

Cold - resistance of hemp (*Cannabis Sativa L.*)

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Introduction

The history of hemp cultivation in Russia gives the evidence that low positive temperature is not a limiting factor for this crop cultivation. The main cultivation areas were in Central Russia. But in the North of the country hemp has been cultivated near the Northern Border of Agriculture (66° N, approx.): from Arkhangelsk the northern limit of hemp-cultivation was extended to Mezen, then reached Pechora River (Ust-Tsilma), to Tobolsk Province, Surgut (61° 17'N). Hemp has been cultivated on the Kolyma River (Verhnekolymsk- 65° N, 153° E) [5]. Thus, it's possible to discover cold-resistant, early-maturing landraces, well-adapted to severe cold climate with low temperatures in spring-time and short summer within the *Cannabis sativa* species, which are extremely desirable for breeding.

In contrast to many crops, seeds of hemp could germinate under condition of +1° - +2° C. It's reported [4], that under periodically changing temperatures seeds of hemp could germinate faster, in contrast to conditions of constant temperatures. Germinated seeds can withstand frosts up to -5°, -1° C for a period of two weeks, and up to -15° C for 24 hours without damage, but the frost of -5° C during the period of initial growth of young roots and hypocotyl has a depressing influence. Extremely negative influence of low temperatures on germination was registered under conditions of high humidity of soil. Plants in stage from seedlings up to budding easily tolerate frosts about -7° C. But, by the stage of flowering and later low extended temperatures delay the growth of hemp, and easy frost stop it.

The necessity of topic

The necessity in traits of earliness and tolerance to low temperatures in spring time for hemp is obvious. Maturing of main cultivars is relatively late in Central Russia. It leads to big losses of fiber and seeds yield because of wet and cold weather in September-October. In Central Russia, fast-growing cultivars could mature for fiber and be harvested in the end of July - beginning of August, and for seeds - in the beginning of September. The early-sowing time is a decisive factor of high yield of hemp. In this case, the crop is afflicted by various pests to a lesser degree.

The development of a hemp plant depends much on the duration of day-light. According to nature of hemp in Central Russia, the growth of plants begins in May, when daylength is above 15 hours. Under the conditions, when the day-light duration becomes longer and longer from May to June, plants grow very intensively. The height of stems is increasing. The yield of hemp-straw is getting high accordingly. The conclusion is that hemp must be sown as early as possible in spring, at the same time with cereals. Traditionally, the beginning of hemp sowing is May 14 in Central Russia, when the temperature of air reaches +12° - +16° C and of soil - +7° - +9° C. In light, mellow soil, sowing is earlier unlike to heavy, wet soil.

The cold-resistance of hemp

The study of cold-resistance in hemp, selection of resistant accessions could play an important role in increasing significantly yields of the crop by means of sowing hemp in early spring time and extending the cultivating areas of hemp both to the North and South of the Planet .

Hemp may be cultivated as a winter-crop. According to previous trials [5], in Central and Southern Russia, seeds sown in autumn winter in swollen or in semi-germinated state. Plants performed extremely well in terms of height, yield, resistance to pests and droughts during next spring and summer. There is enough of water in soil and many afflicting pests are absent in this period.

It's considered, that the real way of plant introduction for the advancement to north areas is by using accessions from the northernmost borderland of the usual area of distribution of the species. Plants from this area are most tolerant to low temperatures. However, the opinions of researchers are different. Some accessions, which were taken from the northernmost area don't show potential for

the advancement to North, in contrast to the accessions which were taken from the center of diversity located far from the northern limit of distribution and manifest tolerance to cold.

Time of harvesting. Maturation of seeds of female plant:	Yield, t/ha		Seed-harvesting, %
	straw	seeds	
from the bottom of inflorescence - up to 50%	3.16	0.42	2.5
From 50% - up to 75%	3.52	0.90	3.8
up to 100%	2.96	0.71	22.0
8 days later after 100% maturation	2.76	0.09	90

The matter is that it's necessary to distinguish species characterized by high level of genetic uniformity over the whole area of distribution, which differ from the ones divided into many geographical and ecological races. Of most importance is the genetic diversity of a population which gives opportunities for selecting tolerant forms. It was the principle we used to select

cold-tolerant forms, which originate both from North Russia and South Russia, Ukraine, Armenia.

The traits of cold-resistance and earliness are closely connected with early harvesting and could significantly reduce the yield losses. The best time for seed-harvesting is the stage of maturity of seeds in the middle of the female plant inflorescence [table]. At this stage of seed maturation the stem of female plants loses the main part of leaves, but seeds don't shatter. The growth of fiber stops and it reaches the highest strength in stem [6].

Trials in the VIR, St. Petersburg.

I suppose, we should pay close attention to studying cold-tolerance of hemp. We can use selected accessions as a base for breeding aimed at improving main traits of hemp such as cold resistance in spring during seed germination, earliness, high seed productivity, high oil content in seed, valuable GLA and SDA fatty acids combination, and first of all - the adaptability of plants.

Since 1996, in the St.Petersburg province we have selected accessions, which were successful in germination under low temperatures in field conditions (up to +3° C during nights iTernopol province).

The stage of seeds maturation in female plant is the decisive factor for time of harvesting and minimizing of losses at harvesting. We analyzed ripening of each female plant over the population per accession. The most early accessions were from eastern Kazakhstan, Local (Russia, Siberia), Local (Russia, Kirov), which didn't produce high yield of seeds per plant. Such accessions as Local (Russia, Kirov) and Local (Russia, Chuvashia) combine traits of the highest seed yield per plant and earliness.

It's reported [6], that the best time for harvesting for fiber the varieties of various earliness is the stage of complete end of mail plants flowering. However, fast-maturing varieties may be harvested at the onset of the stage of 50% flowering of mail plants. The profit of earliness is quite obvious in this case.

Also we analyzed the ripening of male plants. The most early-maturing accessions were Mariiskaya (Russia), Local (eastern Kasakhstan), Local (Tyum, Russia), and Local (Irkutsk, Russia).

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