

## Factors of Intensification in the Hops Cluster of Chuvashia

Anatoly I. Zakharov<sup>a</sup>, Oleg V. Evgrafov<sup>a</sup>, Dmitry A. Zakharov<sup>a</sup>, Elena V. Ivanova<sup>a</sup>, Marija L. Tolstova<sup>a</sup> and Evgeny I. Tsaregorodtsev<sup>b</sup>

<sup>a</sup>Chuvash State Agricultural Academy, Cheboksary, RUSSIA; <sup>b</sup>Mari State University, Yoshkar-Ola, RUSSIA

### ABSTRACT

The complex analysis of development of hop-growing for 1971 - 2015 is carried out. In the conditions of the field experiment made in the Chuvash Republic hop-growing intensification elements - technology of its cultivation, mechanization are fulfilled. Based on researches it is established that the main internal allowance of increase in efficiency of hop-growing is transition to resource-saving low-cost technology of cultivation of hop now. The resource-saving technology of cultivation of hop using a complex of machines allows to reduce labor costs from 500-600 to 180 people - days by 1 hectare, promotes increase in productivity of cones for 30-40% and quality for 15-20%.

### KEYWORDS

Hops, production efficiency, alpha acid, productivity, assessment

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## Introduction

Agriculture makes a substantial contribution to the economic development of both the State as a whole (Kokotkina, Sadovin & Bepalov, 2015) and its regions (Tsaregorodtsev & Sairanova, 2015), making a significant contribution to the development of human capital (Antipova, Alyunova & Belov, 2016), is the scope of innovation (Nikolaeva, Antipova & Belov, 2015) and new management methods (Kulalaeva, Kreneva & Kanyugin, 2016; Mosunova & Tsaregorodtsev, 2006; Sadovin, Kokotkina & Bepalov, 2015; Tsaregorodtsev, Semagin & Mosunova, 2009). The peculiarities of the agricultural sector is highly competitive (Goretov, Gumarova & Tsaregorodtsev, 2015; Kazakovtseva, Gumarova & Tsaregorodtsev, 2015) and the need for investments (Smirnov, 2011; Gumarova, 2014). Since the climate of Russia close to the Canadian experience, we can use them for the development of agriculture (Bilson & Darku, 2015; Rakhhal & Shashini, 2014.)

**CORRESPONDENCE** Evgeny I. Tsaregorodtsev ✉ [evgts@marsu.ru](mailto:evgts@marsu.ru)

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The hops growing industry is small, but its production is necessary for national economy as it affects the production of certain goods of great demand. Hops cones when they are processed, are focused on the needs of the food industry, mainly for brewing beer. In addition to brewing and the production of yeast, hops is used in baking, perfume, pharmaceutical and other industries.

Hops is cultivated in twenty-five countries around the world. In connection with the growing needs of the industry production in the world continuously increases. In the major countries of the world hops growing is a very efficiently and at a high scientific and technical level. With a relatively large volume of production reached an exceptionally high productivity of hops, providing these countries ' competitiveness on the world market and the return on huge investments in production (Altukhov, Agafonov & Gavrillov, 2009).

Hops Russia for the last 25 years is characterized by the decrease of the areas occupied by hops and gross yield of humpops materials. So, in 1991-1995 the total area of the hops was 4319 hectares, 2000-2015 - 1157 hectares and it decreased during this time by 74%. The production of hops subcomplex is unable to adapt to the new economic environment and to new requirements of a rapidly developing brewing industry. The lack of proper economic incentive tool hops-growing enterprises, effective measures of protection of the domestic market for hops, the deterioration of the logistics led to a reduction in planting of hops and reduce the efficiency of the industry (Zakharov, 2015; Timirgaleeva & Grishin, 2013).

### Literature Review

The persistence of these negative trends is the same to hops growing in Chuvashia, where in 2015 the square of the hops took the 407 hectares with an average yield of 18.0 centners out of 1 ha. At this time, as in 70-80 of the last century the Chuvash republic was the main hoplebrook region of Russia, which produced more than 75% of the gross harvest of hops in Russian Federation (Zakharov, 2016; Nesterova, 2015).

The causes of negative events in hops cultivation are related to the fact that the country has undergone significant socio-economic transformation. This led to the fact that many farmers are finding it difficult to adapt to new conditions (Gumarova, Mackushev & Evgrafov, 2016; Goretov, 2012; Tsaregorodtsev, 1998). The observance of the whole complex of technological operations in the cultivation of hops requires a lot of costs, including a capital nature that was not under force to many farms. This led to the transition to the primitive technology of cultivation of hops, destruction of the system of nursery, lower level of skills.

Intensification is the most important condition for expanded reproduction in any sector of the economy, including in hops cultivation. However, the process of intensification of agricultural production has its own characteristics, primarily due to use in agriculture land as the main means of production (Tsaregorodtsev, 2013). In this regard, intensification is not only based on the application of more modern machines, tools and production technologies, but also the use of advanced agrotechnology (Evgrafov & Belov, 2015). Process intensification is multivariate, and therefore the level of intensity of production can be determined only on the indicators that impact all of the factors in their interrelation and interaction. Such indicators in hops cultivation are: the yield per unit of land area in the whole farm or set of farms; crop productivity

(including quality) for individual sectors agriculture and livestock productivity in the livestock industries.

### Research Methods

Increasing the level of intensity provides improved all productivity indicators of growing hops. The increase in the intensity of the hops should be considered as one of the main factors in improving the profitability of the industry.

The combined influence of factors of intensification eventually shows up in the calculation of the productivity of the hops, for what produced the labor, monetary and material costs. Conditions and factors of intensification influence on economic efficiency in the aggregate. However, in practice it is important to know which directions to choose in the moment to get the best value because of labor and material resources, is not unlimited.

Further development of hops-growing is closely linked to the intensification of production in the industry. Since the efficiency of intensification is characterized by the ratio of manufacturing costs to the resulting products, the effectiveness of incremental investments, the growth rate of labor productivity, reduce production costs, the radical improvement of these indicators in hops cultivation requires special attention. The key issue continues to be improving productivity. Intensification is associated with the rational use of all consumed for the production of tools and human labor, a speedy transfer of production on an industrial basis. Studies show the solvability of these issues that contribute to the further development of hops-growing for the future.

Scientific methodology is based on the system approach to the problem under study and the integrated treatment of the processes of cultivation of hops. The methodological basis consists of the works of domestic and foreign scholars on theoretical issues in the field of hops.

In the process of gathering, accumulation and processing of information used different techniques to abstract-logical, monographic, economic-statistical, analytical, design-design, graphics and research methods.

Source of information was the official materials of the bodies of statistics: Goskomstat of the Russian Federation and the Chuvash Republic; normative acts of legislative and Executive bodies of the Russian Federation and Chuvash Republic; the primary accounting documents and reporting of agricultural enterprises of the Republic; materials research. Practical significance of the research is to establish factors determining the efficiency of the industry; the impact of reserves of increase of efficiency of production of hops in the Chuvash Republic.

Hops refers to crops with a small amount of production the global area of its plantations in recent years constitute more than 50 thousand hectares the Largest States of the world hops are Germany (31.9% of world plantings), United States (23.3 percent), Czech Republic (10.3 per cent), China (9.8 per cent). The average yield of hops in the world is in the range of 18 kg/ha in USA and China it exceeds 25 kg/ha (Tabl. 1). The total production of commodity dry hops is about 100 thousand tons. Hops is cultivated in 23 countries (Yakimov, Smirnov & Danilov, 2008).

**Table 1.** Area, yield and production of hops in the world(average for over 2010-2014).

<i>Countries</i>	<i>HopsArea, ha</i>	<i>Yield, c/ha</i>	<i>Grossyield, thousandtons</i>
USA	16100	25,0	42,9
Germany	18500	17,5	31,3
Czech Rep	5300	10,0	5,8
China	4900	25,5	12,5

Since 1991, the world has witnessed a steady tendency to reduction of the area of hops. By the beginning of the XXI century they decreased by 36, 9%.

In Russia hops is cultivated from time immemorial, and in the recent past the square it was more than 4 thousand ha. Hopsproduction in modern Russia is reduced by reducing the area of planting and yield reduction (Tabl. 2).

**Table 2.** Analysis of hops production in the Russian Federation (average per year)

<i>Years</i>	<i>Total area, ha</i>	<i>Including fertile ha</i>	<i>%</i>	<i>Gross harvest of raw materials, tons</i>	<i>Yield, c/ha</i>
1976-1980	6751	4896	73	3033	6,2
1981-1985	6507	5274	81	3468	6,6
1986-1990	5425	4531	83	3444	7,6
1991-1995	4340	3776	87	2420	6,4
1996-2000	2920	2540	87	840	3,3
2001-2005	1880	1598	85	449	2,8
2006-2010	1040	925	89	180	2,4
2011-2015	475	432	91	150	3,5

From the data of table 2 it is seen that the average annual area of hops in 1976-1980 reached 6751 hectares, including fruit - 4896 ha. Average harvest of hops in 1976-1980 amounted to 3033 tones. Since 1996, Russia has experienced a sharp reduction in the production of hops. By the beginning of 2016 the total area of plantations of hops in Russia in all categories of farms amounted to 409 ha, of which 270 were fruit bearing.

The main hops production in Russia was concentrated in the Chuvash Republic, where fruit plantations were located more than 2.5 thousand hectares. the Soil and climatic conditions of the Chuvash Republic are favorable for the cultivation of hops. The hops cultivation here was one of the most highly productive agricultural sectors that contributed to significant strengthening of the economy of collective and state farms (Zakharov, 2015).

However, during the years of economic turmoil the hops-growing industry came to a complete standstill. Currently, the hops is not cultivated only in some farms of the Chuvash Republic, thanks to enthusiasts there is a small area of the hops. In the Republic for years of reforms the production of hops declined multiple times (Tabl. 3).

**Table 3.** Dynamics of area, yield and gross harvest of hops in the Chuvash Republic (annual average for five-year periods)

<i>Indications</i>	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2009	2011-2015
Fertile areas, ha	1960	2537	2923	2761	2568	1658	836	477	184
Yield, c/ha	10,1	8,1	8,7	9,5	8,4	5,0	5,5	6,2	14,7
Gross harvest, tonnes	1980	2055	2545	2619	2162	824	444,3	293,5	263,9

Analysis of table 3 shows that during the period under review the maximum area of plantations of hops - 2923 hectares, was achieved in 1981-1985, the Maximum yield was achieved in 1971-1975 (10 quintals 1 ha), the crop yield in 2015 amounted to 20.1 center per 1 hectare.

In a field experiment conducted in LLC "Agroresursy" of Urmarskaya district of the Chuvash Republic, worked out the elements of intensification hops - the technology of its cultivation, mechanization. The intensification of the production of hops brings to the fore the problem of technological progress, aimed at the introduction of complex mechanization, the latest technology on the basis of which can provide a rapid and effective growth of labor productivity in hops cultivation.

### Results and Discussion

On the basis of researches it is established that the main internal reserve for increasing the efficiency of the hops currently is the transition to resource-efficient low-cost technology of cultivation of hops. It involves the application of complex technological and economic measures. Among the technological measures most important at the present stage is the mechanization of labor-intensive processes, like trimming the main hops rhizomes assemblies, hanging supports towers, preparation of pits for planting and replanting of seedlings, the combination of technological operations for one pass of the unit.

Studies have shown that resource-saving technology of cultivation of hops with the use of machines allows to reduce labor costs from 500-600 up to 180 man - days per 1 hectare, contributes to increasing the yield of cones 30-40% and quality by 15-20% due to timely carry out agricultural activities.

Studies revealed that the introduction of resource-saving technologies based on the maximum mechanization of labor-intensive processes of production of hops possible to obtain stable yields of 22-24 dry hops with 1 ha.

We have found that with the application of modern mechanization of labor in the cultivation of hops in different periods of the process cycle (spring, summer, and fall cleaning) is reduced by 63% compared to manual technology. Labor costs in mechanized harvesting and drying of raw materials reduced by 83% (Tab. 4).

**Table 4.** Reduced labor costs when introducing the mechanized production technology of hops (person hour/ha)

<i>Periods of production of hops</i>	<i>Technology</i>		<i>Laborsavings</i>
	<i>With use of manual labor</i>	<i>mechanized</i>	
Spring	374	134	240
Summer	1212	1042	170
Cleanand dry	3558	652	2906
Autumn	178	130	48
<b>TOTAL</b>	<b>5322</b>	<b>1958</b>	<b>3364</b>

Modern production conditions hops provide savings of resources at all stages of growing, harvesting, processing and use of raw materials. The ultimate goal of the resource is a physical (absolute) and cost (relative) saving all kinds of resources.

In LLC "Agroresursy" of the spring work in the hops starts with the introduction of soil herbicide stomp - 5-6 kg/ha with the incorporation by morenovalley unit. For this operation, mounted harrow PBA-2.5 X is used, which performs operations on the closure of moisture, cleaning off residue, loosening and alignment between the rows of hops for the subsequent mechanized cropping.

One of the most time-consuming operations in the cultivation of hops is the main crop of rhizomes. It should be done in the compressed agrotechnical terms for a total duration of 10-14 days. To fertile hops mechanized pruning of main roots is carried out. To trim free ranks use the trim tool PKH-22. When passing through the row, unit performs pruning main roots and hiding them with a layer of soil 5-10 cm thick. For cutting hops rhizomes of the main pole in series use the trim tool PKH-23.

On the basis of researches it is established that the use of mechanized pruning main roots did not have a noticeable negative effect on the productivity of plants of hops. However, pruning in a short time allows you to use the released workers in other processes and industries subsequent work in optimal agronomic terms, thereby increasing the yield of hops.

Currently, in most hops-growing farms support kick from the hops by hands. In this process, including work on the repair of tapestries, the manufacture and installation of pegs, hooks, devices for hanging, etc.) spend 389 man hours, or 56 person / days for 1 ha of hops, which is 11% of the total cost of labor in the production of hops. For mechanized hanging supports hops in LLC "Agroresursy" used rigs VGH-5.2 and VH-4. The use of these towers allows to increase the productivity of the operation by 2.5 times, reducing labor costs per 1 ha at 236 or 34 man day. Performance per shift with a team of nine people is 2-3 ha. Material and monetary costs of attaching supports, is reduced by 1.6 times. Mechanized hanging supports, besides saving labor and money, due to the high performance gives you the opportunity to carry out further work, in particular to have stems for support, which is very important for increasing the productivity of plants.

During the summer on the hops, depending on weather conditions spend up to five or six row cultivation and two or three hilling up. Applied hinged plow-cultivator PRN-2,5 AH. To Deposit the granular mineral fertilizers used hinged machine MVU-1,7. The unit is mounted on the frame of the plow-cultivator PRN-2,5 AH. Fertilizers can be applied during cultivation between rows and hilling the rows of hops.

The main conditions of high intensity recommended agro-technical measures in hops cultivation must be comprehensive, timely performance, and in the protection of hops against pests, diseases and weeds integrated control systems, including breeding and genetic, agrotechnical, biological and chemical methods.

For the protection of hops against pests and diseases apply fan sprayers OPV-1200, OPV-2000, which have the same device and differ according to the capacity of the tank. In the spring of the most dangerous large alfalfa weevil, constantly and everywhere great harm to the cause of the hops aphid, spider mite, twig moth. Timely detection, forecasting the development of pests, diseases in hops and the application of remedies to prevent the loss. According to the

experiments of each invested in the protection of hops, the ruble pays off fourfold.

The most time consuming is the harvest, which accounts for 41 to 47% of all labor costs. They are 205 – 288 person-days for 1 ha of plantation or 17 – 19 person-days per 1 kg of hops.

Cleaning the hops begins in the phase of the onset of technical maturity. For mechanical harvesting of hops in LLC "AgroResursy" is used hops collecting machine LChH-2 by Czech Republic production. In this technique, the hops vines on the plantation are cut by hand, stacked on trailers NX-0.5 and transported to the harvester for sorting of the bump hops.

Drying freshly harvested hops is produced on holedale PHB-750K Slovak production. After drying and binning hops is pressed into balota. It contributes to a better preservation of the product and creates optimum conditions for subsequent storage and transport. For pressing hops there are used the press of HPG-15 Slovak production.

The use of harvesting machines LChH-2 and post-harvest completion of harvest of bump hops in dryer PHB 750K allows to increase the level of mechanization of the industry to 40-50%, reduce labor costs and increase productivity by 35%.

Mechanization of labor-intensive processes for the cultivation, harvesting and primary processing of hops is one of the main factors reduce the cost and improve product quality.

Timely and high quality execution of all technological processes, wide introduction of achievements of science and best practices will allow in the coming years to significantly increase total yield and harvesting hops.

## Conclusion

The main condition for high intensity is recommended agro-technical measures in hops cultivation, which should be comprehensive and timely performance. The introduction of mechanization, timely and high quality execution of all technological processes will allow in the coming years to significantly increase total yield and harvesting hops. Intensification is associated with the rational use of all consumed for the production of tools and human labor, a speedy transfer of production on an industrial basis. Studies show the solvability of these issues, contributing to the further development of hops-growing for the future.

In order to intensify the hops is a special need for the introduction in production of resource-saving technologies of cultivation and processing of hops, which is in wide use on hops modern technology, advanced techniques etc. We have developed resource-saving technology of production of hops can significantly increase the efficiency of the industry of hops-growing.

Studies show the solvability of these issues that contribute to the further development of hops growing for the future.

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No potential conflict of interest was reported by the authors.

### Notes on contributors

**Anatoly I. Zakharov**, Department of Economics, Management and Agroconsulting, Chuvash State Agricultural Academy, Cheboksary, Russia.

**Oleg V. Evgrafov**, Department of Economics, Management and Agroconsulting, Chuvash State Agricultural Academy, Cheboksary, Russia.

**Dmitry A. Zakharov**, Department of Economics, Management and Agroconsulting, Chuvash State Agricultural Academy, Cheboksary, Russia.

**Elena V. Ivanova**, Department of Economics, Management and Agroconsulting, Chuvash State Agricultural Academy, Cheboksary, Russia

**Marija L. Tolstova**, Department of Economics, Management and Agroconsulting, Chuvash State Agricultural Academy, Cheboksary, Russia.

**Evgeny I. Tsaregorodtsev**, Department of Economics and Finance, Mari State University, Yoshkar-Ola, Russia

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