, manufacturing industry, vehicle industry (Tabara, 2009).

MATERIAL AND METHOD

Hemp requires a gentle and humid climate (corn area). Seeds germinate at 2–3 °C, but a uniform springing is performed at over 8 °C. In optimum conditions, when soil temperature is of 8–10 °C, hemp germinates after 7–9 days, and at 20–24°C the germination takes place after 5–7 days, depending on soil humidity. A great attention should be given to groundwater depth, which must be at

least below 1m, because puddles can damage the crop. Excessive weeds in areas where hemp is cultivated can also risk to stifle the springing plants. That is why, the weeds should be destroyed by any means immediately after the harvest of plant, insisting on doing so up to the preparation of germinating bed. Weeds like creeping thistle (*Cirsium arvense*), couch grass (*Agropyron repens*), vilfa stellata (*Cynodon dactylon*) or Johnson grass (*Sorghum halepense*) and lamb's quarters (*Chenopodium album*), are difficult to control.
The best precursor crops are vegetables and then, straw cereals. Hemp may be cultivated after beet or potato crops, but the fertilization doses will be increased by 15–25%, because the soil remains deprived of nutrients. At its turn, the hemp is a good precursor culture for most of crop plants, as it leaves the soil structured, deases and pests free. The growing rhythm of fiber hemp is rapid and it enables the weeds destroying, thus reducing the stock of weeds in the soil. The fiber hemp or seed hemp cultures are good precursors for autumn cereals and autumn fodder crops (alfalfa, rape, fodder, cereals) as they clear the field in August and early September and soil works can be appropriately performed. Furthermore, the hemp powerful swiveled root extends deeply into soil, mobilizing the nutritive elements and giving increased resistance to draught. Maize should not be used as precursor crop, as the same pests attack hemp, namely European corn borer (*Ostrinia nubilalis*), foddering plants after which the vegetal debris remain and the field is infested by wireworms (*Agriotes sp.*) , sunflower, that has commum deseases and pests as hemp, like white mold (*Sclerotinia sclerotiorum*) and broom–rape (*Orobanche sp.*). Although, in the opinion of certain authors, the hemp behaves very well as single crop and it is preferable not to be cultivated in the same field and neither in neighbouring ones for avoiding to be attacked by hemp moth (*Grapholitha delineana*), that produces important damages, in certain years up to 25–30%.
Hemp is a pretentious plant concerning the soil content in nutritive substances. The main fertilizer appropriate to ecological hemp is the manure. 30–40 t/ha of fermented manure will be applied in heavy and cold soils like black soil, excessive watering soil or brown soil. Better results are obtained when the manure is applied to precursor plants in a quantity of 40–50 t/ha. The manure should be combined with 40–60 kg/ha P2O5. Manure and phosphatic fertilizers will be performed in summer or autumn, along with the basic plower. Organic fertilizers should be compulsory applied in surfaces destined to ecological hemp cultivation. Phosphorus fertilizers applied to hemp for seed mostly compensate the unfavourable action of chemical fertilizers with nitrogen and potassium and positively influence the stem anatomical parts and seed formation, thus increasing the oil content and production. Phosphorus fertilizers are applied in quantities of 40–60 kg/ha s.a., during autumn or before preparing the germinating bed as complex fertilizers.
Generally, Romanian soils are well supplied with potassium. Potassium fertilizers applying is necessary to be done on soils having below 15 mg K2O/100 g , when it is compulsory to apply 40–60 kg/ha K2O. In the fields fertilized in previous years with organic fertilizers, the potassium fertilizers are not more necessary. Potassium is applied in autumn, before the basic plowing or in spring as complex fertilizers. Nitrogen fertilizers act on the general development of plants enabling the stems and seeds growing. The doses of nitrogen fertilizers applied are of 120–150 kg/ha s.a. depending on each zone, soil type and precursor plant. After vegetables, the nitrogen quantity should be reduced approximately by 20 kg/ha s.a., and in case of precursor plants with large consumption of nutritive substances (beet, corn, potato), the quantity is increased by 20 kg/ha s.a.
The nitrogen fertilizers are applied in spring, before preparing the germinating bed, but they can be also applied as little fractions, in a percentage of 15–20% out of total dose when the seed hemp mechanical hoeing is performed. When complex fertilizers (rich in nitrogen) were not applied in autumn, then complex fertilizers should be applied in spring when preparing the germinating bed. The nitrogen dose is completed by an additional share to the necessary one, previously planned. A great attention should be given to uniformity of fertilizers spreading, that, if it is not appropriate, can determine a non–uniformity of plants growing and development and, implicitly a worse quality and diminished production (Brian, Mahmoud, 2016; Tabara, 2005,2009).

RESULTS

— Sowing

Hemp seed must have a minimum purity of 96 % (without broom–rape seeds) and minimum germinating capacity of 80 % (positive production increments are obtained when the germinating is over 90 %). The seed from previous year should be used. Seed material is treated with fungicides (Criptodin 3kg/t). Sowing is performed when at 5–6 cm soil depth, the temperature has stabilized at +8…+9°C (practically before the corn sowing). In case of early sowing, the plants endure low temperatures, so their growing is slowed down and they do not reach the normal height and damages determined by fleas are bigger. When sowing is delayed, the moth can attack, the growing time is shortened and plants prematurely blossom. When the sowing period is failed, the stems and fiber production are diminished. The most appropriate distance between rows is of 12.5 cm. The sowing machine used is SUP–17. Sowing depth is 3–4 cm. In lighter soils or during draught spring, it can reach 5 – 6 cm. After sowing, the harrowing is performed for making rows less visible, thus limiting the damages produced by crows, pigeons, etc.

— Crop preparation works

In medium well-structured soils and for an ideal preparation of soil (lack of weeds), hemp can be viable without any other preparation works. Though, there are cases when crops should undergo maintaining measures. If sowing is performed in loosen field or during draught spring, an immediate rolling should be performed after the sowing. When crust appears during the sowing till springing, then the harrows or ridged rollers should be used. After springing, the perennial weeds with vegetative multiplication (thistle, milk thistle, etc.) are controlled by weeding. Fleas control is performed during the springing time or by applying Lindatox. The hemp moth (*Grapholita delineana*), is controlled not only by rational crop rotation, but also by chemical treatments with Decis or Sumithion. One warning treatment and other two subsequent ones, at 12–15 days, are made, [2,3].
Like any other plant, hemp has the male and the female part. It is very important to determine in field which part is the male and which the

female in order to remove the male part from the crop, because pollination is not recommended. After being pollinated the plant has no more grains. A charge of maximum maxim 2% male per hectare is allowed. Male parts are manually removed. Differences between male and female parts:

male plant is higher;
has bigger inflorescence;
flowers are white;
flowers appear more rapidly at males than at females, [2, 3, 9].

Figure 3 – Hemp: 1,2–male hemp (of summer) ;
3,4–female hemp (of autumn) [2,3,9]

Hemp comprises three parts that can be used:

Seeds can be used to prepare different food, oils and medicinal products.
Fibers have all sorts of industrial uses (starting from clothing till vehicles) – they form the middle layer of the stem and are covered by a thin protective layer.
Woody core remained after extracting the fibers, represents the part (together with lime) used in constructions (although we have found information according to which it is possible to use the whole stem in buildings – meaning that fibers and woody core should not be separated).

— Harvesting

Harvesting is made during two phases both for fiber hemp and seed hemp. For fiber hemp, first, the plants are cut and left in field to dry and in the second phase the leaves are shaken and plants are tied up in bunches of 20–25 cm diameter, that are transported to retting processing plants. For seed hemp, the plants are cut and left to dry for 7–8 days. Threshing of inflorescences is performed with the cereal combine. Threshed seeds are immediately cleaned, conditioned and dried. [11]

Knitting hemp is harvested at the end of blossoming of male plants, when the pollen does not shaken any more. Premature harvesting diminishes the fiber productions as well as plant technological characteristics (mostly its resistance) that are lower. Harvesting delay is also very harmful. The most important losses are determined by stems damaging.

At the same time, fiber is less fine, becomes rough and breakable. In certain areas, hemp is manually harvested. Stems are cut at 4–6 cm height by sickle or special hooks, left on soil as bunches of 15–20 cm thickness, spread to dry.

When the upper part is getting yellow, the hemp bunches are reversed on their other part and dried for more 2–3 days (totally, drying lasts till 4–8 days). After that, the leaves are shaken (leaves should be removed, because chlorophyll depreciates the hemp fiber by staining during retting process and retting processing plants do not receive stems with leaves) and bunches are bound twice if they surpass 100 cm and once, if they are short. [7]

Figure 4 – Hemp harvesting machine, [14]

Mechanized harvesting is performed with special machines. The cut stems are left on soil as a thin layer (approximately perpendicular on machine forward direction). After having dried, the process is similar to manual harvesting, namely: leaves shaking and binding as bunches. Productivity of machines for this procedure without binding device is of 4–5 hectares/shift. In order to use special machines with binding device, the hemp leaves should be removed. Generally, there are recommended the treatments of 100–150 liters of solution per hectare, made by air means spraying. Treatments are performed in the morning up to 10 a.m. or in the evening after 5 p.m. The treatment is done when the leaves and male stems become green–yellowish (10–15 days since the beginning of pollen shaking, namely 10–12 days before harvesting or the blossoming period end). The moment is also chosen in accordance with weather report, as rains over 5 mm that appear in the first 4–6 hours after the treatment could impede the efficacity of products used. It is also to be noticed that the treatment delay till chrolophyll degradation does not ensure the defoliation.

Premature treatment, when male plant leaves are green, may depreciate the fiber, and production is reduced. When treatments are appropriately performed, the defoliation lasts 10–12 days, usually in a percentage of 90–100%. In some cases, magnesium chlorite may be also used for defoliation, 15–17 kg/ha in 200 de l of water, that produces drying and leaves removing within 5–6 days. After the defoliation, the machines directly harvest in bound bunches, that are put in hoods for being dried, and machine productity in this case is of 1.5 Ha/shift.

Figure 5 – Combine of harvesting hemp seeds, stems and leaves [2,3]

HempFlax, a Dutch company established since 1994, is designing, developing and patententing equipment specialized in hemp cultivation, offering an innovating combine able to perform three different harvesting operations at the same time, namely hemp seeds, stems and leaves harvesting. [2,3]

CONCLUSIONS

Hemp is one of the oldest plants cultivated in our country (over 2000 years), being mainly used for fibers in clothing industry. Hemp stems coming from local growing and wild hemp contain 10–12% fibers, and improved varieties– 26–32%. Fiber content within stems is influenced by each variety, technological and soil and climate conditions. Fibers have a series of valuable characteristics related to resistance (to traction, torsion, friction, rotten process), extension capacity (elastic and plastic), spinning capacity, bigger length than fibers of sisal, jute, manila or cotton, that make them useful in various domains: textile industry, manufacturing industry, vehicle industry. [3].

Hemp is another agricultural plant that is cultivated either for fibers, or in mixed purposes, for fibers and seeds. Seed contains 32–35% oil. Hemp long fibers resistant to water action are used to manufacture strong and durable fabrics. The hemp oil is edible and is used in industry. The cakes resulted after extracting the oil, being rich in fats and proteic substances are used as concentrate products to farm animals foddering. The multiple materials resulted after the primary processing of stems are used for heating the plastic greenhouses.

The oldest proof attesting the hemp utilization is a piece of fabric discovered in Mesopotamia, 10,000 years ago. The oldest paper of hemp fiber registered comes from China, 2 millennia ago. The first Diesel engine has been designed to use vegetal oils mostly based on hemp. This is a non–toxic and bio–degradable bio–oil for Diesel engines. In 1930, Henry Ford has produced a car manufactured in a percentage of 70% from hemp (as raw material used). Great artists (Rembrandt, Van Gogh, Gainsborough) paintings have been made on hemp canvas, using water colours extracted also from hemp.

Until 1989, Romania owned the first place in Europe as regarding hemp crop–cultivating 56–70% out of total production and the fourth place in the world (45,000 ha), but in 1994 it reached only 800 ha. The hemp crop advantages and the outstanding characteristics of its fiber make necessary to revive this interesting domain.

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Note:

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