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Dmitrii Dementiev, Inga Ivanova and Valentina Leonteva

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Technology of hop cultivation in the Chuvash Republic

Dmitrii Dementiev^{1}, Inga Ivanova¹ and Valentina Leonteva¹*

¹Federal Agricultural Research Center of the North-East named N. V. Rudnitskogo, Russia

Abstract. The national economic significance of hop is determined by the fact that hop raw material is obligatory and irreplaceable in brewing. In addition, it is used in medicine, baking and perfumery industries. While earlier hops were grown in 11 regions of the Russian Federation, but now only in the Chuvash Republic, Mari El and the Altai territory. There are small areas in the Ivanovo region. Total area of hops production in the Russian Federation is about 400 ha of which less than half a hectare is cultivated in the Chuvash Republic [1]. Today, the situation in the industry is being changed, but very slowly. State support of hop development is being introduced. Thanks to that, there are opportunities to increase areas and gross harvest of hop. To do this, you need to popularize technology of cultivation of such worldwide demanded crop.

Hop belongs to the species common hops- diecious, perennial culture. A distinctive feature is the absence of a perennial crown. Overhead part grows annually to form a powerful bush with a height of 6-7 m or more, and in autumn, after the end of the growing season, it dies. Hop is a climbing vine that can't grow and develop without supporting devices, so its cultivation requires special trellises. There are three kinds of trellises common in the world: low height 3-4,5; medium - up to 5,5; high - up to 7-7,5 meters [2]. In Russia, hop is usually cultivated under trellises 6-7.0 meters high. In Chuvash research branch of Federal state budgetary Research centre of the North-East region the research was done to study the possibilities of cultivation of released hop varieties under low trellises (3 meters). It has been discovered that Krylatsky varieties, Sumer and Podvyazny on such trellises provide up to 14.0 and 16.2 c cones from 1 ha [3].

Hop is light-loving crop, of moderate climate. It grows in zones with an average annual air temperature of 1.5-8.5 °C and the sum of active temperatures (above 10 °S) 1000-3500° S. It is a moisture-loving crop, that is, for normal growth and development requires the amount of annual precipitation from 250 on early varieties and up to 600 mm on later ones. From the soil for hop, it is necessary to divert fertile black soil, grey-forest, or in extreme cases, soddy-podzolic soil with light, medium and heavy loam mechanical composition. During the growing season, it consumes 3-4 times more nitrogen, phosphorus, potassium and calcium than grains. The lack of boron, copper, zinc, manganese and molybdenum slows down the development of the plant. Hop develops better when the environment is slightly acidic and neutral pH of 5.6-7.0 and hydrolytic acidity of 1.5-2.0 mg-EQ per 100 g of soil [4].

When cultivating hop, special attention should be paid to the selection of varieties, their main economic and biological features, as well as to the length of the vegetation period. Most adapted to the conditions of Chuvashia and Central part of in Russia are early-ripening varieties – Feodal, Forward; middle-early Podvyazny, Tsivilsky, Druzhny, Favorite, Pharaon and middle-ripening – Flagman, Sumer, Krylatsky, Mikhailovsky with a growing season of up to 120 days, which isa guarantor of high yields with good product quality [5].

The most reliable and profitable way to lay a hop yard is planting annual young plants in the autumn period (I-II decade of October), which allows you to form full plantations and get up to 3-5 c/ha of hops in the first year.

Hop young plants are grown from stem and green cuttings. The most simple and affordable technology for growing planting material from stem cuttings with one or two pairs of eyes, which form large and full young plants. Hop young plants can also be grown from green cuttings. Although, the method has a number of disadvantages due to the significant costs of manual labor, using large volumes of irrigation water, five-millimeter wire, light reflective polyethylene film (GOST 10354-82) and river sand, but in the absence of sufficient areas of female plantations of new varieties this method of cultivation allows you to get from 1 bush to 100-150 pieces of planting material in the form of green cuttings.

Hop as a perennial monoculture, is cultivated in one area up to 10 years or more. Therefore, we must pay serious attention to choosing the right plot of land. The area under hop is chosen on a level area or slightly sloping downhill southern direction, no closer than 1 km from populated locality, livestock, warehouses with the level of ground water not higher than 2m. The plot should be well lit and protected from the prevailing winds with forest cover. In the summer, on hop yard disking is done in two directions with heavy disk harrows for loosening the top layer of soil and from the germination of weed seeds. Add organic fertilizers (150-200 t / ha), and in case of their absence, the plot is sown with green – manure crops for 1-2 years, depending on the availability of soil nutrients to make phosphoric-potash fertilizer. After that, push aside cultivation is carried out to a depth of 25-30cm along hop yard and cross plowing at 40cm. Lime is spread on acidic soils before that. Pre-planting loosening is carried out in the longitudinal direction to a depth of 22cm and in the transverse direction to a depth of 28cm.

Optimal time period for planting hop is the beginning of October, the best planting material is annual seedlings. Planting is carried out in furrows 28cm deep. In hop yard with rows of 3.0m seedlings are planted in rows of 1,1m, and when 2.5m - after 1.2m. Annual seedling must not be damaged by pests and disease. It has at least 5 roots, with length of 12 cm and a diameter of 0.3cm [6]. They must be pure-bred and recommended in this region. After planting is completed harrowing of rows is carried out. With this method of planting acclimatization of young plants is provided up to 95-97%.

Polypropylene twine is used for making supporters with linear density up to 1600, and fixation of the lower longitudinal twine with density 2200 is done by anchor sticks (moths). There is a tendency of reducing the density of twine to 1200 units.

During the first year on young plantings with VGH-5,2 or VH-4 only one vertical supporter is hung up on a planting. After conducting row-to-row processing to a depth of 16-18 cm with simultaneous harrowing. After growth of the stems up to 60-70 cm plant goes catching and hilling is done manually. When stems grow over 1.5 m a small hilling is carried out. Further care for hop is carried out as soon as there appeared weeds and soil crust with 1-2 row-to-row loosening, mineral fertilizing apply, manual weeding in rows and spraying with pesticides against pests and diseases. In the first year of growth removal of side shoots, pruning and second hop hilling are not done. After harvesting, the stems are rolled into circles and left for physiological ripening until late autumn, after which they are cut off, collect and burn. At the same time, the upper grid of the trellis is cleared from the remaining suspension material.

The most time-consuming and responsible operation on yielding hop yards is cutting of the main hops rhizomes. In young stands low cutting is conducted, for old-aged ones-high cutting with 2-3 pairs of buds left on underground stems.

Studies have found out that during the period of active yielding from 3rd to 10th year after planting, mechanized cutting of the main hops rhizomes both in spring and autumn terms, it is necessary to carry out the first pair of buds resume [7]. To remove excess ground from the rows and collect garbage from the plantation continuous harrowing is done. Polypropylene twine is pulled over the row, the ends which are tied to the anchor sticks or to the base of the posts and it is fixed with sticks every 3-5m to the soil surface.

After the hanging is completed, the supporters are finally fixed with two longitudinal wires to strands on both sides of the center of the plant at a distance of 25-30sm. Removal and catching are carried out after the growth of shoots over 15-20cm. Delaying the terms of work leads to tracery, injury and decrease in labor productivity. In account of a plant 6 most strongly developed shoots are left in the central part of the rhizome, all others are removed.

Modern varieties of hop differ significantly from hop grown at the beginning of the last century. Now the plant has a thicker stem and leaves are much larger. Therefore, while the old varieties of hop were caught on with 6 stems from a plant or more, it is now recommended to catch 2 stems for supporter or 4 stems from a plant. It is allowed to catch two stems on the first supporter and three stems for second supporter. Remaining in stock stems are removed after re-viewing. In case of damage they are unwind and removed. They are changed by stems left in stock.

To improve the ventilation of plants, as well as reduce the degree of damage to plants by pests and diseases it is recommended remove side shoots of hops when catching stems grow over 3.0 m before conducting the first hilling to a height of 1.0m from the soil surface. To facilitate work two times chemical removal of side shoots of hop and pruning is done. At the first removal as defoliant you can use a saturated solution of ammonium nitrate. During the second one the preparation Sukhovey is used on height of up to 1.0m with the norm consumption of 1.7 kg / ha. As a result, creeping shoots, low leaves and weeds in the rows are died out. The first hilling is performed when growing of catching stems over 3.0m with the creation of ridges 20-25cm high from the level of space. The second removal is carried out at a plant height of 6.0m. With the appearance of creeping shoots and weeds in rows the inter-row cultivation is done on the depth of 10-12cm. In dry weather loosening can be enough.

The number of treatments can reduced with the application of herbicides in hop yards. Hop forms a large above-ground mass, reaching in the calculation of the plant up to 6-8 kg and more with an aboveground mass of up to 200-300 kg / ha. Respectively for growth and development a significant amount of nutrients is required. That is why in the hop yard while hilling up, it is recommended to apply fertilizers in the form of feeding in a dose of $N_{120}P_{120}K_{120}$. At the first hilling, complex methods are used fertilizers in a dose of $N_{60}R_{60}K_{60}$, or ammonium nitrate N_{52} , during the second-at after reaching the stems of the top of the trellis- $N_{60}P_{60}K_{60}$ Five years later, the soil is limed. While cultivating hop is exposed to damage and affection by a variety of species of phytophages and phytopathogens, the number of which increases over the years. The most dangerous pests are hop aphids (*Phorodon humuli* Schrk.), hop slimy (*Caliroa annulipes* Klug.), tychius medicagnis (alfalfa mower) (*Otiorrhynchus ligustici* H.), hemp flea (*Psylliodes attenuata* Koch.), common spider mite (*Tetranychus urticae* Koch), wire worms, white grub, potato, stem borer, stem moth, mole cricket. Among diseases - rot: grey (*Botrytis cinerea* Pers.), sclerolaena (*Sclerotinia sclerotiorum* (Lib) de Bary), seedling disease (*Fusarium oxysporum* Schl. *humuli* Komarova), soft bacterial rot (*Erwinia caroto vora* (Jones. Holl.), bacterial cancer (*Agrobacterium tumefaciens* (Sm. et Town.), false powdery mildew (*Peronosplasmopara humuli* Miyabe et Takah (*Pseudoperono spora humuli* Wilson), real powdery mildew (*Sphaerotheca macularis*

P. Magn. F. humuli Lev. *Podospaera macularis* P. Magn.), dark mildew (*Cladosporium spp. rebasidium spp*), penicillina rot (*Penicillium sp.*) [8].

Spring, summer (a few times) and fall examinations are carried out to detect the presence of pests and diseases. Being aware of the situation in hop yards a set of protecting measured against pests and hop disease are taken place.

It was found out that a great importance in the complex protection belongs to agronomical method. With the help of it you can improve growth and development of plants while creating adverse conditions for pests. The destruction of weeds results into the decrease or total reduce of the primary food base for common spider mite, potato stem borer, hemp flea. The destruction spiked spring creeping hop shoots prevents the spread of false powdery mildew.

Placement of hop yards on the leveled, well-ventilated and illuminated areas with the location of rows of hop from south to north and keeping them in clean condition diminishes up to 80% or totally eliminates contamination of plants with potato stem borer. Location on soil with deep groundwater reduces root rot incidence of disease. Picking and burning of after harvesting plants destroys the stock of wintering armyworms of stem moth to 90% and 75% of the common spider mite. Increasing norms of nitrogen nutrition contributes to the contamination of hop aphid and ordinary spider mite, and a strong thickening of hop results in affection by false powdery mildew. When number of pests and diseases is high it is impossible to deal without chemical means of protection. So, chemical measures are taken place against an ordinary spider mite when detected 3-5 samples on a leaf, hop aphid – 5-7 winged or 10 wingless samples on a leaf, wire worm – 3 copies per 1 m², against diseases - as they occur. Economic thresholds of harm may vary depending on weather conditions, type fertilizers applied, agricultural machinery used, the presence of useful organisms entomophages etc.

In the fight against weeds in soil herbicides are applied in hop yards: Stomp Professional, 45% MKS, or Gaitan, 33% KE; post-emergence Baron, 48% VR; Corsair, 48% VRK Bazagran, 48% VR.

To control harmful sucking pests - spider mites hop aphid, hop slimy sawfly, potato stem borer, stem moth, thrips we use a Clipper, 10% KE, Fitoverm, FE-2.0 l / ha, Aliot. 57% KE. Oberon rapid, KS. Against false powdery mildew: Bravo 50 % – 3.0 l / ha, Ridomil gold 60% – 3.0 l / ha, the dry wind – 2 l / ha, Metaxis – 2,5 kg / ha, Ordan – 2.5-3.0 kg / ha. Against wireworms, the larvae of beetles, mole crickets mineral fertilizers treated with BI-58 Novy, 40% CE are used. With the increase for the green mass of hops, the flow rate of the working fluid must be increased from 400 to 1000 l / ha.

For mechanized harvesting of hop hop harvesters Chx-4L, LCH-2, PT-15 of Czech production are used. The capacity of the existing drying equipment PCB-750 provides daily drying of 15 tons of raw hop. In the end of drying in drying chambers hops should have humidity of 8-9%, and in acclimatization chamber up to 11%.

For better safety and transportation of products, cones are pressed in balota (cloth bag) by presses HPG-15 and SETH-502 as well as are granulated.

In early October, in yielding plantations yielding stems are cut and harvested remove from towers for hanging hop the dead of hanging material and burn it.

All work on hop culminates in a pre-winter treatment of row spacing. Cleaning and drying equipment is cleaned from plant debris, soil and prepare for normal storage.

Naturally, as a monoculture, hop in one area is strongly damaged by pests and diseases. There is a significant decrease of the yield of hop and the maintenance of old plantations becomes unprofitable. Therefore, they are uprooted, removed from the rhizomes of plantations and burned. In the future they carry out fall plowing with no push out. In the spring the plot is sown with green manure crops. In hop backset it is desirable to keep hop areas under green manure steam for at least for 2 years. During this period, the soil can be eliminated of infectious stock of pests and diseases of hop. Meanwhile you can arrange

capital repair or reconstruction of hop trellis for further operation and carry out the renewal of hop varieties.

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