

## Distribution of sowing and buckwheat crop capacity in Altai with regard to environmental conditions

Victor Markovich Vazhov, Aleksey Walerjewich Odintsev, Vladimir Nikolayevich Kozil  
Altai State Academy of Education named after V.M. Shukshin, Korolenko Street, 53, Biysk, 659333, Altai Region,  
Russia

**Abstract.** Altai Krai (Territory) is leading Russian region on buckwheat production. This culture is risen in all native zones of the territory. The share of buckwheat sowing is 40% of all-Russian results. But buckwheat crop capacity in Altai is low (7.1 centner per hectare) and varies in time and territory and does not reach average measure for the country that equals 8.3 centner per hectare. Expansion of crop territory by ploughing up fallow lands, optimization of sown areas' structure and improvement of territorial distribution of fields considering environmental conditions together with improvement of zonal territories are reserves of increase of buckwheat production.

[Vazhov V.M., Odintsev A.W., Kozil V.N. **Distribution of sowing and buckwheat crop capacity in Altai with regard to environmental conditions** *Life Sci J* 2014;11(10):552-555] (ISSN:1097-8135). <http://www.lifesciencesite.com>. 75

**Keywords:** buckwheat, Altai Krai, environmental conditions, sown areas, crop capacity

### Introduction

Altai Krai is leading subject of Russian Federation in buckwheat production. Sown areas of this culture in Altai in 2012 reached 494.3 Thousand hectares [1] that equaled 40% of sown area of buckwheat on Russia [2]. Relatively big buckwheat sown areas were only in two of 83 regions of the country – in Orenburg and Orlov regions as well as in the Republic of Bashkortostan [3]. Despite countrywide distribution of buckwheat in Altai and high biological potential of it that equals about 30 centner per hectare, average crop capacity of it in the region is low – 7.1 centner per hectare and it varies in different environmental zones [1, 3]. Low crops of buckwheat are also related with the fact that zonal specifics of its cultivation without considering biological features of sorts and their crop capacity are insufficiently examined as well as non-rational distribution of it over the territory according soil and climate zonal conditions. Although it is known that intensive cultivation technology may increase crop capacity of buckwheat up to 20 centner per hectare and more.

Altai Krai territory is characterized by relatively favourable agricultural and climate resources for growing groats cultures. High procurement price makes buckwheat profitable even with low crop capacity. In late 2013 groats processing companies bought buckwheat in Altai Krai for 8 thousand Rubles for 1 ton that is 1.5-2.0 thousand of Rubles higher than prices for grain crops and millet. Analysis of territorial specifics of buckwheat sown areas distribution allows revealing the dynamics of sowing and crops capacity as well as plan the ways to increase production of this culture in the region.

Sowing buckwheat (*Fagopyrum esculentum* Moench.) is the object of the present research. Research presupposed analysis of sown areas,

buckwheat crop capacity indicators in relation with environmental conditions of Altai Krai as well as the experience of scientific research and production raising it from 2007 till 2013 years.

### Main body

Altai Krai relief is relatively various. There are plains (steppes), hilly and ridge heights (forest-steppe) and foothills plains. Western part of the region is most dry. It is mostly steppe. Eastern and South-Eastern territories belong to forest-steppe and foothills zones with sufficient moistening. Diversity of relief and continental character of climate have significant effect on the geography of buckwheat distribution in Altai Krai [3].

Clearly defined seasonal character and changeable weather are typical for climate of the region. In steppe and forest-steppe regions there are frequent droughts. Annual rainfall is sharply contrast 230-600 mm. Duration of period without frosts is from 115 to 130 days, accumulated positive temperature is 2100-2650 °C.

Kulundinskaya steppe is most droughty area in Altai Krai. It is located in two natural sub-zones: West-Kulundinskaya and East-Kulundinskaya with annual rainfalls, respectively, 230-250 and 300-320 mm. Rainfall distribution is very irregular – up to 40% of annual norm falls in July and August, accumulated positive temperature of the period from May till July is 1600 °C. According to agricultural and climate zoning of the territory Kulundinskaya steppe is the area with high provisioning of warm.

Aleiskaya steppe is characterized by annual rainfall from 265 to 350 mm, of them 160-200 mm falls in May-August. Accumulated positive temperature of the period from May till July is high - 1650-1700 °C. It is most warm territory of Altai Krai.

The climate of Priobskaya forest-steppe is milder, but this territory is characterized by diverse relief. Annual rainfall of Priobie is 305-395 mm and it is relatively regular distributed over seasons. Droughts are less frequent here than in steppe. More that 30% of annual rainfall falls in July and August, accumulated temperature of the period from May till July is 1470-1500 °C. Warm provisioning here is lower than in steppe regions of Altai Krai.

Forest-steppe of foothills of Salair is situated in Biisko-Chumyshskoi native zone and also in eastern part of foothill plain of Salair mountain-ridge in the boundaries of Altai Krai. Most forest-steppe part in the wide plain of country between Ob and Chumysh is crossed by ravine and gully network. Average annual rainfall here is higher that in Priobskaya forest-steppe. It is 400-450 mm and more stable over time. 250-300 mm of rains fall during vegetation period and 150-180 mm of them in May-July; accumulated temperature for the period from May till July is 1400-1500 °C.

Stocked character of the territory grows closer to Salair mountain-ridge and the relief becomes more diverse. Annual rainfall grows and becomes more stable over time - 440-520 mm. From 170 to 220 mm of rains fall I May-July, accumulated positive temperature for the period of May-July is 1370 °C. According to agricultural and climate zoning of Altai Krai the territory lies in the most cold native zone.

Altai foothills are less moistened because average annual rainfall here is from 350 to 440 mm and 180-260 mm falls during vegetation period including 120-170 mm in May-July. Accumulated positive temperature in May-June is 1620-1720 °C. In lower parts of foothills average annual rainfall grows up to 600 mm including 290-370 in vegetation period, 200-250 mm in May-July; accumulated temperature for the period of May-July is 1350-1500 °C.

Soil covering of agricultural territories of Altai Krai is very diverse. There are chestnut soil and grey forest soils here as well as rich black soils – ordinary, leached, south soils, podzolized [3]. Humus content varies greatly and is from 2.5-3.0 up to 8.1-9.0%. Soil conditions of native zones are mostly favorable for buckwheat raising.

According to statistic data [1] sown areas of buckwheat in Altai Krai has changed a lot in last 6 years – from 285 thousand of hectare (2009) to 494 thousand hectare (2012), variation reached 42% (see Table 1).

At the same time distribution of sown areas in Russia in time perspective was different [2]: the least sowing (907 thousand of hectares) was typical for 2011 and the greatest (1301 thousand of hectares) was in 2007 i.e. the difference is about 30%.

The share of Altai sowing of buckwheat in all-Russian scale is great - 30-32%, and in 2011-2012 it even grew up to 40-46%.

Crop capacity of buckwheat in Altai fields (7.1 centner per hectare) is relatively well considering risk factors of Siberian agriculture in comparison with all-Russian (8.3 centner per hectare) and equals 87% [1, 2].

Unstable weather during vegetation period, periodical droughts especially in steppe regions, overmoistening of soil in some years in foothills cause reduction of crop capacity of buckwheat. In 2009-2011 crop capacity of the culture in the region was higher that in the country as a whole. Favorable weather during flowering and harvesting played positive role besides reduction of sown areas had a certain effect.

**Table 1.** Sown area (thousand of hectares) and buckwheat crop capacity (centner per hectare of the territory after harvesting) (farms of all categories)

Indicator	2007	2008	2009	2010	2011	2012	Average
Russian Federation							
Area	1301	1113	932	1080	907	1270	1100
Crop capacity	8.4	9.2	9.0	5.9	9.5	7.7	8.3
Altai Krai							
Area	391	340	285	341	422	494	379
Percent	30	31	31	32	46	40	35
Crop capacity	7.0	6.3	9.6	6.5	7.2	5.9	7.1
Percent	83	68	107	110	76	77	87

Russian Federation now is the greatest producer of grain of this culture and keeps leading place in the world. Former world leader in production and export of buckwheat China in last 10 years stepped back on the second place [4].

Analyzing spatial distribution of sown areas in Altai Krai in general one may see direct correlation with environmental conditions as well as the other grain cultures [5]. The greatest sown areas are located in rich soils of forest-steppe and foothills (see Table 2).

**Table 2.** Sown areas and crop capacity of buckwheat in native zones if Altai Krai (average for 2007-2012)

Native zone	Area		Crop capacity, centner per hectare	
	Thousand hectare	percent	Centner per hectare	Deviation.(+, -)
Kulundinskaya steppe	18.0	5	5.4	-1.7
Aleiskaya steppe	54.4	14	6.7	-0.4
Priobskaya forest-steppe	70.8	19	6.6	-0.5
Forest-steppe of Salair foothills	159.2	42	7.8	+0.7
Altai foothills	76.5	20	9.2	+2.1
Total over the region	378.9	100	7.1	0

Large number of bee families traditionally inhabiting such native zones also promotes concentration of sowing of buckwheat in forest-steppe and foothills. There have been more than 120 thousand of bee families inhabiting Altai in last years. Besides large honey yield the work of fertilizer

insects on buckwheat supports good fructification and increase grain harvest [6].

More than 40% of sow areas are located in forest-steppe of Salair foothills, in 20% in Priobskaya forest-steppe and in the foothills of Altai. Native conditions of these zones support better adaptation of buckwheat to the habitat [7]. More than 20% of sowing is in steppe territory of Altai Krai with less fertile soils and droughty climate. The share of buckwheat in the period from 2007 to 2012 in ploughland of the region by native zones is also different. Average indicator for the region is 7.5%, in Kulundskaya steppe buckwheat had been raised on 1% of ploughland of Altai Krai, in Aleiskaya steppe – about 5%, in Priobskaya forest-steppe – about 6%, in forest-steppe of Salair foothills – more than 11% in Altai foothills – more than 8%.

Maximum crop capacity of buckwheat was in Altai foothills – 9.2 centner per hectare that is higher than all-Russian level and also in forest-steppe of Salair foothills – 7.8 centner per hectare. Average crop capacity over the region is 7.1 centner per hectare. In other native zones of Altai crop capacity of the culture is lower the average regional indicator.

Scientific and production experience proves that there are reserves for buckwheat production in Altai Krai. Dikul (has been zoned from 1999) is the less demanded sort of 6 zoned sorts of buckwheat in Altai. In last years sown areas of Devyatka and Disain are being actively increasing so both sorts are perspective for the region.

The most pressing agrotechnical question is the choice of optimal time of sowing that may change over the calendar during a month even in one farm. One of the reasons of extension of sowing time is the diversity of native conditions, or night frost possibility. The other reason is diversity of productive moisture resources in soil. For example, in JSC “Stepnoi” in 2013 buckwheat sort Dikul and Devyatka were sown in different time: from 26<sup>th</sup> of May to 20<sup>th</sup> of June, crop capacity was from 9 to 12 centner per hectare. Sort Natasha (zoned since 2003) with sowing at 10<sup>th</sup> June gave crop capacity 10 centner per hectare (LLC “Aleksandr-P”), the later time of sowing of this sort (for 5 days) gave crop capacity 10-15 centner per hectare (collective farm “Zhivitsa”), the same crop capacity was obtained with sowing at 4<sup>th</sup> of June and later (“Tselinagrocnab”). Sort Dialog (zoned since 2008) was sown from 15<sup>th</sup> of May and later gave crop capacity 14 centner per hectare (LLC “Agrofirma ‘Urozhai’”) up to 17 centner per hectare (LLC “Oktauabrskoie”), sort Inzerskaya (zoned since 2002) with sowing in June gave more than 7 centner per hectare (LLC “Vostochnoye”). Sown areas of these sorts in farms were from 60 to 2400 hectares.

Leading farms in Altai foothills (LLC “Agroservis” and collective farm “Rodnik”) in 2012 obtained good crop capacity of buckwheat on the fields with the area of 100-640 hectares with sowing from 12<sup>th</sup> of May till 17<sup>th</sup> of June. Sort Davyatka provided crop capacity at the level of 13-19 centner per hectare, Dikul and Dialog on the fields with the area from 109 to 1536 hectares – 9 centner per hectare (agricultural production cooperative society “Khkeborobnii”, collective farm “Bachurina T.I.” and agricultural production cooperative society “Rodina”). Average crop capacity of sort Devyatka the had been sown in LLC “Solonovskoye Mkh” in 2013 in the area of 817 hectare was greater than 11 centner per hectare.

Vegetation periods of last years for buckwheat were contrast in moistening. 2012 was heavy droughty and 2013 was overmoistered. So the choice of sorts adapted to different raising conditions with high agrotechnical background allows obtaining relatively high harvests of buckwheat in Altai that belongs to the territory of risky agriculture in Russia.

Analysis of the structure of sown areas of grain cultures allowed revealing that in some regions of Altai Krai the share of buckwheat sowing is increased up to 30% and more of sown area of all grain cultures that significantly exceeds the area of the fallow used for grain cultures.

Grain cultures are the foundation of agriculture of Altai Krai that provides economic welfare of most producers.

Increased sown area of buckwheat leads to reduction of crop capacity of grain cultures in crop rotation for 15-20% with biological and climate potential to not less than 25 centner per hectare. At the same time in Altai in 2012 there were more than 336 thousand of hectares of fallow lands. Sown areas of groans cultures may be extended due to these areas. Our research (2003-2013) has shown that success of zonal agrotechnics of buckwheat depends not only on the choice of the best time for sowing but on fertilization, ways of sowing and seeding rate [8]. All these factors should be focused on development of favorable conditions for the best inflorescence forming, productive flowering and good fructification that support high output of grain [9, 10].

In steppe area the culture should be sown in the first decade of June that allows more effectively using summer rains in the second half of vegetation period. In forest-steppe it is more rational to sow buckwheat at the end of the third decade of May – beginning of June, in foothills – not later than the first decade of June.

Good field germination rate, preservation of vegetation to harvesting and the best biometrical indicators are provided by application of N<sub>30</sub>P<sub>30</sub>K<sub>30</sub>

locally with sowing of buckwheat. Foliar nutrition during budding with microfelsitic fertilizer "Master" with formula 18+18+18+3 as well as artificial extrapollination of buckwheat flowers provides good effect.

Favorable conditions for rich harvest of grain are provided in wide-row sowing with row-spacing 0,45 m but in this case it is necessary to undertake timely measured against weeds.

Considering the contrast character of meteorological conditions, characteristics of moistening, low level of field taming that leads to high infestation seeding rate of buckwheat in steppe with all ways of sowing should be lower than those for forest-steppe and foothills that are more moistened. For row sowing recommended norm should be 3.0-3.5 million of germinating grains per 1 hectare, for wide-row sowing – 2.0-2.5 million of germinating grains per 1 hectare depending on the level of moistening of the territory.

### Conclusion

Significant increase of crop capacity of buckwheat in Altai Krai in the closer perspective may be problematic due to low biological and climate potential of individual native zones and periodical droughts that increase the deficit of productive moisture in soil.

Sustainable increase of buckwheat grain production together with improvement of zoning technology may be achieved by expansion of sowing with using for agricultural purposes fallow lands by ploughing up and land-improvement.

The problem of buckwheat sown areas increasing may be solved by optimization of existing structure of sown areas as well as improvement of territorial distribution with account for relief, existence of watercourse and reservoirs, meadows, woodland belts and small woods. In such places there are good conditions for wild fertilizers that actively fertilize buckwheat flowers together with honey bees.

Scientific and production experience of buckwheat raising shows that application of zonal agrotechnical complex with account for food regimen and fertilization specifics allows obtaining in Altai Krai the harvest of this valuable culture at the level of 20-25 centner per hectare.

### Acknowledgements

Research has been carried out with funding of The Ministry of Education and Science in the scope of basic part of State Order (Research and Development # 353).

### Corresponding Author:

Dr. Vazhov Victor Markovich

Altai State Academy of Education named after V.M. Shukshin

Korolenko Street, 53, Biysk, 659333, Altai Region, Russia

### References

1. "Altaikraistat Information". Dated 18.09.2013 Volume 22-16/763:2.
2. Federal State Statistic Service. Sown areas and crop capacity of agricultural cultures by categories of farms in farms of all categories. Date Views 21.02.2014 [www.gks.ru/wps/wcm/connect/rosstat\\_main/rosstat/ru/statistics/enterprise/economy/](http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/enterprise/economy/).
3. Vazhov, V.M., 2013. Buckwheat in the fields of Altai. Moscow: Publishing House of the Academy of Natural Sciences, pp: 188.
4. Wang Y. and C. G. Campbell, 2004. Buckwheat production, utilization, and research in China. *Fagopyrum*, 21: 123-133.
5. Chasovskikh, V.P. and M.L. Tsvetkov, 2011. Main directions of development of grain production in agricultural and industrial complex of Altai Krai. *Altai State Agrarian University Herald*, 12: 33-38.
6. Vazhov, V.M., 2013. Foliar feeding and pollination of buckwheat as a factor of high yield and seeds quality on the black earth of Altai. *International Journal of Applied and Fundamental Research*, 1: Date Views 25.02.2014 [www.science-sd.com/pdf/2013/1/24461.pdf](http://www.science-sd.com/pdf/2013/1/24461.pdf)
7. Fesenko, A.N., O.I. Romanova and N.N. Fesenko, 2012. Peculiarities of common buckwheat adaptation to growing conditions. *The European journal of plant science and biotechnology*. V. 6, special issue 2: 75-79.
8. Vazhov, V.M., V.N. Kozil and A.V. Odintsev, 2013. General Methods of Buckwheat Cultivation in Altai region. *World Applied Sciences Journal*, 23 (9):1157-1162.
9. Quinet, M., V. Cawoy, I. Lefevre, F. Van Miegroet, A.L. Jacquemart and J.M. Kinet, 2004. Inflorescence Structure and Control of Flowering Time and Duration by Light in Buckwheat (*Fagopyrum esculentum* Moench.). *Journal of Experimental Botany*, (55)402: 1509.
10. Unatsuki, H., W. Maruyama-Funatsuku, M. Agatsuma and K. Fujino, 2000. Ripening Habit of Buckwheat. *Crop Science*, (40)4. Springer-Verlag GmbH: 1103-1108.

03/06/2014