"DEVELOPMENT OF SEA BUCKTHORN AND OTHER HORTICULTURAL MARKETS IN THE ASIA REGION"

AsiaBerry-2024

Proceedings by the Economic Institute of the National University of Mongolia

"DEVELOPMENT OF SEA BUCKTHORN AND OTHER HORTICULTURAL MARKETS IN THE ASIA REGION"

AsiaBerry-2024

30 October – 1 November

Wednesday, October 30, 2024

RESEARCH DAY 1. COLLABORATION OF TRIPLE HELIX

Time	Function	Location
Moderator: Mr. Uchral Purev. Vice President of the MNAFB		
8:00 a.m. – 8:50 a.m.	**Registration**	Library 502 National University of Mongolia
9:00 a.m. – 9:30 a.m.	**Open of the Conference** **Host Speech** *Mr. Nasanjargal Darjaa* President of the Mongolian National Association of Fruits and Berries **Welcome Speech** *Mr. Jambaltseren Tumur-Uya* State Secretary of MOFALI **Open Speech** *Prof. Ochirkhuyag Bayanjargal* Rector, National University of Mongolia **Open Speech** *Prof. Baasansukh Badarch* Rector, Mongolian University of Life Sciences **Guest Speech** *Dr. Thomas Moersel* President of German Sea buckthorn Society Vice President of ISA	Library 502 National University of Mongolia
9:30 a.m. – 9:35 a.m.	**Introduction to the development of sea buckthorn and other horticultural industry in Mongolia: 1954-2024**	Library 502 National University of Mongolia
9:35 a.m. – 9:50 a.m.	**Development of the Mongolian Sea buckthorn Market toward Asian and other Markets** *Prof. Tsevelmaa Khyargas* National University of Mongolia	Library 502 National University of Mongolia
9:50 a.m. – 10:10 a.m.	**Group photo**	
10:10 a.m. – 10:50 a.m.	**Break**	
Moderator: Mr. Uchral Purev. Vice President of the MNAFB		
10:50 a.m. – 11:10 a.m.	**Sea buckthorn products (Hippophae rhamnoides L.) – actual trends in Germany and the European Community** *Dr. Thomas Moersel* President of German Sea buckthorn Society Vice President of ISA	Library 502 National University of Mongolia
11:10 a.m. – 11:30 a.m.	**Assessment of genetic diversity of Mongolian sea buckthorn (Hippophae rhamnoides L.) cultivars using the RAPD-PCR method.**	Library 502 National University of Mongolia

	Turmunkh Gerelchuluun. Ph.D Mongolian University of Science and Technology	
11:30 a.m. – 11:50 p.m.	**Study of sea buckthorn harvesting by branch cutting in the condition of Siberia region** *Dr. Zubarev Yury* Vice President International Sea buckthorn Association Federal Altai Scientific Center of Agrobiotechnologies, Barnaul.	Library 502 National University of Mongolia
11:50 p.m. – 12:10 p.m.	**The development status of China's sea buckthorn industry** *Mr. Zhang Bin* International Sea buckthorn Association	Library 502 National University of Mongolia
12:10 p.m. – 2:00 p.m.	**Lunch**	
Moderator: Prof. Tsevelmaa Khyargas, National University of Mongolia		
2:00 p.m. – 2:20 p.m.	**Trade facilitation measures for exporting sea buckthorn** *Tsendsuren Davaa, PhD* Director (WSO RM Advisor) Risk Management Division Customs General Administration of Mongolia	Library 502 National University of Mongolia
2:20 a.m. – 2:40 p.m.	**Sea buckthorn meadow-garden, technological and economic aspects** *Prof. Oleichenko Sergey Nikolaevich* Kazakh State Agrarian Research University (Kaznaru)	Library 502 National University of Mongolia
2:40 p.m. – 3:00 p.m.	**Assessment of land suitability for fruit planting: A pathway to sustainable development** *Nasanjargal.D, Khandsuren.D, Myagmarjav.I, Oyuntuya.Sh, Buyanbaatar.A* School of Agroecology Mongolian University of Life Sciences	Library 502 National University of Mongolia
3:00 a.m. – 3:30 a.m.	**Break**	
Moderator: Mr. Uchral Purev. Vice President of the MNAFB		
3:30 p.m. – 3:50 p.m.	**Sea-buckthorn: complex processing** *Prof. Kotova Tatiana* East Siberian State University of Technology and Management Ulan-Ude	Library 502 National University of Mongolia
3:50 p.m. – 4:10 p.m.	**Morpho-genetic variation of wild sea buckthorn populations in Mongolia (Hippophae rhamnoides l. Ssp. Mongolica rousi)** *Tsendeekhuu.Ts, Dorjderem.B, Enkhtuul.Ts* National University of Mongolia	Library 502 National University of Mongolia
4:10 p.m. – 4:30 p.m.	**Practical Experience in Industrial Gardening with Orientation on Mechanized Harvesting: Honeysuckle and Sea buckthorn** *Karpov Victor* Technical director in Tomsk production company “SAVA”	Library 502 National University of Mongolia
4:30 p.m. – 5:00 p.m.	**Discussion Session** Q&A Peer-reviews	Library 502 National University of Mongolia
6:00 p.m. – 9:00 p.m.	**Dinner for foreign participants**	Tuushin Restaurant

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Thursday, October 31, 2024

RESEARCH DAY 2. SESSION 1: SCIENTIFIC AND EMPIRICAL RESEARCH

Time	Function	Location
8:20 a.m. – 8:50 a.m.	**Registration**	Soyombo B Tuushin hotel
Moderator: Turmunkh Gerelchuluun. Ph.D Mongolian University of Science and Technology		
9:00 a.m. – 9:20 a.m.	**"Utilizing Natural Fruits and Berries as Selection Materials in Mongolia"** *Khandsuren.D, Dorjderem.B* School of Agroecology Mongolian University of Life Sciences Peer-review	Soyombo B Tuushin hotel
9:20 a.m. – 9:40 a.m.	**Diseases of cultivated sea buckthorn, damage, and optimal methods of control** *Uranchimeg.A, Batchimeg.T* Institute of Plant Protection Research Peer-review	Soyombo B Tuushin hotel
9:40 a.m. – 10:00 a.m.	**Biochemical and technological study of boiled sausage with the addition of sea buckthorn seeds** *Bolortsetseg.N, Itgelsaikhan.E* School of Technology in Darkhan-Uul aimag Mongolian University of Science and Technology Peer-review	Soyombo B Tuushin hotel
10:00 a.m. – 10:20 a.m.	**Research Results on Harvesting Methods for Sea Buckthorn (Hippophae rhamnoides L.)** *Munkhtuvshin.Kh, Khandsuren.D* School of Agroecology Mongolian University of Life Sciences Peer-review	Soyombo B Tuushin hotel
10:20 a.m. – 10:50 a.m.	**Break**	
Moderator: Ass.Prof Khandsuren Damba, PhD. Mongolian University of Life Sciences		
10:50 a.m. – 11:10 p.m.	**The Effect of organic and inorganic mulches on the weed of sea buckthorn** *Otgon.J, Battsengel.B, Saikhantsesteg.S, Atarsaikhan.T* Institute of Plant and Agriculture Sciences Peer-review	Soyombo B Tuushin hotel
11:10 a.m. – 11:30 p.m.	**Research on the biology, ecology, damage, and distribution of the sea buckhorn fly (Rhagolethis batava Hering, 1958) in Mongolia.** *Munktsetseg.B, Ganchimeg.G, Dorjderem.B, Turbat.T* Institute of Plant Protection Research Peer-review	Soyombo B Tuushin hotel
11:30 a.m. – 11:50 p.m.	**Study findings on fighting methods against weed species in sea buckthorn field.** *Amarsaikhan.J, Azzaya.T, Otgonsuren.M* Institute of Plant Protection Research Peer-review	Soyombo B Tuushin hotel

11:50 a.m. – 12:10 p.m.	**Intensive technologies of sea buckthorn cultivation for central regions of Russia** *Mr. Puzrakov Ilya* Head of the "Sady Elizavety" Company Peer-review	**Online** Soyombo B Tuushin hotel
12:10 a.m. – 12:30 p.m.	**The comparison of monoterpenoids in Mentha and berry plants** *Tingting Huang, Undarmaa.D* School of Agroecology Mongolian University of Life Sciences Peer-review	Soyombo B Tuushin hotel
12:30 a.m. – 1:00 p.m.	**Wrap Up** Q&A Comments	Soyombo B Tuushin hotel
1:00 p.m. – 2:00 p.m.	**Lunch**	Soyombo B Tuushin hotel
7:00 p.m. – 11:00 p.m.	**Gala reception**	Tuushin Restaurant

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RESEARCH DAY 2. SESSION 2: INDUSTRY EXCELLENCE AND COMPETITIVENESS

Time	Function	Location
8:20 a.m. – 8:50 a.m.	**Registration**	Soyombo A Tuushin hotel
Moderator: Mr. Carl Krug, Key Expert II for the EU ITDM project		
9:00 a.m. – 9:20 a.m.	**Sea buckthorn leaves – from plantation to commercial application ten years research and development in Germany** *Mr. Axel Waehling* NIG Nahrungs-Ingenieurtechnik Peer-review	Soyombo A Tuushin hotel
9:20 a.m. – 9:40 a.m.	**Sea buckthorn industry upgrading through entrepreneurship and innovation.** *Nasanjargal Darjaa, Tsevelmaa Khyargas* MNAFB, National University of Mongolia Peer-review	Soyombo A Tuushin hotel
9:40 a.m. – 10:00 a.m.	**Distribution of Sea buckthorn and Market Potential in Nepal** *Mr. Youba Raj Pokharel* Forest Officer Ministry of Forest and Environment, Deputed at Commission for the Investigation of Abuse of Authority (CIAA), Kathmandu Peer-review	Soyombo A Tuushin hotel
10:00 a.m. – 10:20 a.m.	**Xinjiang Zhongke Sea buckthorn Technology** *Mr. Xu Jun* Chairman Xinjiang Zhongke Sea buckthorn Technology Company Ltd. Peer-review	Soyombo A Tuushin hotel
10:20 a.m. – 10:50 a.m.	**Break**	
Moderator: Professor Tsevelmaa Khyargas, National University of Mongolia		
10:50 a.m. – 11:10 p.m.	**Aligning the Uvs chatsargana GI with SDGs** *Munkhnaran Lkhagvasuren and Tsetsegsuvd Zagir* Uvs Sea buckthorn Producers' Association NGO Peer-review	Soyombo A Tuushin hotel
11:10 a.m. – 11:30 p.m.	**Support for the Sea buckthorn cluster initiative through the EU-funded ITDM project.** *Mr. Carl Krug* Key Expert II for the EU ITDM project Peer-review	Soyombo A Tuushin hotel
11:30 a.m. – 11:50 p.m.	**Work Exchange on Research in Sea-buckthorn Breeding, Cultivation, and Product Transformation** *Mr. Han Xiao* Hebei Shenxing Sea buckthorn Research Institute	Soyombo A Tuushin hotel

	Peer-review	
11:50 a.m. – 12:10 p.m.	**Extraction and study of the biological activity of flavonoids from Altay region sea buckthorn extraction cake** *E.S. Batashov, E.V. Averyanova, M.N. Shkolnikova, E.D.Rozhnov* Altayvitaminy Pharmaceutical Company Peer-review	Soyombo A Tuushin hotel
12:10 a.m. – 12:30 a.m.	**Introduction to Zelt Bio** *Mr. Eduards Vilks* **Sea buckthorn: A potential new industrial crop for Pakistan.** *Dr. Tanveer Ahmad* Ex-Chairman Department of Horticulture MNS-University of Agriculture Multan Peer-review	Soyombo A Tuushin hotel **Hybrid**
12:30 p.m. – 1:00 p.m.	**Wrap Up** Q&A Comments	Soyombo A Tuushin hotel
1:00 p.m. – 2:00 p.m.	**Lunch**	
7:00 p.m. – 11:00 p.m.	**Gala reception**	Tuushin Restaurant

FIELD DAY 3. TECHNICAL TRIP

To the Terelj Mountain Lodge (a unique program will be delivered to the participants who joined the technical tour.)

POSTER PRESENTATIONS

1. **Efficiency of biological preparations against sea buckthorn fly**
   Dejidmaa T[1], Nasandulam D[2], Batbayar N[1], Munkhtsetseg B[1]
   [1] Institute of Plant Protection Research
   [2]School of Agroecology, Mongolian University of Life Sciences
2. **Using DEM-CFD simulation in the berry's separation process**
   Ulziisaikhan P[1], Ganbold D[2], Gangerel.Kh[3]
   [1] Head of Graduate Department, School of Mechanical Engineering and Transportation,
   Mongolian University of Science and Technology
   [2] Lecturer, School of Engineering and Technology, Mongolian University of Life Science
   [3] Lecturer, School of Mechanical Engineering and Transportation
   Mongolian University of Science and Technology
3. **Study of the biology, ecology, distribution, and damage of the plum fruit moth (Grapholita funebrana Treitschke,1835) in Mongolia**
   Munkhtsetseg.B, Ichinkhorloo.B
   Institute of Plant Protection Research. laboratory of Entomology
4. **The results of research on Sea buckthorn and other fruit species at IPAS, Mongolia**
   D.Gantuya, U.Juuperelmaa , D.Oyungerel, S.Battumur
   Institute of Plant and Agricultural Sciences
   Fruit and berry, ornamental plant research division
5. **Primary assessment of the genetic diversity for sea buckthorn (hippophae rhamnoides l.) in Mongolia**
   Dorjderem Balchin, Khandsuren.Damba, Jamiyansuren Sandagdorj, Ninj Badam
   School of Agroecology, Mongolian University of Life Sciences
6. **The effect of different mulching types on the weed of berry blue**
   Otgon.J, Battsengel.B, Saikhantsesteg.S, Atarsaikhan.T
   Institute of Plant and Agriculture Sciences

CONTENTS

1. UTILIZING NATURAL FRUITS AND BERRIES AS SELECTION MATERIALS IN MONGOLIA

Khandsuren Damba[1], **Dorjderem** Balchin[1], **Nasanjargal** Darjaa[2]

1- Ass. professor, /Ph.D/, MULS, School of Agroecology
2- Mongolian National Association Fruits and Berries

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ABSTRACT

Seabuckthorn sub specie (Hippophae rhamnoides L. ssp mongolica Rous.) in the western region of Mongolia is found in the Altai and Khangai high mountains of Uvs, Hovd, Zavkhan, Bayan-Olgii, and Gobi-Altai aimags, as well as their tributary mountains. It grows along rivers such as the Hovd, Tes, Bohmuron, Torkhilog, Bulgan, Buyant, Zavkhan, and Borkh, and their tributaries. In the central region, it grows along the Selenge River in Bulgan and Selenge aimags (from the Selenge sum area of Bulgan province to the Selenge-Orkhon junction) and around the Orkhon-Selenge confluence."

Propagation of natural sea buckthorn using green cuttings has made a significant contribution to the fruit farming sector in Mongolia. This effort has not only supported the development of a national variety but has also facilitated the collection and field placement of primary genetic and breeding materials, enhanced the level of research, and provided essential resources. The research team considers this a highly successful and impactful project.

Roots began to develop 2–3 weeks after planting the green cuttings, and full rooting was estimated to occur after 4 weeks. Propagation of the berry plants through green cuttings resulted in a survival rate of 92.76% of the planted stock, which was then prepared for overwintering.

The average annual growth of natural sea buckthorn green cuttings was 13.86–15.2 cm, indicating that the nutrient area was sufficient, agricultural practices were followed in proper sequence, and procedures were carried out according to standards, as reflected in these quantitative indicators.

Keywords: *Natural wild seabuckthorn, softwood propagation, form, generation, resource, gene bank*

ITRODUCTION

Approximately 70 types and species of berry plants, adapted to the characteristics of various regions of Mongolia, are grown across its vast landscapes."Among these plants, the most

important in terms of its distribution, resources, and social, economic, and health significance is Sea buckthorn (Hippophae rhamnoides), which belongs to the Elaeagnaceae family."

Seabuckthorn sub specie (Hippophae rhamnoides L. ssp mongolica Rous.) in the western region of Mongolia is found in the Altai and Khangai high mountains of Uvs, Hovd, Zavkhan, Bayan-Olgii, and Gobi-Altai aimags, as well as their tributary mountains. It grows along rivers such as the Hovd, Tes, Bohmuron, Torkhilog, Bulgan, Buyant, Zavkhan, and Borkh, and their tributaries. In the central region, it grows along the Selenge River in Bulgan and Selenge aimags (from the Selenge sum area of Bulgan province to the Selenge-Orkhon junction) and around the Orkhon-Selenge confluence."

"The native range of Hippophae rhamnoides spp. Mongolica Rousi, a subspecies of sea buckthorn that grows in Mongolia, was confirmed by the Finnish researcher A. Rousi, the Mongolian scientist T. Tsendekhu (1996), and the Chinese researcher Lian Yongchang, along with other researchers (1998. (Ts, Variation in natural populations and phenogeographic study of Mongolian sea buckthorn (Hippophae rhamnoides L ssp. mongolica Rus). , 1996)

Researcher T. Tsendekhuu mentioned in his work that A. Rousi's study of the subspecies was based on the evolutionary genetics of sea buckthorn

The subspecies *(H. rhamnoides L. ssp. mongolica Rousi)* is primarily distributed in the river valleys of Central Asia, Europe, Siberia, and other regions of Asia. However, particular subspecies also grow at altitudes of 2,500 to 3,000 meters in the Pamir, Caucasus, and Himalayan mountains. (G.Pagma, 1974).

Mongolian researchers have been studying the distribution, resources, and locations of native sea buckthorn while also collecting various samples from the sea buckthorn thickets and shrubs in river basin areas involved in the research. They subsequently cultivated these samples in research institutes and stations, with the ultimate goal of developing new varieties of cultivated sea buckthorn for the country.

In addition to studying the distribution and resources of natural sea buckthorn and promoting its sustainable use, the Mongolian government has implemented specific measures to develop a scientifically based policy and strategy for advancing fruit farming.

To study the distribution and resources of natural sea buckthorn in Mongolia, collect various forms of it, and establish new fruit-growing enterprises for cultivating other types of fruit, exploratory research was conducted from 1959 to 1961. This research confirmed that fruit could be cultivated over an area of 12,000 hectares at 36 sites across 12 provinces, including Tuv, Selenge, Bulgan, Uvs, Hovd, Zavkhan, and Gobi-Altai.

Research has been conducted on the ecological environments, natural characteristics, and climatic features of river valleys with natural sea buckthorn thickets and shrubs in Mongolia, as well as the characteristics of plant community composition in these environments and the distribution and resources of natural sea buckthorn (D.Nasanjargal and others, 2014)

Researcher K. Myrzabek conducted a study on the distribution and resources of natural sea buckthorn in several soums of Bayan-Ölgii Province, updating the total area of sea buckthorn

distribution in Mongolia to 14.3 thousand hectares (Distribution, resources, and local varieties of natural sea buckthorn (Hippophae rhamnoides L. ssp. mongolica Rousi) in Bayan-Ulgii Province Doctoral dissertation,, 2000, pp. 22-38; Kh, 2000)

Specifically, various samples of natural sea buckthorn have been collected as seeds and softwood cutting propagation and cultivated at several locations, including the Shaamar Fruit and Vegetable Research Station in Selenge Province, the Sea Buckthorn Research Station in Ulaangom, Uvs Province, the Beekeeping Research and Production Station in Battsumber, Tuv Province, as well as the Darhan Plant Agriculture Research Institute, the Mongolian University of Life Science's "Agropark" Research and Training Center, and the research fruit garden area in Nart, Boronuur soum, with the aim of creating conditions for developing new varieties in the future.

RESEARCH OBJECTIVES

1. Collect high-yielding, low-thorn natural sea buckthorn varieties with high oil and nutrient content in one area to establish primary breeding material.
2. Propagate natural sea buckthorn using green cuttings.
3. Study certain morphological characteristics of natural berry-producing plants.

RESEARCH METHODOLOGY

Time of Year to Take Softwood Cuttings

Softwood cuttings are taken in late June through early July from the current season's growth. Cutting material should be flexible but mature enough to snap when sharply bent.

Methods for Pruning and Rooting Green Softwood

We harvested the cuttings in the cool of the morning from the medium-sized branches with a diameter of 4-5 mm and a length of 20 cm, which grew from the apex and lateral branching of the parent tree's crown. The bark was carefully removed without damage, and the cuttings were bundled in groups of 50 to 100. They were then immersed in a heteroauxin solution (a rooting stimulant) and kept in a cool place for 16 hours. Before planting, the cuttings were removed from the solution and thoroughly rinsed with clean water.

Growth regulator auxin hormone are substances that enhance the growth and regeneration capacity of plant tissues. They not only increase the rooting percentage of cuttings from green branches of sea buckthorn but also shorten the time required for root formation, accelerate the growth of the cuttings, and improve their quality.

Preparing Soil for Propagating Softwood Seabucktorn in a Greenhouse

The soil for propagating green cuttings in the greenhouse was prepared as follows:

- ✓ The soil in the construction area for the fog generation device was excavated to a depth of 40 cm, and a layer of river gravel 10 cm thick was spread evenly on top.
- ✓ This layer is intended to allow excess water accumulated in the soil to drain down freely.

- ✓ Black soil will be used. The black soil was crushed and sifted to separate out debris and plant roots, then spread in a 25 cm thick layer over the gravel. Coarse sand was evenly distributed in a layer 8-10 cm thick on top.

Methodology for Operating the Fogging Device

- ✓ Water was pumped from the artificial lake and applied through the fog generator, resulting in a water absorption of 2.5-3 cm per square meter over a 10-minute irrigation period.
- ✓ The green house fogging system not only keeps the soil for the cuttings consistently moist but also atomizes the water under high pressure, maintaining the humidity inside the greenhouse at a constant level of 95-98% and the air temperature between 20-30°C, thereby preventing the cuttings from drying out until they establish roots.
- ✓ Irrigation was consistently performed using the fog generation device from 7 AM to 8 PM. During the cool conditions of the morning and evening, misting was applied at intervals of 7-10 minutes; in the heat of the day, the intervals were set to 3-5 minutes; and during overcast and rainy conditions, misting occurred every 10-15 minutes for durations of 30 seconds to 1 minute. The leaves of the sea buckthorn were kept consistently covered with water.

Temperature and relative humidity measurements within the plastic film greenhouse

During the plant growth period, air temperature measurements were taken around 11, 14, and 17 hours, and the average temperature inside the greenhouse was determined over a 10-day period.

RESEARCH RESULTS

Samples of natural sea buckthorn green shoots were collected from various forms of sea buckthorn that grow along the river basins in five soums of Zavkhan, Hovd, and Uvs provinces *(Table 1)*.

A total of 8150 shoot summer's pruning, which is performed during is shoot trimming, which is performed during samples were collected from 11 forms of natural sea buckthorn distributed in the Western region, and these were then transferred to cultivation. Of these, 8150 samples were prepared from the following locations:

Table 1. Collected samples and materials of natural Sea buckthorn

№	Simple	Location	Number	Explanation
1	Sample 1	Zavkhan, Aldarkhan soum, Borkh river	184	The height of the bush is 2m, it has a vertical crown, medium thorns, and orange fruits.
2	Sample 2		414	
3	Sample 3	Zavkhan river, Mongolian sand	1500	Титмийн өндөр 2м орчим, саглагар титэмтэй, өргөс багатай, жимс тод шар өнгөтэй.
	Sample 4		931	
4	Sample 5	Zavkhan, Durvuljin soum, Black bush	410	
	Sample 5		1346	

	Sample 6		500	The height of the crown is about 2m, it has a loose crown, few thorns, and the fruit is bright yellow.
5	Sample 7	Zavhan, Durvuljin soum, Ulaan buraa	684	It has a weeping crown, many thorns, and red fruits.
6	Sample 8	Khovd, Bulgan soum, Sumiin ganuu	3000	The bush is low, with a weeping crown, and the fruit is yellow
7	Sample 9	Khovd, Bulgan soum, Ulaan uzuur	850	The bush is low, with a weeping crown, and the fruit is yellow
	Sample 10		640	The weeping crown has many thorns, the fruit is large, and the color of the fruit is bright red. The weeping crown has with many thorns, the fruit is large, and the color of the fruit is bright red.
8	Sample 11	Uvs, Tes soum	850	Саглагар титэмтэй, өргөс ихтэй, тод шар өнгийн жимстэй
	Sample 12		850	It has a weeping crown, many thorns, and bright yellow fruits
		Total	*8150*	

Results of the research on planting Seabucktorn softwood propagation

In the plastic-covered greenhouse, the air heats up very quickly on sunny days. To maintain a temperature of 22-25°C for the softwood cuttings, we opened the vents on the front and back sides of the greenhouse to allow airflow. During our research, on cloudy days, the greenhouse temperature was on average 2-3°C lower than on sunny days.

In the greenhouse where natural sea buckthorn softwood cuttings were propagated, the relative humidity was maintained at 75-80%. Air circulation was facilitated by opening the vents on the west and east sides, allowing the hot air to rise and escape while cooler air entered, thereby preventing overheating. To further protect the plants from excessive heat, a black shade net was used to reduce the intensity of sunlight.

Before planting the natural sea buckthorn softwood cuttings, the specially prepared soil was thoroughly watered to ensure full moisture saturation. Using a specialized row marker, the shoot trimmings were planted with a spacing of 7x7 cm, providing a 49 cm^2 nutrient area for each cutting. The pinch off the 4-5 leaves from the lower halves of the cuttings removed, leaving 4-5 buds exposed above the soil surface. After planting, the soil around the softwood cuttings was carefully compacted by hand.

The humidity inside the greenhouse was measured using a hygrometer, and the fogging system was activated when the humidity dropped below 85%. The temperature inside the greenhouse was measured in the morning, midday, and evening with a thermometer.

After the softwood cuttings developed roots, watering was reduced, and the greenhouse doors were opened in the morning and evening to acclimate the plants to outdoor conditions."

Results of the study on the air temperature and relative humidity in the greenhouse

The optimal temperature for rooting green cuttings is 22-30°C, with a relative humidity of 85-95%. Temperature has a lesser effect on root growth compared to stem and leaf development, but when the temperature decreases, root growth slows, resulting in fewer, shorter, and thicker roots. Soil moisture levels play a critical role in the development of the root system (*Table 2*).

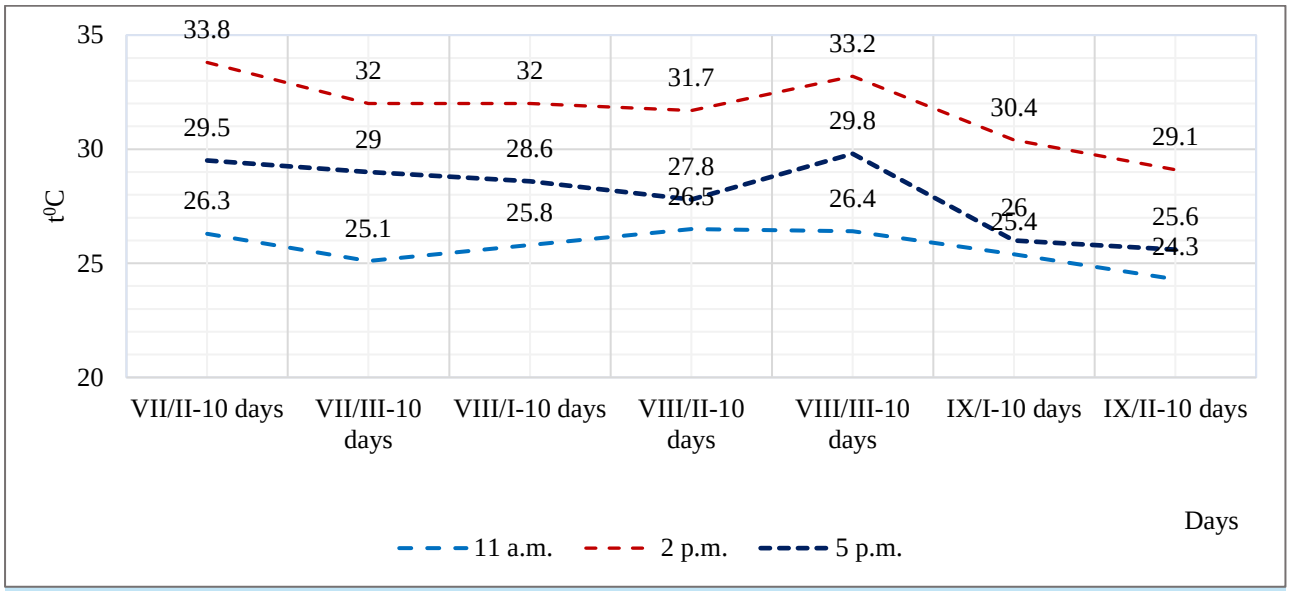
Table 2. Study of the Greenhouse condition

№	10 days	Air temperature			Air relative humidity		
		11a.m.	14 p.m.	17 p.m.	11 a.m.	14 p.m.	17 p.m.
VII	II 10 days	26.4	33.8	29.5	72.3	75.5	74.23
	III 10 days	25.1	32	29	82.85	80.1	82.8
	Average	**25.75**	**32.9**	**29.25**	**77.58**	**77.8**	**78.52**
VIII	I 10 days	25.8	32	28.6	86.8	84.5	87.8
	II 10 days	26.5	31.7	27.8	83.9	83.6	85.7
	III 10 days	26.4	33.2	29.8	70.2	75.2	74.1
	Average	**26.7**	**30.4**	**28.4**	**85.4**	**83**	**86.08**
IX	I 10 days	25.4	30.4	26	87	85.3	85.9
	II 10 days	24.1	29.8	27.1	85.3	85.45	83.65
	III 10 days	24.3	29.1	25.6	87.47	86.53	91
	Average	**25.9**	**29.1**	**26.25**	**88**	**85.6**	**89**

During the growth period of the plants, air temperature measurements were taken around 11, 14, and 17 hours, and the average environmental changes in the greenhouse were determined over a 10-day period. Measurements taken at these times corresponded to the high angle of the sun, with sunlight hitting at a 30-degree angle at 11 AM and again at 30 degrees at 5 PM. It was observed that the air temperature inside the greenhouse became excessively high, resulting in the plants wilting and turning yellow (D.Khandsuren, 2015)

Our research indicated that on the 10th of July, the highest recorded temperature was 31.5 degrees Celsius.

At this time, we opened the edge of the greenhouse that was not exposed to sunlight and used a shade cloth to operate the fogging system at intervals of 5 to 10 minutes to regulate the temperature. Additionally, we observed that as the air temperature increased, the humidity level decreased, and conversely, when humidity increased, the temperature decreased.



Picture 1. Trends in Air Temperature within the Greenhouse

One of the significant factors influencing the survival, growth, and development of green cuttings and rooted softwood cutting in a greenhouse is temperature and humidity.

During the periods of study, the air humidity in the greenhouse was measured at 77.5-79.0% during the second ten days of July and August, while the remaining periods showed humidity levels of 82.2-91.0% *(Picture 1)*.

Table 3. Survival Rate of green softwood, %

№	**Simple**	**Location**	**Number**	**Survival Rate of softwood, %**
1	Sample 1	Zavkhan, Aldarkhan soum, Borkh river	210	91.43
2	Sample 2	Zavkhan, Aldarkhan soum, Borkh river	210	97.14
3	Sample 3	Zavkhan river, Mongolian sand	1500	63.33
4	Sample 4	Zavkhan river, Mongolian sand	931	93.92
5	Sample 5	Zavkhan, Durvuljin soum, Black bush	410	97.67
6	Sample 6	Zavkhan, Durvuljin soum, Black bush	1346	92.86
7	Sample 7	Zavkhan, Durvuljin soum, Black bush	500	90.56
8	Sample 8	Zavhan, Durvuljin soum, Ulaan buraa	684	91.9

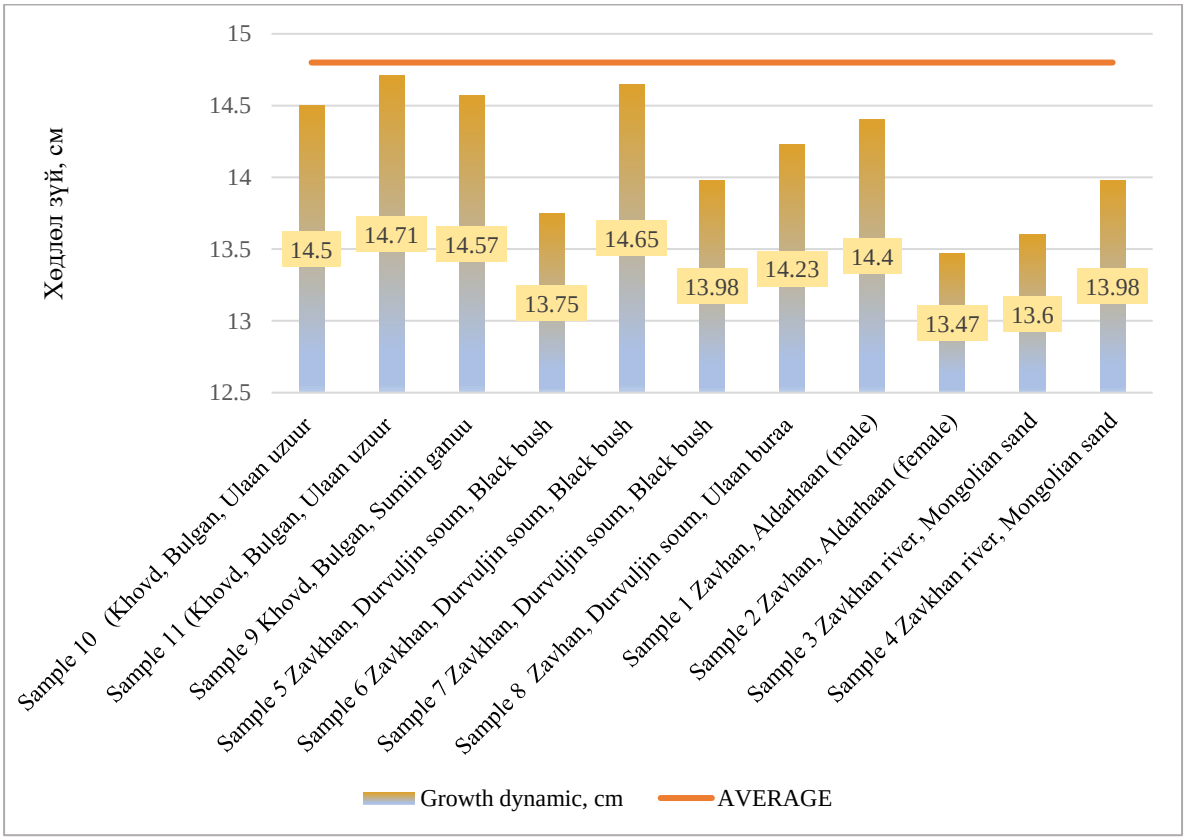
9	Sample 9	Khovd, Bulgan soum, Sumiin ganuu	64	98.57
10	Sample 10	Khovd, Bulgan soum, Ulaan uzuur	850	98.48
11	Sample 11	Khovd, Bulgan soum, Ulaan uzuur	650	95.57
		Average	*8150*	*91.94*

The green softwood cuttings of natural sea buckthorn were treated with a growth promoter and transported from the western region, located 1400-1500 km away from Ulaanbaatar, within 2-3 days.

We planted softwood cuttings of green branches with 4-5 leaves, and during the rooting process, the leaves fell off, and new leaves emerged, completing their growth. The newly formed leaves underwent photosynthesis, resulting in vigorous plant growth and creating conditions for future independence. Photosynthesis is essential for all living organisms, as it releases vital oxygen back into the atmosphere.

The application of rooting stimulants during planting was effective, resulting in a survival rate of 91.94%, indicating that the care for the propagation of softwood cuttings was properly executed *(Table 3)*.

The growth of softwood cuttings is inconsistent and their survival rates vary due to the climatic and ecological characteristics of the parent plants.



Picture 2. The average growth dynamic of the green cuttings of natural sea buckthorn, cm

Biometric measurements of the green cuttings were taken from 20 plants in each repetition after the growth of the softwood cuttings had ceased. When measuring from the root collar of the green cutting to the top of the plant, the average growth was found to be between 13.86 and 15.2 cm. This indicates that the spacing between rows and plants was appropriate *(Picture 2)*.

Results from the collection of pollen, seed, and softwood cutting samples from wild berry plants

Pollen samples were collected during the flowering period of natural Sea buckthorn, which blooms early in spring, from April 25 to May 15, 2023. The samples were gathered from eight riverine sea buckthorn populations across 10 districts in the Zavkhan, Khovd, Uvs, Selenge, and Gobi-Altai aimags.

Pollen samples from late-flowering berry plants were collected from the Hangai floristic region and areas around Ulaanbaatar. The collection included around 20 species of plants, such as 4 species of rose (Rosacaeae), 5 species of Altain Honeysuckle (Lonicera), and 2 species of Blackcurrant (Ribes).

Table 4. Number of the collection of pollen, seed, and softwood cutting samples from wild berry plants

№	Family, genus, and species names of natural berry plants	Sample forms		
		Sample pollen	Seeds and fruits	Softwood cutting
1	*Hippophae rhamnoides*	8	24	24
2	*Sambucus manshurica*	1	1	1
3	*Lonicera*	2	2	2
4	*Rosacaeae*	4	2	2
5	*Grossularia acicularis*	2	2	
6	*Ribes rubrum*		2	2
7	*Vaccínium vítis-idaea*		1	
8	*Vaccínium caesariense*		1	
9	*Eleaeagnus L.*		1	
10	*Lycium rutnenicum*		1	
Нийт		**17**	**37**	**31**

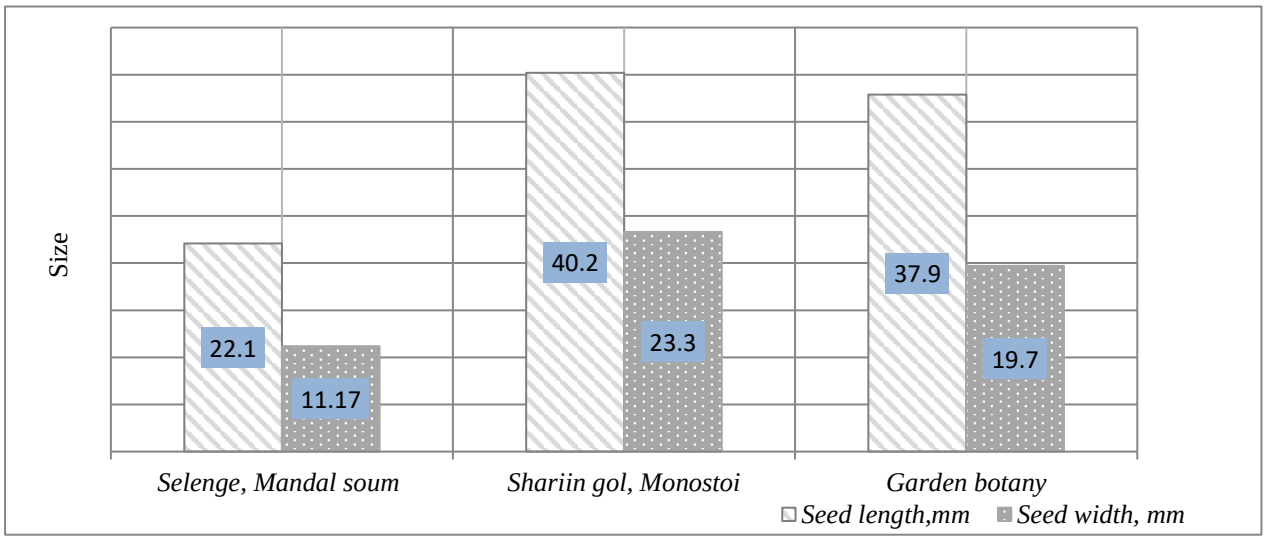
A total of 85 samples were collected, including 17 samples of natural fruit plant pollen, 37 samples of fruit seeds, and 31 samples for vegetative propagation (green softwood cuttings) *(Table 40)*.

For example,

Table 5. Comparative results of (Rosa) seeds, mm

№	Plant name	Site of sampling	Average seed lengt (mm)		Average seed width (mm)	
			x±m	Cv %	x±m	Cv%
1	*Rosa acicularis*	Selenge, Mandal soum, Teregtiin davaa	22,1±0,3	7,7	11,17±0,2	11,2
2	*Rosa acicularis*	Shariin gol, Monostoin am	40,2±6,3	6,3	23,3±0,3	9
3	*Rosa acicularis*	Batany gardan in UB	37,9±0,5	8,2	19,7±0,3	10,8
4	*Rosa oxyacantha*	Batany gardan in UB	36,2±0,5	6,5	22,3±0,4	9,7
5	*Rosa palustris*	Batany gardan in UB	35,4±0,5	6,9	18,6±0,3	8,8
6	*Rosa pimpinellifolia*	Batany gardan in UB	37,8±0,8	12,2	23,7±0,5	12,1
7	*Rosa laxa*	Batany gardan in UB	35,4±0,5	7,3	24,1±0,5	10,9

From the above table, it can be seen that when comparing the two natural species, the lengths and widths of the seeds of cultivated and acclimatized roses in the Botanical Garden are approximately similar; however, there are differences between the species. The length and width of the seeds of the wild rose (Rosa) collected from the Monostoi area in the Shariin Gol sum of Darkhan-Uul aimag are greater than those of the cultivated roses. The number of achenes per fruit is 4-8 for the wild species and 5-17 for the cultivated species.



Picture 3. Results of Comparison of natural and cultivated samples (Rosa acicularis)

The seed size was determined using the MIVNT Micro- Image Analysis system.

The above samples were compared with cultivated samples. When comparing the samples, the seed length of the sample from Mandal soum in Selenge Province was 15.8 mm shorter, while the seed from Monostoi on the Sharyn Gol River was 2.3 mm longer. The seed width of the sample collected from Mandal soum in Selenge was 8.53 mm smaller, whereas the seed width from Monostoi on the Sharyn Gol River was 3.6 mm larger. Based on these research findings, the sample from Monostoi on the Sharyn Gol River exhibited greater seed length and width (*Picture 3*).

This difference is attributed to the characteristics of the natural environment and climate.

Table 6. Comparative Results of the Morphological Characteristics of Natural Sea Buckthorn Seeds

№	**Number of samples**	**Site of sampling**	**Average seed lengt (mm)**	**Average seed width (mm)**	**Seed thickness, mm**	**1000 seed weight**
1	Sample 1	Zavkhan, Aldarkhan soum, Borkh river	3,9±0,9	1,8±0,07	1,2±0,03	12,1±0,2
2	Sample 2	Zavkhan, Aldarkhan soum, Borkh river	3,5±0,1	1,4±0,1	1,2±0,45	10,3±0,1
3	Sample 3	Zavkhan river, Mongolian sand	4,6±0,1	2,6±0,04	1,6±0,045	13,9±0,03
4	Sample 4	Zavkhan river, Mongolian sand	4,55±0,3	2,7±0,09	1,7±0,46	13,8±0,14
5	Sample 5	Zavkhan, Durvuljin soum, Black bush	3,9±0,9	1,8±0,07	1,2±0,03	12,1±0,2
6	Sample 6	Zavkhan, Durvuljin soum, Black bush	3,5±0,1	1,4±0,1	1,2±0,45	10,3±0,1
7	Sample 7	Zavkhan, Durvuljin soum, Black bush	3,6±0,05	1,4±0,6	1,2±0,04	10±0,1
8	Sample 8	Khovd, Bulgan soum, Sumiin ganuu	3,9±0,1	1,9±0,6	1,7±0,045	12,1±0,2
9	Sample 9	Khovd, Bulgan soum, Ulaan uzuur	4,7±0,1	2,9±0,1	1,4±0,5	13,9±0,01

10	Sample 10	Khovd, Bulgan soum, Ulaan uzuur	3,6± 0,8	2,4±0,2	1,1±0,045	11,2±0,1
11	Sample 11	Khovd, Bulgan soum, Ulaan uzuur	4,1± 0,1	2,3±0,2	1,4±0,5	13,5±0,1

The natural sea buckthorn fruit exhibits various shapes, including round, oval, egg-shaped, and elongated forms, with a diversity of colors that distinguish it. Based on the morphological characteristics of natural sea buckthorn seeds, it is possible to develop new hybrid varieties. Seed morphology including shape and surface feature depends on genetic and hereditary traits of the plant, as well as on ecological conditions Epidermal characters are only slightly influenced by environmental conditions ((Barthlott, Wilhelm, 2008).

According to the research results, Samples 3 and 4 have a diameter of 4.55–4.60 mm, while Sample 9 measures 4.7 mm, which is 0.6–0.9 mm larger than the others. Additionally, seed thickness in Samples 4 and 8 is 0.2–0.5 mm greater than in the other samples. The average seed width is also 0.2–0.3 mm larger. Based on the 1000-seed weight, Samples 4 and 9 show the best performance.

CONCLUSION

1. Propagation of natural sea buckthorn using green cuttings has made a significant contribution to the fruit farming sector in Mongolia. This effort has not only supported the development of a national variety but has also facilitated the collection and field placement of primary genetic and breeding materials, enhanced the level of research, and provided essential resources. The research team considers this a highly successful and impactful project.
2. Roots began to develop 2–3 weeks after planting the green cuttings, and full rooting was estimated to occur after 4 weeks. Propagation of the berry plants through green cuttings resulted in a survival rate of 92.76% of the planted stock, which was then prepared for overwintering.
3. The average annual growth of natural sea buckthorn green cuttings was 13.86–15.2 cm, indicating that the nutrient area was sufficient, agricultural practices were followed in proper sequence, and procedures were carried out according to standards, as reflected in these quantitative indicators.
4. A total of 85 samples were collected, including 17 samples of pollen from wild fruit-bearing plants, 37 samples of ripe fruits, and 31 samples for vegetative propagation (green cuttings). Samples of natural sea buckthorn from Bulgan soum in Khovd province and along the Zavkhan River have superior seed morphological characteristics compared to others.

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2. SEABUCKTHORN PRODUCTS (HIPPOPHAE RHAMNOIDES L.) – ACTUAL TRENDS IN GERMANY AND THE EUROPEAN COMMUNITY

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Key words: European seabuckthorn products, quality control and organic production.

The German Seabuckthorn market is characterized by many differences. The cultivation is predominantly ecological (organic) and the products themselves represent a niche product. As a result, consumers place special demands on Seabuckthorn products in terms of quality. Seabuckthorn is perceived by the public as a particularly healthy food. In connection with this, it is expected that these products are free from undesirable accompanying substances, contaminants and additives.

In the past decades usage of Seabuckthorn juice and oil were the main areas of business. In the presence the full usage of raw materials became more interesting. So, especially use of leaves or by-products from berry-processing came into focus. Extracts are one main focus of R&D. Leaves from Seabuckthorn are already in the market, products based on extracts from leaves are actually more located in other fields than food. During the routine examination of raw materials, semi-finished products and finished products, we found to varying degrees that even products that were labeled as ecologically produced are contaminated with residues of pesticides and chemicals. This effect also occurs to a greater extent in the case of imported goods from third countries or other EU member states. As a rule, it can be stated that the residues found are of the order of magnitude that can be attributed to unintentional contamination of the raw materials or the processed products. From our observations, the following categories of substances in particular are to be classified as critical: residues from pesticides, polyaromatic hydrocarbons, plasticizers, chemical starting materials. Based on the legislation of the European Union on organic farming, we try to determine together with our clients where the substances entered can come from. The following typical ways of contamination are evident for the raw goods that were produced in relatively close proximity to German processing plants:

1. Contamination by drifts at neighboring conventional farms. In particular, this provides explanations for contamination with pesticides
2. Previously unexplained contamination with polyaromatic hydrocarbons. So far we have not been able to establish any connection with processing technology, location or other parameters.
3. Plasticizers and other chemicals used in the cleaning or manufacture of items that come into contact with the product. A risk position arises here, particularly when using plastics for storage or transport.

4. Entries of unknown type of chemicals. The contamination of former chemical sites, military training areas and open-cast lignite mines, including the associated power plants, plays a decisive role here, particularly in eastern Germany.

If one evaluates the found experimental data, one sees that a relevant toxicological risk does not exist. On the other hand, one has to admit that exposure to these substances is undesirable from the consumer's point of view and therefore does not improve the reputation of Seabuckthorn products.

3. ASSESSMENT OF LAND SUITABILITY FOR FRUIT PLANTING: A PATHWAY TO SUSTAINABLE DEVELOPMENT

Nasanjargal Darjaa, Mongolian National Association Fruits and Berrie

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INTRODUCTION

Mongolia is located in the highlands of Central Asia. It boasts a vast landscape, featuring a combination of high mountains, dense forests, and expansive steppes. It is fragmented into extreme microclimate zones in terms of physical geography and relief, and in some areas it gets -40-450 cold in the winter. In the summer, it heats up to more than 400 degrees, and the ground freezes 2.5-3 meters deep. There is little precipitation after the ground freezes in most regions. Due to the low amount of snow and strong winds in the area, the impact on soil moisture reserves is insufficient, largely due to the lack of snow cover. In addition, frequent spring frosts that persist until late in the evening and early autumn frosts create unfavorable conditions for fruit cultivation, which has hindered the intensive development of the industry.

Despite these natural and climatic features, nearly 70 types of wild fruits are adapted to the conditions of the regions.

For instance, sea buckthorn, gooseberry, blackcurrant, blue honeysuckle are grown in the high mountains of the western region and the river edges originating from them, blueberries, cranberry, red currant, blackcurrant, blackberry, rose hip berry, black cherry, raspberry are grown in the central and eastern region forests and in the edges of rivers. Nitraria sibirica, desert cistanche, goji, and Vincetoxicum sibiricum are widely grown in the southern Gobi desert

Due to the diverse land formations and extreme climatic conditions, the cultivation of fruits in Mongolia started considerably late, in the middle of the last century. For example, the first research-experiment-production organization, "Shaamar fruit and vegetable research station" was established in 1954 in Shar Kokhoi, Shaamar Sum, Selenge Province, and 36 locations in

12 provinces -Central, Selenge, Bulgan, Uvs, Hovd, Gobi-Altai, Bayankhongor, etc. were surveyed between 1959 and 1961, and it was determined that fruits can be planted in a 1210-1465 ha area. Based on this study, with government support, fruit cultivation and breeding were successfully implemented on a total of approximately 1000 hectares in various regions of the country. The implementation was carried out based on scientific research and experiments.

In the 1990s, when the socio-economic regime was transitioned to a market economy, the research institute, which was primarily engaged in fruit cultivation and research and experimentation, was privatized and divided into smaller units, including regional branches, farming units, and agricultural union brigade units. It gradually ceased operation.

However, at the beginning of 2000, the activity of fruit farming was revived with the government's attention. The government has approved and implemented the national programs "Seabuckthorn" (2010-2016) and "Fruit and Berries" (2018-2022), respectively. In support of the government's policies, within the framework of cooperation between international banking and financial institutions and the government, it provided appropriate technical assistance and financial investment support for projects and programs implemented in the country. For example, FAO implemented the technical assistance project "Improving Fruit Production in Mongolia" between 2017 and 2019.

However, the country meets only 5% of the population's domestic fruit and vegetable demand, and 95% of it is imported from foreign countries. According to statistics, 18,000 to 22,000 tons of fruits are imported annually, resulting in a significant amount of currency being spent, which hurts economic development. Apples, pears, peaches, plums, oranges, and grapes are predominant in almost 50% of all imported fruits.

Gobi and steppes of the country with a good heat balance /south of the 48th latitude from Bulgan Sum in Khovd Province to Khalkhgol Sum in Dornod Province/ and relatively less affected by extreme cold and strong winds, with good soil fertility and water supply - the main area for agriculture /Selenge, Central, Bulgan, Darkhan-Uul, etc/, there are still traces of the experience of successfully planting most of the seeds and stone fruits mentioned above based on the previous research.

It is believed that the "Billion tree" initiative in 2020 and "Food supply and security" initiative in 2021 by the President of Mongolia is of great importance for development of the fruit industry of which mainly dependent on imports that aims on one hand, to reduce the negative effects of climate change and protect the nature, and on the other hand, to improve domestic food production to secure the population's food demand.

Therefore, within the framework of the Scala project, to implement policies and decisions of the higher and local levels of the government effectively, the activities shall include as below; research and analysis of the factors of efficient and appropriate management of fruit cultivation are carried out according to the appropriate methodology, study the opinions of local administrations, experts, fruit growers, breeders, and producers of the respective provinces and soums, and evaluation conclusions are drawn up and recommendations are made accordingly to the government level.

RESEARCH OBJECTIVES

The primary objective of the project is to identify drought-resistant fruit varieties suitable for cultivation in the western agricultural region, determine the value chain, assess the suitability of cultivation land, create an atlas, and make it publicly available in the context of introducing climate change-adapted and mitigation technologies. Within this goal, the following objectives:

1. To determine the current state of the fruit and berry industry in Mongolia and the characteristics of cultivation in the western region,
2. Develop research methodology, conduct field research, and summarize results.
3. To identify good practices of climate change adaptation and mitigation,
4. Identify the types and varieties of drought-resistant fruits and determine their value chain.
5. Evaluate the suitability of the cultivation land for growing fruits.

RESEARCH METHODOLOGY

We will conduct field research and process the results according to the following route.

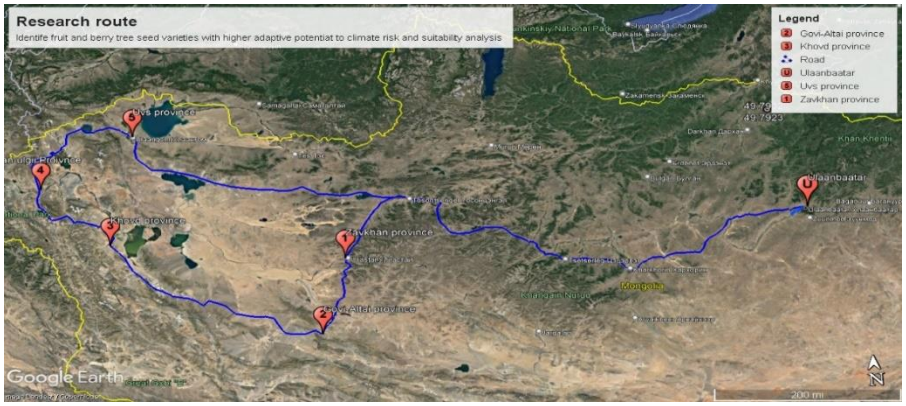


Fig 1. Route of the field survey

This study will be conducted using the multi-criteria geographic information system methodology, which involves developing and evaluating the suitability of land for fruit cultivation in the western region of Mongolia. To this purpose, the following tasks were set:

- Identifying constraint factors for assessment of land suitability for fruit growing
- To select and identify the main factors affecting the assessment of the land suitability for fruit growing
- Developing an evaluation hierarchy of factors influencing the assessment of the suitability of fruit-growing land
- Mapping and processing based on integrated evaluation of land suitability for fruit cultivation
- Validate the accuracy and consistency of the integrated suitability assessment image with an error matrix

To implement the above goals and objectives, the following assessment and mapping methods will be used.

CONSTRAINT FACTORS

The base condition map is represented by numeric values of 0 and 1, which represent allow and disallow conditions, where the value 0 represents an impossible or disallowed condition and a value of 1 represents an allowed or possible condition.

Factor maps (parameters impact map and factor map)

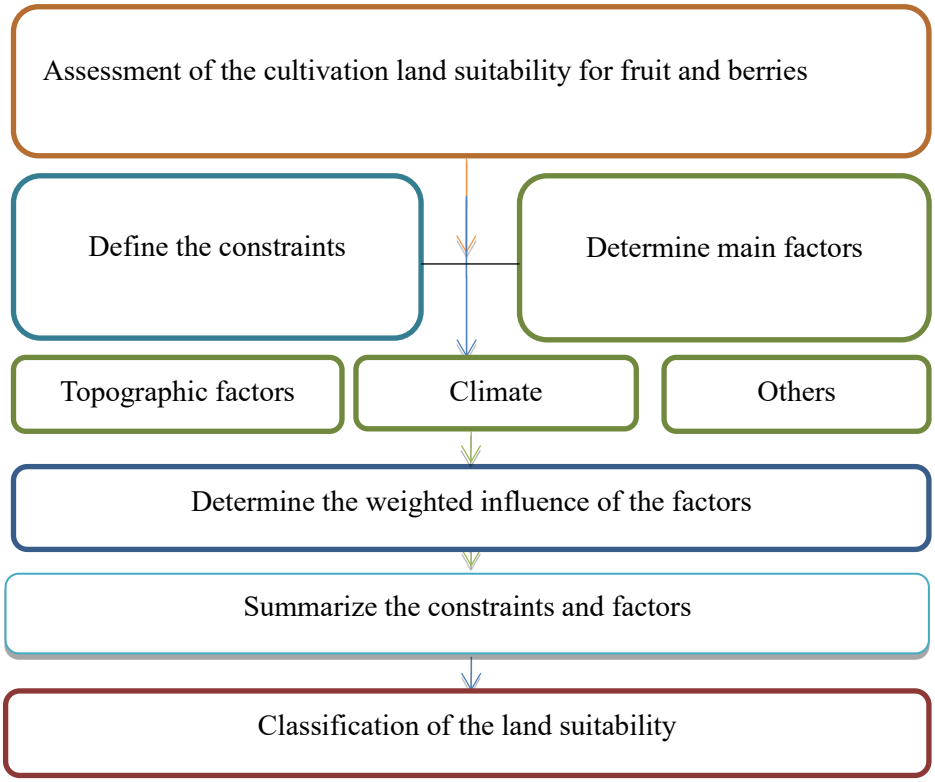


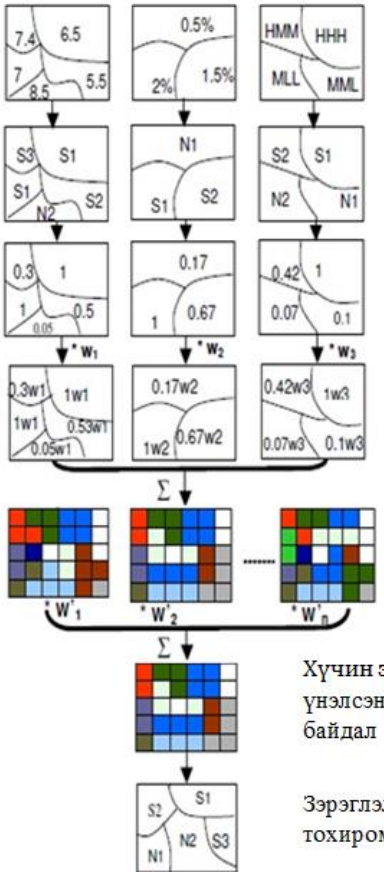
Fig 2. When multiple factors are used in suitability assessment, the weighted average influence method is used.

To select a suitable location, the selected factors are classified according to their suitability for the fruits, and a scoring method is developed and adjusted to each parameter of the evaluation factor.

To evaluate the suitability of land, firstly, the basic conditions are selected and a mapping of the constraints, and secondly, the Factor map, representing the influence of the criteria, is calculated according to the land suitability assessment method.

Schemes of the cultivation land suitability for fruit and berries

Land suitability primarily involves a large amount of data and encompasses multiple factors. The analytic hierarchy process (AHP) is a classical land suitability analysis procedure that gives a systematic approach to making proper decisions for site selection. It also suggests the integration of the GIS-based land suitability model for site selection (Mendoza 1997).



Factors

Classified factors

Ranked factors

Weighted factors

Suitability by factors

Summarize suitability by factors

Suitability by ranks

Fig 3. Stages of the weighted influence for multifactors

Source: Assessment of land condition, quality and suitability, I.Myagmarjav, P.Myagmartseren

Accuracy and compatibility rating methodology

Accuracy assessment is a necessary step in research and should be used in social planning and decision-making where the level of confidence that modeled images represent reality is sufficient.

In other words, the overall accuracy is obtained by dividing the sum of the diagonal cells by the total number of cells ('classes 1 to q') (Foody 2002, Joseph 2005). In the figure, the overall accuracy is expressed as (SUM(n11+ n22+n33……+nqq)/n)·100, and the mathematical formula is given below by Foody.

$$General\ accuracy = \frac{\sum_{i=1}^{q} n_{ii}}{n} \times 100$$

nii – i sum of diagonal class q- Max number of class

In a perfect model (which certainly does not exist in reality), all cells of the comparison class intersect and match, leaving the rest blank, resulting in 100% accuracy (Joseph 2005).

Cohen's kappa coefficient (κ) is a statistic that is used to measure inter-rater reliability (and also intra-rater reliability) for qualitative (categorical) items. It is generally thought to be a more robust measure than simple percent agreement calculation, as κ takes into account the possibility of the agreement occurring by chance. There is controversy surrounding Cohen's kappa due to the difficulty in interpreting indices of agreement. Some researchers have suggested that it is conceptually simpler to evaluate disagreement between items (Congalton et al. 1999; Stehman and Czaplewski 1998, Smits et al. 1999, Janssen 2000, Foody 2002).

$$\text{Kappa coefficient} = \frac{n\sum_{i=1}^{q} n_{ii} - \sum_{i=1}^{q} n_{i+}\, n_{+i}}{n^2 - \sum_{i=1}^{q} n_{i+}\, n_{+i}}$$

RESAERCH RESULTS

Evaluation of the basic conditions of land suitability for fruit and berry cultivation

In a Boolean map, a data value has two value conditions: 0 and 1. A conditional value of 0 indicates an impossible or disallowed condition, and a conditional value of 1 indicates an allowable or possible condition. A comprehensive assessment of the above basic conditions requires a detailed assessment of the factors that allow the conditions.

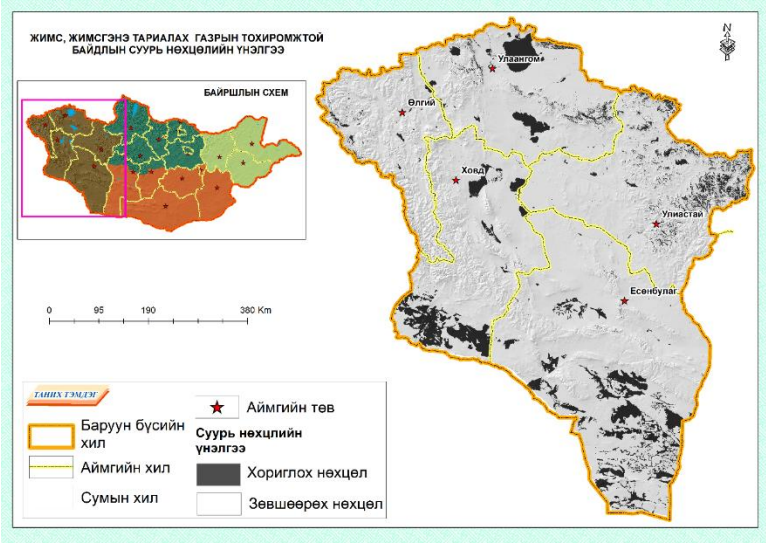
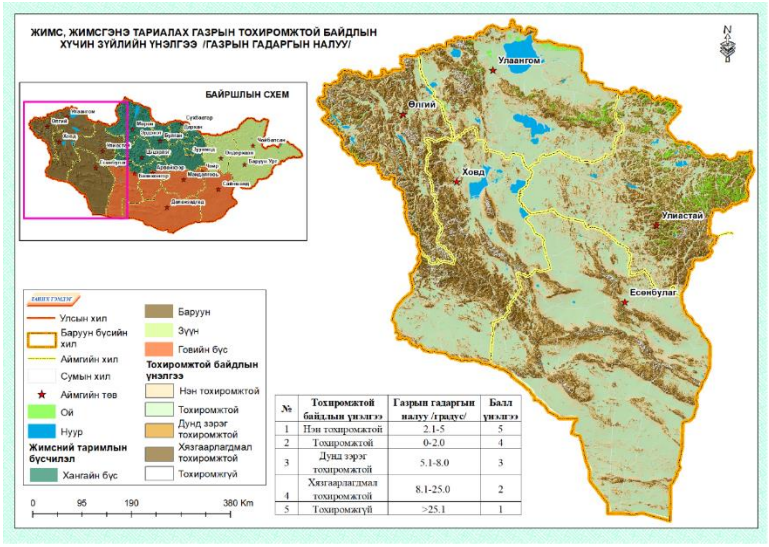


Fig 4. Evaluation of the basic conditions of land suitability for fruit and berry cultivation

Evaluation of suitability of land surface slope

The condition of the surface slope has a significant effect on the natural resources necessary for agriculture, such as moisture, heat, and solar radiation (B. Chimedregzen, 2004). From this point of view, it is important to develop criteria for surface slope that affect the suitability of agricultural land. For this reason, it was considered that the grade of the slope will affect the assessment of the suitability of the land for fruit and berry cultivation as follows:

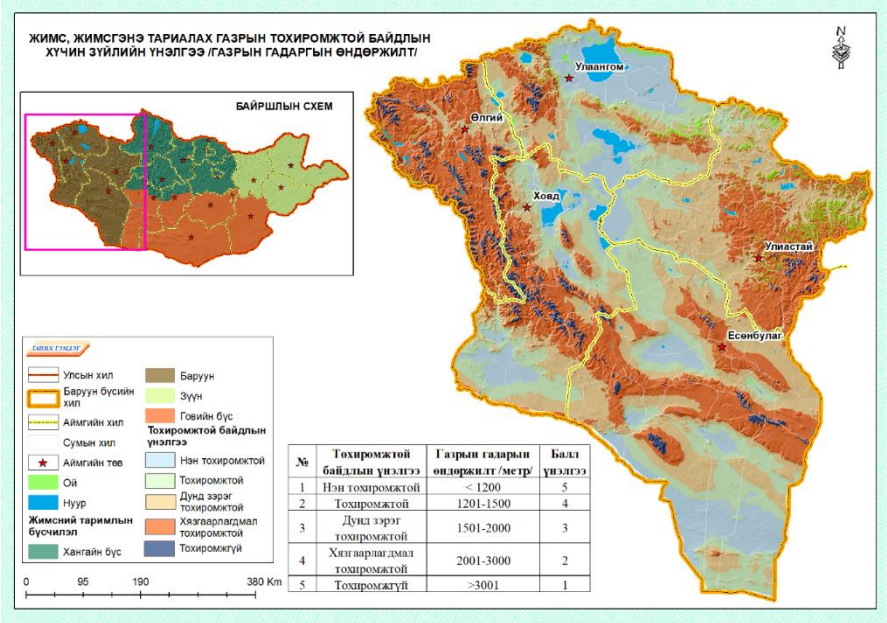


№	Тохиромжтой байдлын үнэлгээ	Газрын гадаргын налуу /градус/	Балл үнэлгээ
1	Нэн тохиромжтой	2.1-5	5
2	Тохиромжтой	0-2.0	4
3	Дунд зэрэг тохиромжтой	5.1-8.0	3
4	Хязгаарлагдмал тохиромжтой	8.1-25.0	2
5	Тохиромжгүй	>25.1	1

Fig 5. Evaluation of the suitability of land surface slope

Evaluation of the suitability of land surface elevation

As the elevation of the surface, such as the slope of the surface, has a significant impact on natural resources, moisture, heat, and solar radiation, which are essential for growing fruits and vegetables, a hierarchy of evaluation criteria has been established.



№	Тохиромжтой байдлын үнэлгээ	Газрын гадаргын өндөржилт /метр/	Балл үнэлгээ
1	Нэн тохиромжтой	< 1200	5
2	Тохиромжтой	1201-1500	4
3	Дунд зэрэг тохиромжтой	1501-2000	3
4	Хязгаарлагдмал тохиромжтой	2001-3000	2
5	Тохиромжгүй	>3001	1

Fig 6. Evaluation of the suitability of land surface elevation

The size of the area was calculated by dividing it into grades in a way that the elevation of the land would affect the assessment of its suitability for growing fruits and vegetables.

Evaluation of line suitability

The 90 m resolution SRTM-DEM map of the western region of Mongolia was evaluated using the Arcmap software to evaluate 5 levels of elevation depending on the elevation value.

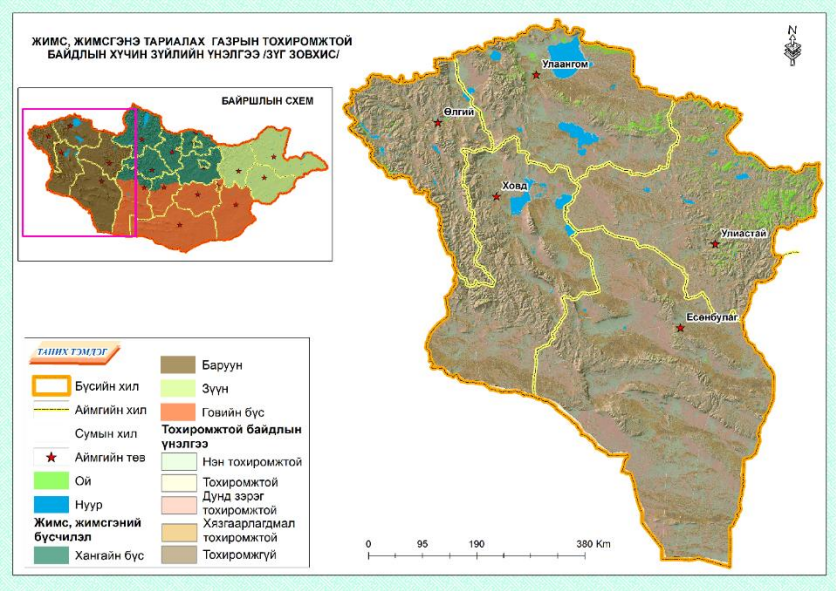


Fig 7. Evaluation of line suitability

The area was divided into grades to determine its suitability for fruit and berry cultivation.

Assessment of the suitability of water supply sources

In assessing the suitability of a place for growing fruits and vegetables, the area size was divided into grades based on how the water supply source would affect it.

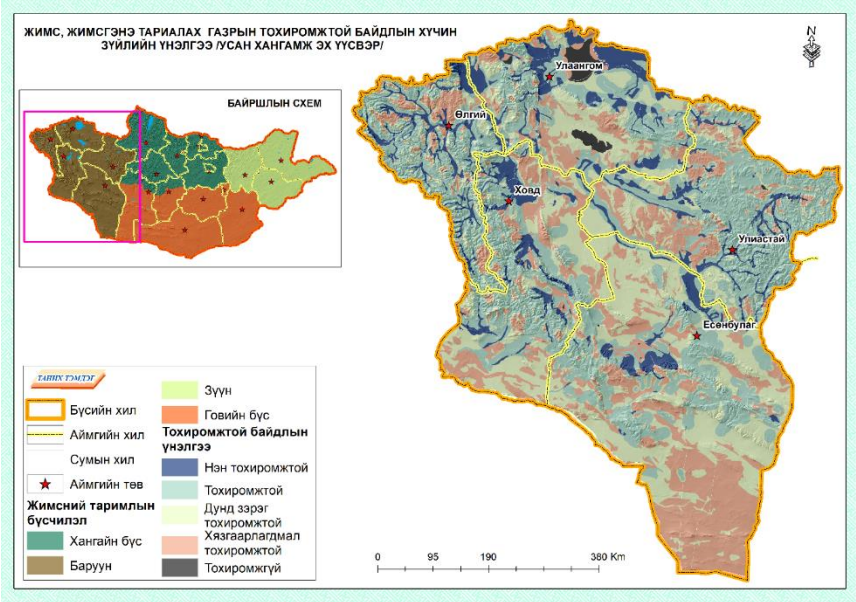


Fig 8. Assessment of the suitability of water supply sources

Evaluation of suitability of soil typology

When choosing a place to grow fruits and vegetables, it is necessary to plant them in dark brown or brown soil with good nutrient composition of sandy loam and light loam particles, not exposed to slopes or prevailing winds. However, it is not suitable for cultivation in soils with low fertility, heavy grain content, salty, salty, marshy and swampy soils..

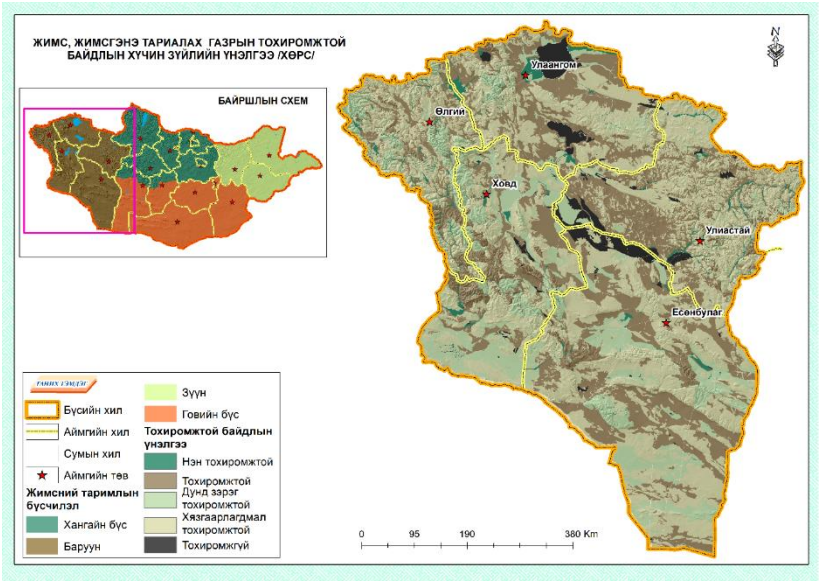


Fig 9. Evaluation of suitability of soil typology

Evaluation of suitability of heat supply

It is important to consider the conditions required by the environment in which cultivated plants, fruits, and berries are growing, or the influence of plant life factors (heat, moisture, air).

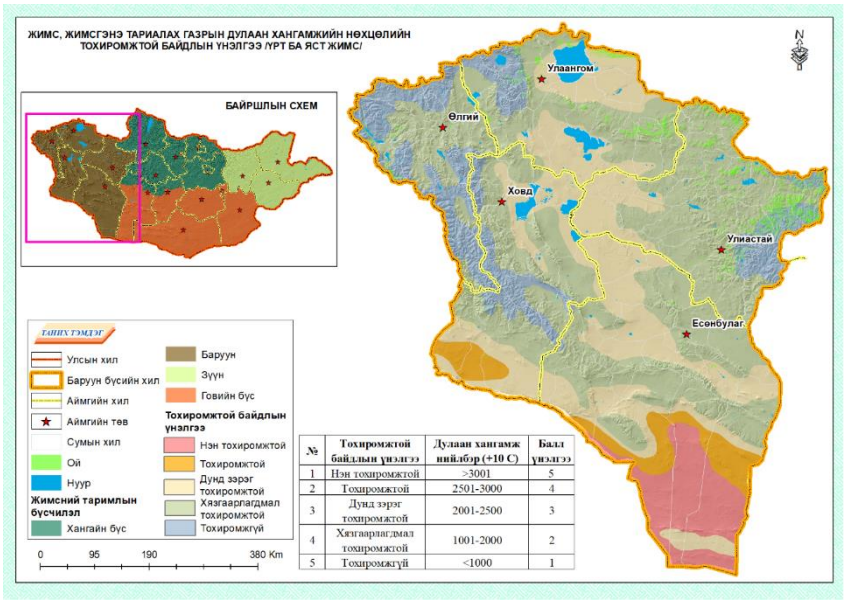


Fig 10. Evaluation of suitability of heat supply

Suitability assessment of total annual precipitation

The total amount of precipitation in Mongolia is low, but the amount of annual precipitation varies from place to place depending on the location of the mountains and their height. For example: 250-390 mm of precipitation falls in the mountainous regions of Khangai, Khuvsgul, and Khentis, and in the valleys of large rivers, while in the mountainous regions of Altai, 90-130 mm and in the plains about 180-280 mm. Thus, as the amount of precipitation decreases from the north to the front, the minimum annual precipitation is 70-150 mm in Gobi region.

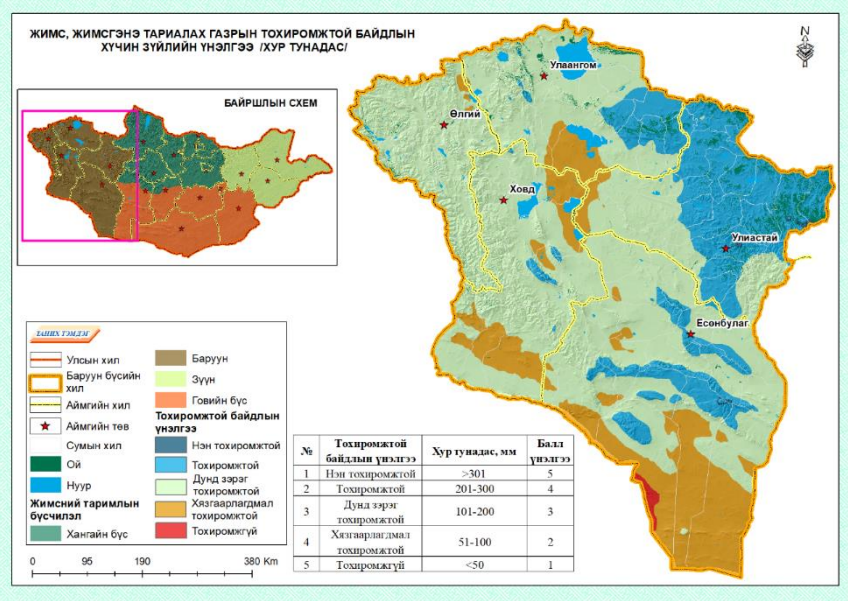


Fig 11. Suitability assessment of total annual precipitation

Suitability assessment of mean wind speed

The size of the area was calculated by dividing it into grades according to how the average annual wind speed affects the assessment of the suitability of the place to grow fruits and vegetables.

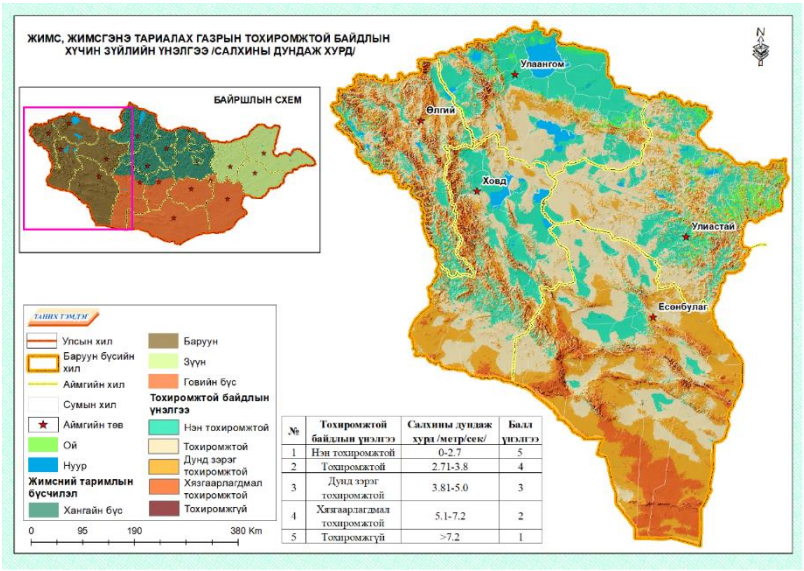


Fig 12. Suitability assessment of mean wind speed

An integrated evaluation of fruit and berry suitability factors

The overall assessment of the above factors was mapped using radiometric correction, and all images were corrected with a value between 0-255. The higher the value, the more suitable, and the lower the value, the area is not suitable for fruit and berry cultivation..

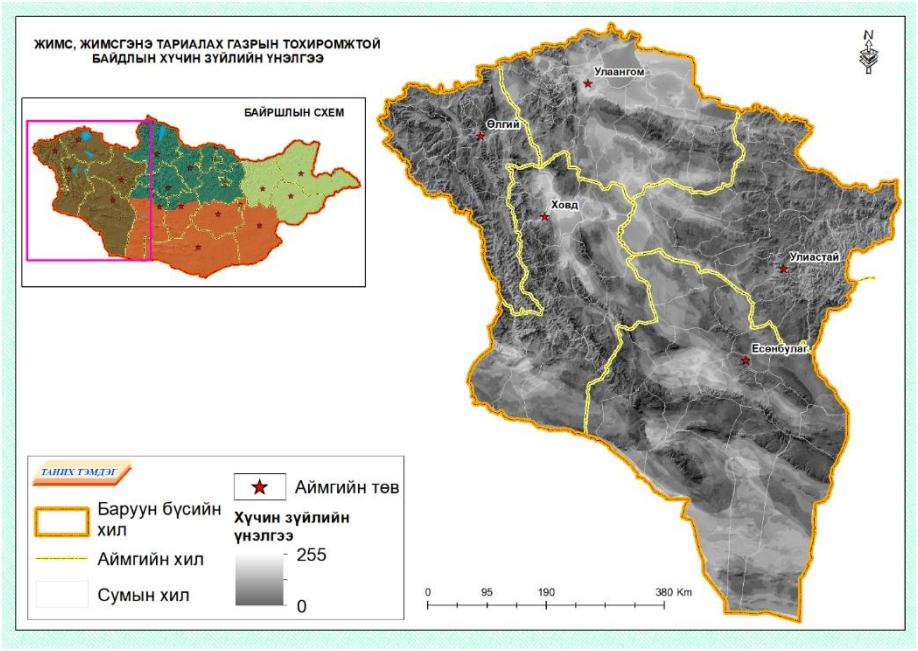


Fig 13. An integrated evaluation of fruit and berry suitability factors

An integrated assessment of the suitability of the site for the cultivation of fruits and vegetables

When carrying out the evaluation of the suitability of the land for fruit and berry cultivation, two main evaluations were carried out: basic conditions and factors**.**

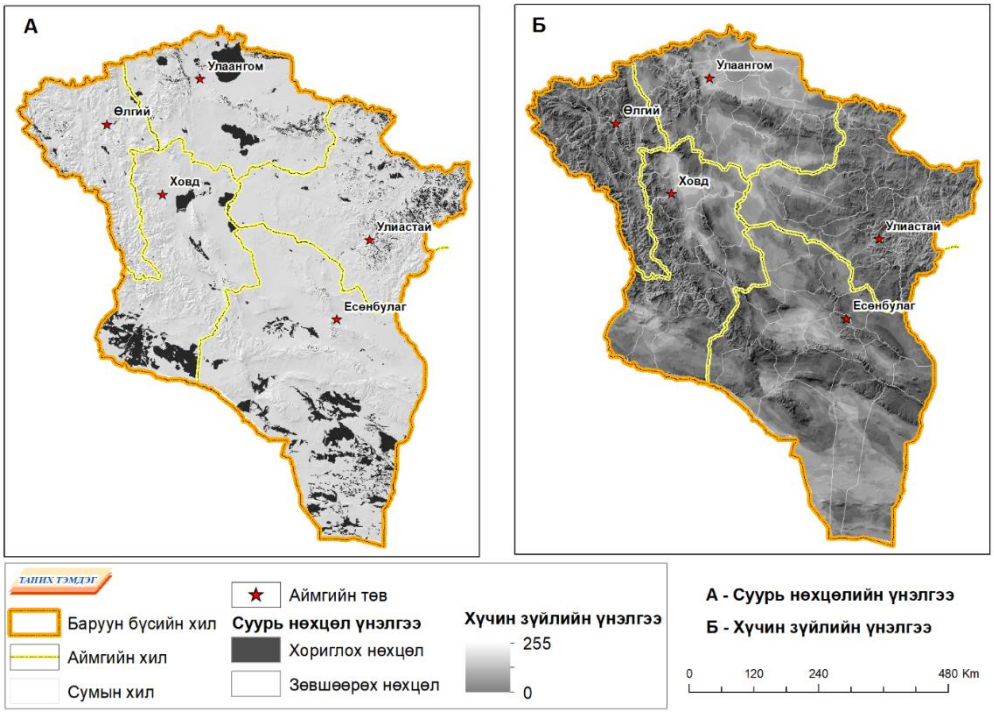


Fig 14. Baseline and factor assessment

An integrated assessment of the suitability of the site for the cultivation of fruits and vegetables

When making a comprehensive evaluation of land suitability for fruit and berry cultivation, it was classified as suitable, moderately suitable, limited suitable, unsuitable, and basic conditions limiting land use.

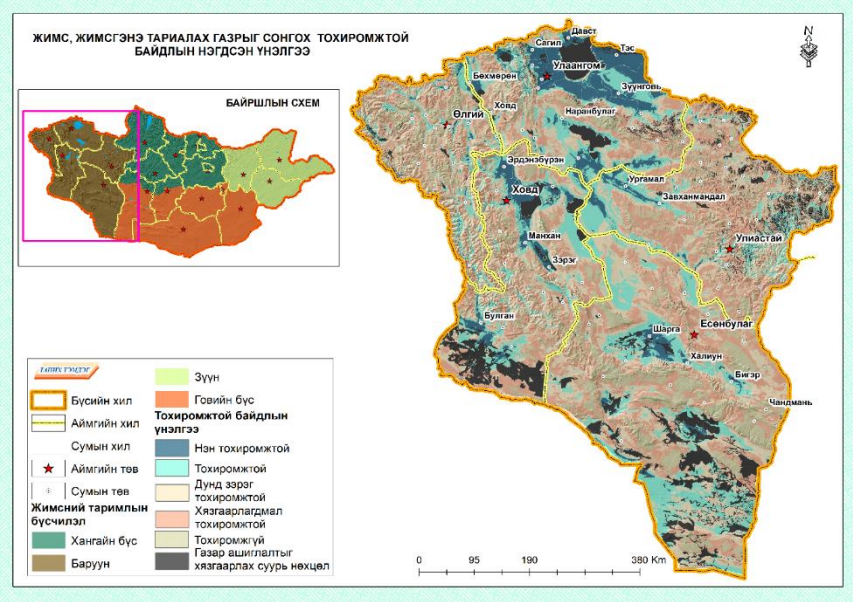


Fig 15. An integrated assessment of the suitability of the site for the cultivation of fruits and vegetables

According to the results of the integrated assessment of the suitability of the land for fruit and berry cultivation, 9.3 percent of the total area of the western region, or 39,253 km², is very suitable, and 19.1 percent, or 80,635 km², is moderately suitable. The area is moderately suitable, 24 percent of the 101,550 ha area is limited suitable, 14.2 percent or 60,105 km² is unsuitable, 9.7 percent or 41,009 km².

Table 1. The results of the integrated assessment of the suitability of the place for the cultivation of fruits and vegetables

№	Classification of soil	Western region		Bayan-Ulgii		Khovd		Uvs		Zavkhan		Govi-Altai	
		км^2	%	км^2	%	км^2	%	км^2	%	км^2	%	км^2	%
	A	1	2	3	4	5	6	7	8	9	10	11	12
1	Very convenient	39253	9.3	4328	1.0	5229	1.2	11211	2.7	6081	1.4	12404	2.9
2	Appropriate	80635	19.1	10309	2.4	11618	2.8	12643	3.0	14526	3.4	31539	7.5
3	Moderately suitable	99932	23.7	13972	3.3	18408	4.4	15161	3.6	19927	4.7	32464	7.7
4	Limited suitability	101550	24.0	11604	2.7	21082	5.0	14661	3.5	23981	5.7	30222	7.2
5	Inconvenient	60105	14.2	5735	1.4	11326	2.7	9073	2.1	11979	2.8	21992	5.2
6	Basic conditions for limiting land use	41009	9.7	1150	0.3	10108	2.4	8147	1.9	6812	1.6	14791	3.5
All		422484	100.0	47098	11.1	77772	18.4	70895	16.8	83306	19.7	143412	33.9

CONCLUSION

1. According to the results of integrated suitability assessment of land for fruit and berries cultivation, 9.3 percent (3942072 ha) of total area in the western region is suitable, 26 percent (10980532 ha) area is moderately suitable, 33.2 percent (14033451 ha) of area is limited suitability, 21.7 percent (9186456 ha) of area is not suitable, and 9.7 percent (4105865 ha) of area is basic condition to limit land use. According to the results of this study, the western region has 52.1 percent of its total area suitable for growing fruits and vegetables.
2. When comparing the results of soil in the forest strip area and the natural area, soil pH is slightly increased, and soil humus content decreased by 0.07-0.11% in the forest strip area. Important soil nutrients, nitrogen (0.25- 1.18 mg/100 g soil) and phosphorus (0.18-1.62 mg/100 g soil), increased in the forest strip areas. However, potassium (4 -15 mg/100 g soil) is decreased. Therefore, it is advisable to use fertilizers in areas with forest strips in appropriate doses and according to scientific norms.
3. In the western region, the proportion of physical clay in the soil, i.e., less than 0.01 mm, increased by 0.3-3.7 percent in the area with a forest strip compared to the area without a forest strip, as indicated by the results of the soil analysis. There is an opportunity to reduce the negative effects of climate change by having a positive effect on the substance regime.
4. Most of the citizens who participated in the survey, 46.8 percent, earn their main household income from agricultural production.
5. In terms of time engaged in business, 92 percent of them are up to 6 years, and 92.7 percent of them are more than 6 years, but 80 percent of the participants in the study of Bayan-Olgii province are engaged in fruit, 6.7 percent are seeds, 20 percent are seedlings, and 6.7 percent are leaves; In Gobi-Altai province, 88.2 percent of respondents grow fruit, 17.6 percent of seedlings, in Zavkhan and Hovd province, 100 percent of fruits, 16.7 percent of respondents in Zavkhan province, seeds, 50 percent of respondents, seedlings, 11.1 percent of respondents in Hovd province, and 96 percent of respondents in Uvs province. Fruits, 8 percent seeds, 20 percent seedlings, and 4 percent leaves indicates that the development level of the value chain is relatively weak in regions where agricultural business is primarily developed. At the same time, the production of processed products is starting to recover. Households work in both the raw material supplying and processing stages of the fruit value chain.
6. 52.4 percent of the respondents reported growing sea buckthorn on more than 75 percent of their total area, 9.8 percent on 60-74 percent, and 6.1 percent on 45-59 percent. However, 31.7 percent of all respondents cultivate currants on 29 percent or less of their total area, and 13.4 percent of them cultivate cherries on 13.4 percent of their total area. Considering that 15.9 percent of all respondents grow other fruits and vegetables on most of their land, diversification has begun; however, a more detailed analysis is needed. Eighty-two percent of fruit growers answered that they can fully utilize the capacity of their fields, 14.5 percent did not, and 3.6 percent did not know.

7. When determining the structure of the fruit value chain configuration in the western economic region, it is necessary to demonstrate a map of the innovation of the fruit value chain in the selected aimags, to find a business model and solution for the fruit supply chain, to expand the logistics of the trade flow, and to describe and plan comprehensive measures to improve the business environment of the aimags step by step.

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4. “SEABUCTHORN MEADOW-GARDEN, TECHNOLOGICAL AND ECONOMIC ASPECTS”.

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In Kazakhstan and neighboring Kyrgyzstan, wild sea buckthorn species Hippophae rhamnoides, (subspecies turkestanica) grows. This species is characterized by xerophytism, which manifests itself in small fruits and significant thorniness of shoots. In Kazakhstan, this species grows over a large area in the south and southeast of Kazakhstan and is localized mainly in river beds and mountainous areas. Wild sea buckthorn is one of the dominants of the Issyk-Kul region. It is distinguished here by significant polymorphism and stable fruiting. Moreover, massive damage to it by pathogenic organisms is observed here to an insignificant extent. In Issykul, since the end of August, harvesting of sea buckthorn has been carried out for the sale of fruits on the local market and in neighboring republics, Kazakhstan and Uzbekistan. The climate of the Issyk-Kul region, especially its coastal part, is favorable for the majority of berries. It is characterized by mildness and the absence of frost.

According to independent experts, the world demand for sea buckthorn is huge and continues to grow as well as in Kyrgyzstan and Kazakhstan. Therefore, a significant increase in its area is predicted in the coming years. Plantation cultivation of sea buckthorn has been held back due to the species' stubbornness and, consequently, problems with harvesting. Wild crop areas are often inaccessible for the logistics of the harvesting process, and labor productivity in this operation is very low. In European countries, where the fixed minimum wage is high, industrial harvesting of fruits in wild plantations is problematic. Altai varieties, especially the latest generation, can solve this problem.

Plants of cultivars of sea buckthorn have certain disadvantages that are clearly manifested in traditional growing systems. Slow entry into the fruiting season and increasing yields significantly reduce the economic efficiency of growing crops and its attractiveness for farmers. Manual harvesting in unproductive plantations is also highly costly, despite the achievements in breeding. In the southern regions, Altai varieties, unlike the local ecotypes of the turkestanika subspecies, ripen very early and do not stay on the branches for a very long time, burning and drying out. A big problem in growing sea buckthorn is also its high attractiveness for various bird species. Therefore, the industrial cultivation of sea buckthorn in these regions, as well as on the coastal lands on Issyk kul on the Kyrgyzstan and in particular in the south-east of Kazakhstan, which is generally favorable for industrial cultivation, has been problematic until recently.

Optimal ecological conditions for sea buckthorn are observed where the frost-free period does not exceed 180 days, and thaws in winter are not so long. Sea buckthorn plantations should not be planted where the sum of active temperatures above 10^0C exceeds 3300C. To the soils of sea buckthorn. due to the presence of nodule bacteria, it is more tolerant. The coastal region of Issyk-Kul with an altitude of 1600 m should be recognized as the zone of ecological optimum for sea buckthorn. In the south-east of Kazakhstan, the optimal altitude for sea buckthorn is

between 850-1300 m above sea level. Below this level, it is too hot for sea buckthorn in summer, and above this level, due to high solar activity and daytime thaws in winter, cultivated sea buckthorn does not adapt well enough and reduces its yield due to summer stagnation and winter awakening of buds. In the Issyk-Kul region, these phenomena are not observed.

The labor productivity of pickers on new varieties can reach 30 kg per day sometimes 50 kg. There are a number of other approaches to harvesting sea buckthorn, including mechanized. We do not recommend the use of direct combining for a number of reasons, the main of which is significant damage to plants after exposure to shaking mechanisms and rapid self-fermentation leading to a significant deterioration in the harvested crop. As a rule, the plant, after two - a maximum of three periods of such harvestining, begins to dry out and dies. To date, there are no varieties fully suitable for this type of harvesting. As a definite alternative to manual harvestining, it is possible to recommend cutting fruit-bearing branches, followed by freezing and shaking the fruits. Traditional cultivation methods of planting one maximum of three thousand plants per hectare are not quite suitable for this method of harvesting. Having entered full fruiting for 4-5 years after cutting the branches with a harvest, the plants will be restored within two years. Therefore, only two industrial crops will be obtained within seven to eight years. This does not allow us to achieve the necessary economic efficiency and is unlikely to be widely used in production. **I**n Kazakhstan, in the early 2000s, the technology of the sea buckthorn meadow garden was developed, based on fundamentally new basic directions. First of all, this affected the density of plantings, which was increased by more than 10 times. Then, a variant of complete mowing of the aerial parts of plants with a crop in the 3rd year after planting was tested. This allows you to minimize the cost of manual labor in this operation. The yield obtained in the experiments reached 40 tons in terms of 1 ha. The study of cut bushes showed that they fully grow back in a year and form a yield of the same level as in the 3rd year. Those. about 80 t/ha of fruit can be obtained from the plantation in five years, which ensures high economic efficiency.

In 2018, experimental work with the sea buckthorn meadow garden was continued in Kyrgyzstan on new generation varieties. The nutritional regime has been improved so much through the use of fundamentally new biostimulants and fertilizers. This made it possible to obtain a basic 40 t/ha under production conditions, and 1.3 times higher in experimental plantings. The Research Institute of Horticulture of Siberia has also developed a machine for separating fruits from branches, which, in addition to freezing, allows using shaking equipment for harvesting. In Europe and Chine such equpment already widely used. All this indicates that the developed technology has no alternative and broad prospects for its mass implementation in various regions.

We also evaluated the innovative technology in comparison with the currently existing and implemented in Russia, European countries and China. As noted earlier, the lack of an effective technological solution to a large extent held back the prospects for a wide distribution of sea buckthorn, especially in developed countries, where the level of the minimum wage is very significant.

In the variant of the meadow-garden, full depreciation of plantations and the receipt of significant profits are planned already for the 3rd year after planting. Cutting highly dense

plantations allows you to plan a similar harvest for the 5th year after planting, which was experimentally proven by us in the course of research work carried out in the southeast of Kazakhstan. And since harvesting works make up only a small part of the costs and do not exceed 16% with almost 50% with other technologies, the advantage of the technological solution proposed by us is unambiguously. At the same time, profitability during the five-year technological cycle increases by 3.6-6.1 times, and the cost of production decreases by 1.6-1.9 times, respectively. For comparison, we also show the option of harvesting fruits in wild plantations practiced in China, India and Kyrgyzstan, which has no further economic prospects and causes significant environmental damage.

5. MORPHO-GENETIC VARIATION OF WILD SEA BUCKTHORN POPULATION'S IN MONGOLIA (*HIPPOPHAE RHAMNOIDES* L. SSP. *MONGOLICA* ROUSI)

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ABSTRACT

Sea buckthorn is one of the valuable species in the Mongolian flora. The natural populations of the plant the significant material to select and cultivate the sea buckthorn, virgin grove - biological resource to use and preserve.

In this study, the variability of phenotypic features and genetic variation among Mongolian populations of *Hippophae rhamnoides* L. spp. *mongolica* Rousi were analyzed and compared.

Mongolia is a native range of this subspecies. Also, the Mongolian sea buckthorn has disjunction distribution, occurring in different natural zones of Mongolia and along valleys of eight rivers. We conducted studies of the morphological features in different natural zones, where desert, semi desert botanic-geographical region Mongolia ((Dzungaria Gobi and Great Lakes depression, Bulgan, Zavhan, Khovd, Tes river) and forest steppe (Selenga, Orkhon and Sognogor Bayangol rivers). The morphological characters ssp. *mongolica* in Mongolia distinguished from ssp. turkestanica (Singh et al., 2011), and also seed features different from ssp. *turkestanica*, ssp. *caucasica* and ssp. *rhamnoides.*

As well as we evaluated the H^2-specific value of the fruit oil according to the results we obtained, in the forest-steppe zone the values of oil H^2 are: 0.38 for the Selenga population, 0.32 for the Sognogur – Bayangol population, 0.43 for the Bogd-Chigestei population; in the desert and semi-desert zones: 0.62 for the Khovd population, 0.72 for the Zavkhan population, 0.56 for the Tes river, and 0.58 for the Bulgan river

Keywords: population variation, heritability, genetic resource.

INTRODUCTION

Hippophae rhamnoides ssp. *mongolica* Rousi is one of the Mongolian indigenous rare wild plant because its native locality is Mongolia, although its distribution range occurs with comparatively limited in adjacent regions: China (Altai mountain), Kazakhstan and Russia (Altai territory, Tuva republic, Irkutsk territory and Buriat Republic) respectively.

Hippophae rhamnoides ssp. *mongolica* Rousi 's bush usually up to 2.5 m, seldom 6 m high, branches mostly straight, rather slender, of a quill grayish or brownish color, older stems often rough, twisted, lateral thorns long and slender, usually non branched. Leaves alternate, mostly 40-60 mm long, 5-8 mm broad (length/breadth ratio mostly 7-10), often broadest toward the apex or near the middle, with rather obtuse apex, green or slightly silvery above, silvery white beneath, without or with a few rust-colored stellate hairs. Dry fruits 6-9 mm long, 5-8 mm broad, spherical or nearly so, peduncle 1 to 4mm, seeds elliptic, flattened, mostly 3.8-5.1 mm long (Rousi A, 1971).

The genus *Hippophae* L. belongs to the family *Elaeaginaceae*. The *Hippophae* was founded by C. Linnaeus, including only two species which were recorded in Species Plantarum in 1753. On the basis of the analysis of variation three species *Hippophae* are recognized, *H. rhamnoides* L., *H. salicifolia* D.Don., and *H.tibetana* Schlecht (Rousi A, 1971).

Based on the Rousis classification of *Hippophae* and a lot author's one research, the new systematic classification of genus has been established as follows 6 (7) species and 12 (11) subspecies (Lian Y, 1998, Dong Rui Jia et all 2012). The following species and subspecies are: 1. *H.salicifolia* D.Don (China, Bhutan, Nepal, India, and Pakistan); 2. *H. rhamnoides* L and it's subspecies are: *H. rhamnoides* L ssp *sinensis* Rousi (China), *H. rhamnoides* L ssp *yunnanensis* Rousi (China), H. *rhamnoides* ssp *turkestanica* Rousi (China, Kashmir, Tadzhikistan, Kirghizia, Kazakhstan, Uzbekistan), H. *rhamnoides* L ssp *mongolica* Rousi (Mongolia, Russia, Eastern Kazakhstan, China), *H. rhamnoides* L ssp *caucasia* Rousi (Azerbaijan, Georgia, Armenia, Russia, Turkey, Iran), H. *rhamnoides* L ssp *carpatica* Rousi (Romania, Ukraine, Yugoslavia, Hungary, Austria, Germany), *H. rhamnoides* L ssp *rhamnoides* Linn (Poland, Germany, Denmark, Sweden, Finland, Russia, Norway, Netherland, Belgium, France and Britain), *H. rhamnoides* L ssp *fluviatilis* van Soest (Austria, Italy, Switzerland, France, Spain); 3. *H.goniocarpa* Lian, X.L. Chen et K.Sun (China) and its subspecies are: *H.goniocarpa* ssp *goniocarpa*; 4, *H.gyantsensis* (Rousi) Lian (China, India); 5. *H.neurocarpa* S.W.Liu et T.N.Ne (China) and its subspecies are: *H.neurocarpa* ssp *stellatopilosa* Lian et X.L. Chen, *H.neurocarpa* ssp *neurocarpa*; 6. *H.tibetana* Schlecht (China, Nepal, India) 7.*H.litangensis* Lian, X.L. Chen ((Rousi A, 1971).

Some characters of *H. rhamnoides* L ssp *turkestanica* Rousi are following: epidermis of branches silvery, with more and usually branched thorns, leaves narrower, both surfaces commonly silvery: carpopodium 3-4 mm long. Rousi noted that ssp t*urkestanica* occurred in the Dzungaria Gobi region; however this subspecies has not been identified.

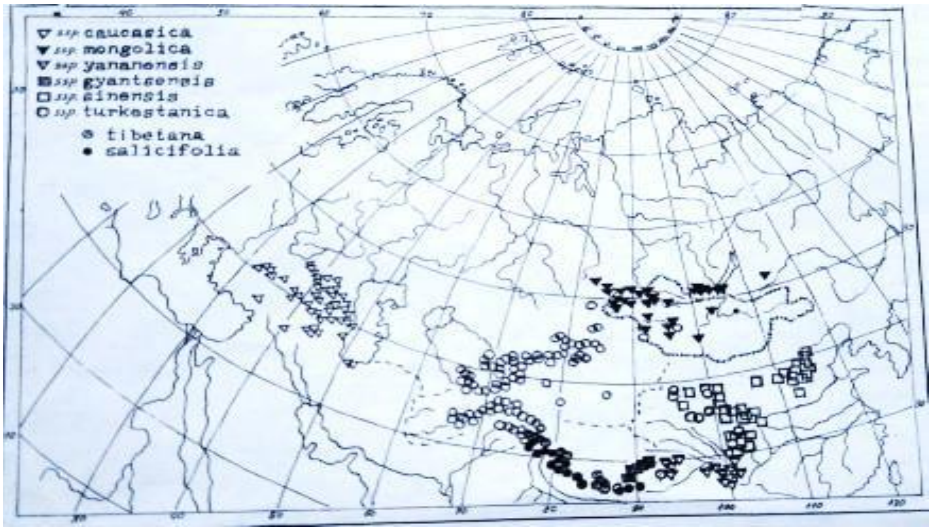

Figure 1. The distribution of the Asiatic including *caucasian* taxa of the sea buckthorn specimens studied (Rousi, 1971).

The subsp. *mongolica* has spread over almost the entire territory of Mongolia where occurs on river lands. In addition, the distribution map of subspecies has been presented in which most of their population range belongs to the western and north part Mongolia, it means the distribution area of ssp *mongolica* occupies one third of the total territory of Mongolia (Figure 1).

MATERIALS AND METHODS

Variability of characters and their frequency of phenotypically class intervals and their geographic distribution with pheno-geographic spatial expansion are based on the latest statistics and phenotypic analysis (Lakin, 1990).

The broad sense heritability in comparison, between populations where e^2 ecological factor and H^2 the share of genetically determination has been defined by Rone (1978). This method based on the comparing the variation population of SB (P) and its clone (cl) limits and intervals (B.M.Роне and others 1974). If S^2_{ph}= 1 then H^2+ e^2=1 and here H^2-genetic factor, e^2-ecological factor and H^2 ranged from 0 to 1.

RESULTS AND DISCUSSION

1.1. Morphological variation of wild sea buckthorn

Hippophae rhamnoides ssp. *mongolica* Rousi is one of the Mongolian indigenous rare wild plant because its native locality is Mongolia. Although its distribution range occurs with comparatively limited in regions: China (Altai mountain), Kazakhstan and Russia (Altai territory, Tuva republic, Irkutsk territory and Buriat Republic) respectively.

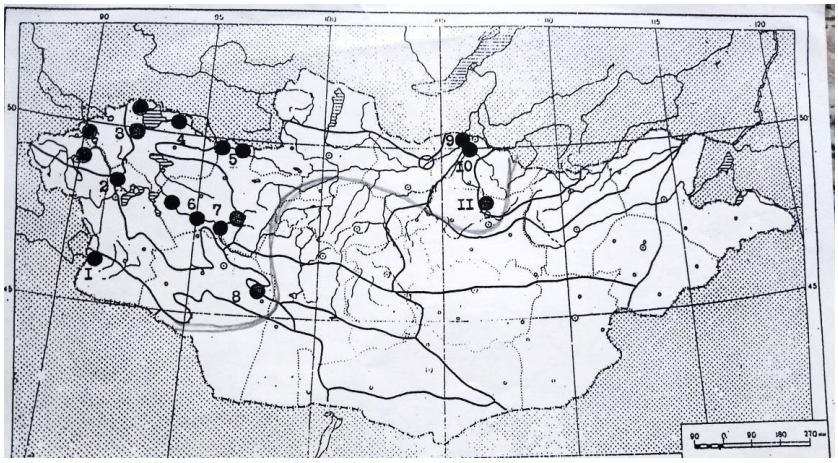

Figure 2. Map of the study area and the 11 sites with their location at the natural populations of ssp.*mongolica* within their Mongolian range: (Ts.Tsendeekhuu, 1996). 1.Bulgan river 2.Hovd river 3. Ulaangom, 4.Tes river (Uvs prov) 5.Tes river (Zavkhan prov) 6.Zavhkan river 7.Borkh river 9.Selenge river 10. Orkhon river 11.Sognogor-Bayangol.

According to the zones the Mongolian vegetation divided on 16 botanic geographical regions (Grubov, 1982). In this connection, occurrence of the spp. *mongolica* populations within its Mongolian distribution territory located mostly in Western part Mongolia along the valley of rivers follows: Bulgan, Khovd, Bukhmurun, Zavkhan, Te s(Uvs prov), Borkh, Tes (Zavkhan prov), and Selenge and others (Figure 2).

Variability of the quantitative features of vegetative and reproductive organs such as leaves, branch, fruit and seed, comparatively in different populations, and their vegetation zones has been analyzed by biometrical statistic (Figure 3,4)

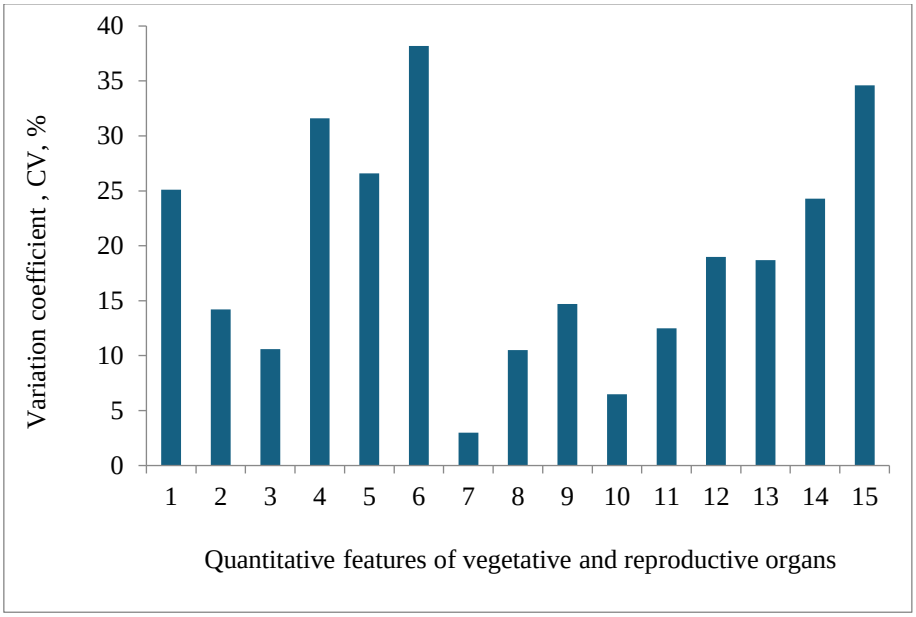

Figure 3. The variation level of different characters of sea buckthorn ssp. mongolica. (Desert, semi desert region: Bulgan, Khovd, Zavkhan, Bogd-Borkh, Tes rivers and population near

Biger). Fruit: 1- weight, g 2- length, mm 3-diametr, mm 4- pedicel length 5- breaking force from branch, H 6- yield, kg/h; Seed: 7- weight,g 8-length,mm 9-wigth, mm 10- thick, mm; Leaf: 11-length,mm 12-wigth, mm; Branch: 13- length of two years branch 14-number of two years branch 15-friuts number

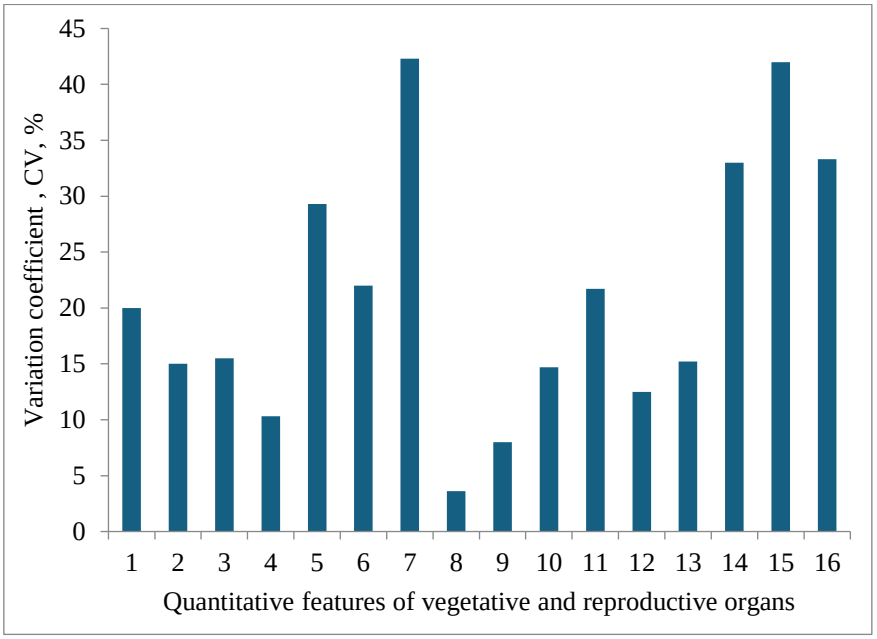

Figure 4. The variation level of different characters of sea buckthorn ssp. mongolica. (Forest steppe region: Selenge river, Bogd-Chigestei and Sugnugur-Bayangol population). Fruit: 1- weight,g 2- length, mm 3-diametr, mm 4- pedicel length 5- breaking force from branch, H 6- yield, kg/h; Seed: 7- weight 8-length,mm 9-wigth, mm 10- thick, mm; Leaf: 11-length,mm 12-wigth, mm; Branch: 13- length of two years branch 14-number of two years branch 15-friuts number

As a result, the most significant variation of characters is fruit weight, branch length, fruit numbers, and number of branches. From the above figure, the variation coefficient of the characters of the generative organs is stable. It has less variability, making it important for selection work and the cultivation of sea buckthorn.

Frequency of variation intervals with maximum oil content increased in the strip land around the Great Lakes Depression desert steppe, Dzungaria Gobi Desert, while the frequency of minimum oil content intervals was another characteristic of spatial distributions. Thus, minimum frequency intervals of oil content spreading from the above-mentioned maximum intervals center towards two opposite directions, West and East territorial expansion.

1.2. Genetic variation of some characters of wild sea buckthorn

Heritability coefficient is generally expressed as the proportion of genetic variations to the total phenotypic variance within a specific population and environment (Н.П.Дубинин, 1986)

We evaluated the H^2-specific value of the fruit oil. According to the results we obtained, in the forest-steppe zone the values of oil H^2 are: 0.38 for the Selenga river, 0.32 for the Sognogur –

Bayangol river, 0.43 for the Bogd-Chigestei river; in the desert and semi-desert zones: 0.62 for the Khovd river, 0.72 for the Zavkhan river, 0.56 for the Tes river, and 0.58 for the Bulgan river.

Region	Dzungaria Gobi and Great Lakes depression, desert and semi desert						Khangai, forest steppe			Average
Populations	Bulgan river (Khovd prov.Bulgan soum)	Khovd river (Khovd prov. Erdeneburen soum)	Zavkhan river (Zavkhan prov. Aldarkhhan, Durvuljin soum)	Tes river (Uvs prov.Tes soum)	Biger lake, (Gobi-Altai prov. Biger soum)	Plantation (Uvs prov. Ulaangom soum)	Bogd river. (Zavkhan prov. Uliastai soum)	Selenge river (Selenge prov. Zuunburen soum)	Bayangol, (Tuv prov. Batsumber soum)	
(H^2)	0.58	0.62	0.72	0.56	0.65	0.41	0.43	0.38	0.32	0.51
(e^2)	0.42	0.38	0.28	0.44	0.35	0.59	0.57	0.52	0.68	0,.49
Comparative result	(H^2) – 0.59 (e^2) – 0.41						(H^2) – 0.38 (e^2) – 0.62			

It can be seen from above results that the heritability coefficient H^2 in the population of Bulgan, Khovd, Zavkhan river Biger and Tes river, which are part of Central Asian deserts and steppes, is higher than other populations. A very interesting result is in the desert and semi desert region, especially in the Zavkhan river of the Great Lakes Depression, the genetic factor of oiliness accumulation is higher than the forest-steppe region.

CONCLUSION

From study of morpho-variation the variation coefficient of the characters generative organs such as fruit weight, length and diameter also seed weight, length of seed and leaf as well seed thickness are stable and low variability, so it is important for selection work and cultivation of sea buckthorn.

The ratio of ecological (e^2) and genetic (H^2) factors are in average 0.49 and 0.51. It seems that almost the same in all regions and both factor should be considered. However, it is specific character of ecological (e^2) factor is different in natural zones of Mongolia. This is a fact that should be taken into attention in the cultivation of agro-technic and maintenance of oil seeds.

We conclude that, this is a long process during of natural selectivity, accumulating oil in wild sea buckthorn, increasing evolutionary genetic factors in order to avoid from the effects of the semi desert stress, and thereby stabilizing their genetic system.

The center Mongolian sea buckthorn population range as Great Lakes Depression semi desert region is a native land one of the historical range of sea buckthorn because the CV%, value H^2, and intervals of normal distribution of many characters were very different in both center and peripheral parts in Great Lakes Depression, according to Vavilov's doctrine about the original center of the cultivated plants.

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6. PRACTICAL EXPERIENCE IN INDUSTRIAL GARDENING WITH ORIENTATION ON MECHANIZED HARVESTING. HONEYSUCKLE AND SEA BUCKTHORN

Viktor Karpov

North Garden

«Practical experience in industrial gardening with orientation on mechanized harvesting. Honeysuckle and sea buckthorn»

We represent the SAVA Group of Companies, Russia, Tomsk. Sava Group of Companies includes Tomsk production company Sava, «North Garden» and «Sava Altai». The topic of our report «Practical experience in industrial gardening with orientation on mechanized harvesting. Honeysuckle and sea buckthorn». A few words about the weather conditions in Tomsk. In Tomsk the climate is sharply continental. The average temperature in summer +21 above zero and in winter -17 degrees below zero. The annual amount of precipitation in Tomsk is 568 mm. Most of them fall in the warm period of the year.

The company has been processing berries and fruits for 25 years, produces 600 products and supplies them to supplies them throughout Russia and to 21 countries around the world, including Mongolia. We are now supplying cheese curd fillings to Mongolia.

The company processes more than 1,000 tons of sea buckthorn and supplies oil for export.

SAVA has been processing honeysuckle for over 20 years and is the largest honeysuckle processor in Russia. Since 2019, North Garden has been implementing a project to establish an intensive honeysuckle garden. During this time, an intensive honeysuckle garden with an area of 100 hectares, a chokeberry garden of 10 hectares and 40 hectares of currants were planted. Planting is continuing.

We apply an integrated approach to the implementation of the project, namely: from growing a seedling to obtaining the final product. This allows us to obtain the minimum cost of raw materials with the properties we need. This is achievable with mechanized harvesting. In order to be able to pick berries by harvester, we use the following technologies: planting in a ridge under agro cloth, bush shape - inverted triangle, characteristics of berries - dense skin, fruit detachment force is light, steady ripening, selection of varieties with different maturation periods, tinning of row spaces, optimal garden layout for the convenience of machinery.

On the slide you can observe photos of the technologies that we use.

I will tell you more about the fertigation and drip irrigation system. It includes a 4000 M3 storage pool, 24 km of underground pipelines, 416 km of drip tape. Irrigation is controlled by the Galileo controller Galcon, Israel. Due to the fact that the garden is quite large - 2 km in length. Water supply valves are controlled via Motorola radio channel. Control of EC and PH is doing in automatic mode. Daily we use 650 m3 of water in the garden. Whole system is controlled by 1 person.

This year we bought a Polish trailed harvester from the company Weremchuk «Karen». Since the bushes are still small, we did not manage to pick more than 70% of the berries from the bush (some of the berries were below the harvesting level of the harvester). Though our bushes raised above the soil with the help of a ridge. Nevertheless, we are satisfied with the quality of the berry harvest. We harvested 22 tons in 2024. The bushes are young and the garden is just coming into yield. The cost per 1 kg by a mechanized harvester is $ 0,4. The berries were for processing, so there was shock freezing in the field. The time between berry picking and freezing was no more than 30 minutes. This allowed us to get high quality berries.

SAVA harvests about 2,000 tons of sea buckthorn per year. A logistics center with shock freezing chambers and a refrigerator of up to 2000 tons for primary processing of berries and branches is located in Biysk. The equipment for the complex processing of berries into juice, oil and seeds is located in Tomsk.

In recent years company faces problems with berry harvesting - a high shortage of personnel for berry harvesting. Also, the cost of manual labor is high. There is no technology for mechanized sea buckthorn harvesting.

Research on the mechanization of sea buckthorn harvesting has been conducted by different companies over the past decades. Lisavenko Institute, Institute of Mechanization of Agriculture Moscow. In 2022-2023, the Littau USA combine harvester was used in Greece to harvest sea buckthorn berries.

In 2021, we laid a small experimental sea buckthorn plantation with drip irrigation and fertigation in a ridge for agro cloth. On it, we have worked out methods to reduce the force of berry detachment by treating bushes with special preparations. A decrease in the separation force from 1.8 Newtons to 0.7 Newtons was obtained.

In 2024, we tested the harvesting of sea buckthorn by Karen Weremchuk combine harvester on plantations in Tomsk and Biysk. At the same time, up to 70% of the berries were harvested without damaging the bushes after 2 passages of the combine.

These are just the first results and there are still many factors that need to be optimized to improve collection efficiency. These are varieties with low detachment force, optimal bush shape, plantation treatment before harvesting for reducing the force of detachment of berry, setting the optimal mode of the combine, the number of passages of the combine and etc.

But what we can say with certainty is that harvesting sea buckthorn by combine is possible, the cost of harvesting will be much lower than manually. In contrast, impossible to harvest sea buckthorn by combine from plantations that were not laid out for harvesting by combine.

7. DISEASES OF CULTIVATED SEABUCKTHORN, DAMAGE AND OPTIMAL METHODS OF CONTROL

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ABSTRACT

Sea buckthorn is the predominant fruit crop in Mongolia, holding substantial economic value. Its fruit is extensively utilized in food production and serves as a key ingredient in various cosmetic products due to its beneficial properties. Sea buckthorn is also renowned for its medicinal and therapeutic benefits. As demand for sea buckthorn products continues to rise, its cultivation has expanded rapidly in recent years, driven by growing consumer interest in its health-promoting properties. Plant protection, including the protection of crops from diseases and pests, is important in creating conditions for obtaining high-quality and stable yields from sea buckthorn cultivation. Effective plant protection, particularly safeguarding crops from diseases and pests, is essential for ensuring high-quality and stable yields in sea buckthorn cultivation. Implementing proper protection strategies is key to maximizing the crop's productivity and economic potential. Under the soil and climatic conditions of Mongolia, seven species of microorganisms and macroorganisms have been identified as disease-causing agents in cultivated sea buckthorn. Among these, the most prevalent and damaging are the fungal diseases dried-shrink (*Fusarium sporotrichoides)* and wilt (*Verticillium dahliae)*. Although less widespread, diseases such as endomycosis (*Monilia altaica*), scabies (*Stigmina hippophaes*), brown spot (*Alternaria alternata*), black canker (*Sphaeropsis malorum*), main stem rot (*Trametes versicolor*), and bacterial canker (*Pseudomonas syringae*) negatively impact the growth of sea buckthorn and reduce yields. Therefore, future efforts to control these diseases should not be overlooked to ensure sustainable production.

Keywords: *Hippophae rhamnoides* L., dried-shrink, wilt, endomycosis, scabies, brown spot, canker.

INTRODUCTION

Sea buckthorn (Hippophae rhamnoides L.) is a shrub in the Elaeagnaceae family, with six species and twelve subspecies growing wild across Europe and Asia. It is cultivated in several countries, including Mongolia, China, India, Nepal, Pakistan, Russia, the United Kingdom, France, Denmark, the Netherlands, Germany, Poland, Finland, Sweden, and Norway[1].

Research on sea buckthorn diseases has been conducted in our country since 1987 at the Research Institute of Plant Protection. However, few publications have disseminated these findings. In recent years, as sea buckthorn cultivation has expanded domestically, the incidence of infectious diseases that severely impact its growth and yield has also increased, according to research. This has underscored the need to study diseases affecting cultivated sea buckthorn, identify causative agents, assess disease spread, determine the causes and severity of damage,

and develop effective control measures for practical applications. This objective forms the foundation of our current research efforts.

MATERIALS AND METHODS.

This article is based on findings from field research conducted from 2018 to 2024 across cultivated sea buckthorn fields in the provinces of Tuv, Selenge, Darkhan-Uul, Arkhangai, Bulgan, Uvs, and Zavkhan, as well as in sea buckthorn fields managed by district committees around Ulaanbaatar.The pathogens affecting sea buckthorn cultivation were identified based on the results of laboratory tests, and their external symptoms were documented through photographs taken during field research.

The prevalence of sea buckthorn disease was assessed as a percentage by comparing the number of infected plants to the total plant population within the study area. Disease impact varies based on the distribution and severity of specific pathogens, with certain diseases capable of significantly reducing yields or even causing complete crop loss

RESULTS.

Our research identified six species of lower fungi, one species of mushroom, and one bacterial species impacting sea buckthorn cultivation in Mongolia (Table 1). Among these, two types of wilting diseases are the most widespread and severe, with leaf and fruit diseases directly contributing to yield reduction. Although less common, diseases such as black rot, bacterial rot, and stem rot also pose serious threats, leading to the death of sea buckthorn plants.

Table 1. **Species composition of pathogens organisms of Cultivated seabuckthorn diseases**.

Name of diseases	Taxonomy of pathogens			
	Class	**Order**	**Family**	**Species**
Verticillium wilt	*Sordariomycetes*	*Glomerellales*	*Plectosphaerellaceae*	*Verticillium dahliae*
Fusarium dried-shrink	*Sordariomycetes*	*Hypocreales*	*Nectriaceae*	*Fusarium sporotrichoides*
Endomycosis	*Leotiomycetes*	*Helotiales*	*Sclerotiniaceae*	*Monilia altaica*
Scabies	*Dothideomycetes*	*Capnodiales*	*Mycosphaerellaceae*	*Stigmina hippophaes*
Brown spot	*Dothideomycetes*	*Pleosporales*	*Pleosporaceae*	*Alternaria alternata*
Black canker	*Dothideomycetes*	*Botryosphaeriales*	*Botryosphaeriaceae*	*Sphaeropsis malorum*
Main stem rot	*Agaricomycetes*	*Polyporales*	*Polyporaceae*	*Trametes versicolor*
Bacterial canker	*Gammaproteo-bacteria*	*Pseudomonadales*	*Pseudomonadaceae*	*Pseudomonas syringae*

The predominant diseases affecting cultivated sea buckthorn in Mongolia.

FUSARIUM DRIED-SHRINK is the most destructive and widespread disease affecting sea buckthorn, present in nearly all of our study sites. Our research identified the primary cause as Fusarium sporotrichoides, a soil-borne fungus. This pathogen blocks the main stem veins, preventing the plant from absorbing water and nutrients, leading to dehydration and wilting. Affected trees may exhibit partial branch dieback, with some entire trees succumbing and ceasing to grow. In certain cases, diseased trees produce a few leaves and fruits at branch tips, but these wilt and droop before fully ripening.

Damage of disease: This is the most damaging disease, as infected trees die completely and cannot regenerate.

Prevalence of disease: According to 2018 research findings, Fusarium Wilt had a prevalence of 3.1–6.3% in sea buckthorn fields in Bayangol, Mandal, Tsagaannuur, and Shaamar sums of Selenge Province, resulting in a 2.5–5.8% yield loss. In Tseel, Sumber, Batsumber, and Bayanchandman sums of Central Province, the prevalence of Fusarium Wilt ranged from 1.2–3.0%.[1]

Research conducted in 2020 revealed that the prevalence of Fusarium Wilt in sea buckthorn was 12.0–14.5% in Ikh-Uul, Uliastai, and Songino sums of Zavkhan Province, and 6.1–14.8% in Baruunturuun, Tarialan, and Ulaangom sums of Uvs Province.

In 2022, the prevalence of sea buckthorn dried-shrink disease in Batsumber sum of Central Province reached 13.8%, resulting in an 8.3% loss in harvest. The following year, 2023, saw a prevalence of 18.4% in Ulziit khoroo of Khan-Uul District, Ulaanbaatar city. In 2024, the prevalence of tree rot disease in Uliastai sum, Zavkhan Province, escalated to 46%, leading to a 40.0% loss in orchard yield.

Figure1. Dead seabuckthorn trees and branches withered from dried-shrink disease in Uliastai sum of Zavkhan province 2024.

VERTICILLIUM WILT is one of the most common diseases affecting sea buckthorn crops worldwide, caused by the pathogenic fungus *Verticillium dahliae*. Infected trees display yellowing leaves that fall prematurely, beginning from the top of the crown. The fruit on these leafless branches ripens prematurely, leaving the tree bare. Eventually, the remaining fruit will drop, and the bark will turn black. This pathogenic fungus is rooted in the soil and is transmitted through lesions on the stems and branches.

Damage of disease: Cultivated sea buckthorn bushes affected by Verticillium Wilt may partially or completely dry out and die.

Prevalence of disease: According to research conducted in 2018, the prevalence of sea buckthorn wilt disease ranged from 5.2% to 8.1% in Mandal and Tsagaanuur sums of Selenge Province, with a prevalence of 3.1% in Uvs Province. In 2020, the prevalence increased to 7.5% in Haliun sum of Gobi-Altai Province and ranged from 11.2% to 14.0% in Songino and Uliastai sums of Zavkhan Province. By 2024, the prevalence of sea buckthorn wilt disease was reported at 8.0% in Aldarkhaan sum and reached 28.6% in Uliastai sum of Zavkhan Province, resulting in fruit yield losses ranging from 6.0% to 20.0%.

Fig 2. Symptoms of wilted seabuckthorn trees in Bayan-Agt sum Bulgan Province. 2021

Control methods of Dried-shrink and Wilt diseases: To manage dried-shrink and wilt diseases, it is essential to remove diseased and dried branches, as well as uproot dead trees. Disinfecting the holes in infected trees with specialized treatments, such as copper sulfate, is also recommended. Preventive measures include proper care for sea buckthorn trees, which involves spring and autumn pruning and applying a 3% Bordeaux liquid in the spring. Additionally, providing adequate irrigation during drought conditions, applying biological preparations containing *Bacillus subtilis* bacteria three to four times during the growing season, controlling weeds, and ensuring proper fertilization can help prevent dried-shrink and wilt diseases in sea buckthorn.

ENDOMYCOSIS is caused by the pathogenic fungus Monilia altaica. The first symptoms typically appear in mid-August, coinciding with fruit ripening, when the fruit begins to pale

and soften. The internal soft tissue of the fruit transforms into a light, slimy liquid, eventually causing the skin to rupture and juice to leak out, which can then infect healthy fruit. Endomycosis is often triggered by soft tissue damage due to sudden temperature fluctuations. The pathogen can be spread through frost, raindrops, and insects with sucking mouthparts. The fungus survives in the bark of tree branches or on the skin of fallen fruit during the winter, and as the plant grows the following year, new fruit can become infected by wind and water droplets.

Damage of disease: Infection from endomycosis affects the quality of sea buckthorn fruits, leading to direct yield losses. Some infected fruits may turn white and develop cracks during storage, further diminishing their marketability.

Prevalence of disease: Disease Prevalence: The prevalence of endomycosis in sea buckthorn fruits has been documented at various rates over the years. In 2018, it was recorded at 3.8% in Uvs Province. By 2020, the prevalence decreased to 1.5% in Haliun sum of Gobi-Altai Province. However, in 2021, it increased to 6.9% in Selenge sum and 5.3% in Orkhon sum of Bulgan Province. In 2022, the prevalence reached 8.5% in Batsumber sum of Central Province.

Fig 3. Symptom of Sea buckthorn Endomycosis disease in Selenge sum of Bulgan province. 2021

Control methods of Endomycosis diseases: Effective management of endomycosis involves several key practices. In early spring, prior to bud break, a 3% solution of copper sulfate or iron sulfate can be applied to disinfect sea buckthorn trees and branches. During the fruit development phase, it is advisable to administer three applications of biological preparations containing Bacillus subtilis, spaced 10 to 14 days apart. Experimental studies have demonstrated that applying the Russian biological preparation Phytosporin three times during the fruiting stage can provide up to 80.0% efficacy in protecting against sea buckthorn endomycosis.

SCABIES DISEASE: is caused by the pathogenic fungus *Stigmina hippophaes*. Initial symptoms manifest on the branches of sea buckthorn as splitting and cracking of the bark, which can subsequently lead to infection of the fruit. Infected sea buckthorn fruits exhibit

pitting and the formation of dark ulcers due to the pathogenic fungus. Furthermore, fruits that are infected during the growing period often turn black after harvesting and during storage, significantly impacting their quality and marketability.

Damage of disease: Infected sea buckthorn fruit tends to yellow prematurely, with the affected areas eventually turning black. The flavor and overall quality of the diseased fruit deteriorate significantly. Recent studies have shown that Scabies disease has spread to Mongolian sea buckthorn plantations, resulting in a reduction in fruit yield by 5% to 20%.

Prevalence of disease: Research conducted in 2018 indicated that the prevalence of sea buckthorn scabies disease was 15.8% in Batsumber sum of Central Province. In 2021, prevalence rates were recorded at 7.3% in Erdenebulgan sum of Arkhangai Province, 7.6% in Bayan-Agt sum, and 4.7% in Selenge sum of Bulgan Province. By 2024, the prevalence of sea buckthorn scabies disease had decreased to 3.2% in Baruunturuun sum of Uvs Province.

Fig 4. Seabuckthorn Scabies disease in Erdenebulgan sum Arkhangai Province, in 2021 and in Baruunturuun sum Uvs Province, in 2024.

Control methods of Seabuckthorn Scabies disease: Effective management of sea buckthorn scabies disease involves several key practices. Fallen fruit and leaves from infected trees should be thoroughly removed and incinerated to prevent further spread. In spring, a 3% solution of copper sulfate and a 3% Bordeaux liquid should be applied to the sea buckthorn trees to disinfect them. Bark ulcers should be treated with a 3% copper sulfate solution and then coated with a lime solution or specialized putties and tree paints. In the second half of summer, it is recommended to conduct two applications of a 1% Bordeaux liquid at 10-day intervals. Additionally, 2 to 3 applications of biological preparations containing *Bacillus subtilis* should be administered during the growth period of the sea buckthorn.

BROWN SPOT disease in sea buckthorn is caused by the pathogenic fungus *Alternaria alternata*. In recent years, this disease has been increasingly detected in Selenge, Darkhan, and Bulgan provinces, as well as in Khentii province, the agricultural center of Mongolia, with its prevalence rising annually. Symptoms typically manifest in the second half of summer as round brown spots on the leaves. Heavily infected trees exhibit yellowing leaves that dry out

prematurely. The disease can also infect the fruit, leading to the development of a black mold that causes the fruit to turn black. The pathogenic fungus spreads through wind and rainwater in the form of conidia during the growth phase of the plant. Prolonged wetness on leaf surfaces accelerates disease progression, and the fungus can persist in plant debris and fallen leaves, expanding its range year after year.

Fig 5. Seabuckthorn Brown spot disease in Buregkhangai sum Bulgan province. 2021

Damage of desease: The premature yellowing of sea buckthorn leaves, characterized by numerous brown spots, adversely affects fruit development. As the disease progresses, it spreads to the fruit, resulting in a loss of flavor in the affected berries. Furthermore, even after harvesting, infected fruit can pose a risk of contaminating healthy fruit.

Prevalence of disease: Brown spot disease in sea buckthorn was recorded with a prevalence of 1.5% in Batsumber sum of Central Province in 2018. This increased to 6.8% in Tsagaannuur sum of Selenge Province in 2020 and further rose to 10.2% in Buregkhangai sum of Bulgan Province in 2021.

Control methods of Seabuckthorn Brown spot disease: Thoroughly clean the fallen leaves in the sea buckthorn garden. Weeds are removed from the field during the growing season. To prevent brown spot disease, spray with fungicides and biological agents that act on *Alternaria* fungi when the disease is not detected and to limit the spread of the disease. Repeat the spraying of fungicides and biological preparations 2 to 3 times with an interval of 10 days.

SEABUCKTHORN BACTERIAL CANKER disease is caused by the bacteria *Pseudomonas syringae pv.syringae*. The leaves of trees infected with the bacterial canker disease suddenly wither and fall, and wedge-shaped cracks form in the bark of the main stem and branches, separating diseased tissue from healthy tissue. Bacterial exudate is released from infected tree branch wounds. Diseased trees stop growing, and in winter, the lateral shoots freeze. Severely affected trees will freeze. Frozen branches and trees die without regrowth.

Bacterial canker diseases of Sea buckthorn trees are manifested in two forms: slow and chronic disease. In young trees, branch buds become partially diseased and gradually wither, while in chronically infected trees, the entire tree withers and dies. The disease-causing bacteria hibernates in sores on the bark of infected trees, and the infection spreads through rain and wind. In winter and spring, the damaged bark can become infected with bacteria and make the tree sick.

Damage of disease: Sea buckthorn trees infected with the bacterial canker disease slowly wither and die.

Prevalence of disease: According to the results of the 2021 research, Sea buckthorn bacterial canker disease was registered with a prevalence of 1.0% in Erdenebulgan sum of Arkhangai province.

Control methods of Seabuckthorn Bacterial canker: When pruning fruit trees and bushes, apply garden paint and wax putty to the cut area. Painted with lime solution the main stem of the seabuckthorn trees to prevent the bark from cracking in the winter. Remove diseased trees by Bacterial canker and dead branches from orchards and burn them. During the growth period of sea buckthorn trees and bushes are additionally fertilized with phosphorus-potassium fertilizers. During the growing period, spraying to prevent diseases is done with biological preparations containing *Bacillus subtilis*, and spraying is repeated 2 to 3 times at 10-day intervals.

Fig 6. Seabuckthorn bacterial canker disease in Erdenebulgan sum Arkhangai province in 2021.

The mushroom Trametes versicolor causes MAIN STEM ROT. This mushrooms infects old, diseased and weakened sea buckthorn trees, penetrates through cracks in the bark of its stems and branches, and parasitizes from the veins of the main stem. In the cracks of the bark of the main stem of the tree, at first, small round light mushrooms with a diameter of 1 to 2cm will grow, and as the mushroom grows, the color will change and become mottled, such as brown-gray and brown-green. The underside of the mushroom is brownish pink. As the fungus grows, it will cause the main stem rot of Sea buckthorn.

Damage of disease. Sea buckthorn trees die from main stem and branch rot.

Prevalence of disease: Sea buckthorn main stem rot disease has a prevalence of 2.5 to 4.3% in Batsumber sum of Central province in 2018 to 2019, 3.0% in Selenge sum of Bulgan province in 2021, and in 2022 year in the 21st khoroo of Songinokhairkhan district of Ulaanbaatar city was found in Arghunt with a prevalence of 5.2%.

Fig 7. Seabuckthorn main stem rot disease by causing mushroom Trametes versicolor in Selenge sum Bulgan province in 2021.

Control methods of Seabuckthorn primary stem rot disease: To prevent this disease, make healthy and rejuvenating pruning of the buckthorn tree every year. Grown tree trunks are painted with a lime solution and garden tree paint to protect them from cracking and fungal infections. When wood mushrooms start to grow, cut the mushrooms with a sharp knife. Disinfect the rest by applying a 3% solution of copper sulfate. Then, seal open wounds and cracks in the tree bark with a special putty.

CONCLUSION

In Mongolia, cultivated sea buckthorn trees are affected by seven species of microorganisms and one species of fungus. The absence of effective disease prevention measures in sea buckthorn cultivation has resulted in increasing crop losses. For instance, in Uliastai sum of Zavkhan Province, the prevalence of sea buckthorn dried-shrink disease surged from 14.5% in 2020 to 46.0% in 2024, resulting in a 30% loss of fruit yield. Similarly, the prevalence of sea buckthorn wilt disease increased from 14.0% in 2020 to 28.6% in 2024, resulting in a 20.0% yield reduction. Over the past four years, more than 50% of the 10 hectares of sea buckthorn fruit trees have succumbed to disease and desiccation, underscoring the consequences of neglecting crop health.

While plant diseases may be less prevalent during certain years due to climatic conditions, outbreaks can occur when conditions become favorable. Therefore, it is imperative to implement proactive measures for disease management during the sea buckthorn's growing season in Mongolia.

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8. BIOCHEMICAL AND TECHNOLOGICAL STUDY OF BOILED SAUSAGE WITH THE ADDITION OF SEABUCKTHORN SEEDS

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ABSTRACT

As part of this research, seabuckthorn seeds were added to the main raw materials of boiled sausage, such as beef and pork, in versions of 5%, 10%, and 15%, and technological tests were carried out. Through experimental work, we have determined the sense, physico-chemical and biochemical parameters of the finished boiling sausage by grinding seabuckthorn seeds, adding them to the minced meat, using standard methods of meat products such as MNS 5035:200, MNS 342:84, and MNS 2060:2007. As a result of the research, boiled sausage with 10% seabuckthorn seeds met the requirements of the standard in terms of biochemical, physical-chemical and technological characteristics, and compared to seabuckthorn seedless jam, which is a control sample, the amount of protein, oil, minerals and vitamins, which are biological values, was increased. Boiled sausage spoils very easily during storage and becomes an ideal environment for the growth of microorganisms. According to the results of the analysis, the health indicators of selected sausages with 10% of seabuckthorn seeds are good, and the indicators of oil oxidation are low, which is related to the content of antioxidants such as tocopherols, flavonoids, ascorbic acid, and unsaturated fatty acids contained in seabuckthorn seeds. This indicator increases the shelf life of boiled sausage, improves the body structure and increases the output.

Keywords: *biological activity, water binding, oil binding, structure, recipe ingredients, output, color stability, microflora*

INTRODUCTION

In order to increase the amount of nutrients in food products and increase the variety of food products with regulatory functions, the development of production technology of the products enriched with food raw materials with high biologically active content is being carried out on a large scale. It is more effective to use natural, non-chemical, organic food additives in food products.

Buckthorn fruit, which is widespread in Mongolia, has more natural antioxidants, ascorbic acid, beta-carotene, and tocopherol content than other fruits. At present, in our country, seabuckthorn fruit is processed to extract juice and oil, and the seeds and pulp, which are secondary raw materials, are not widely used in food production.

Seabuckthorn seeds are an additional product with high biological and food value and physiological significance. Seabuckthorn seeds contain antioxidant tocopherol, ascorbic acid, carotenoids, protein and amino acids as nutrients compared to other fruits [1].

Therefore, it is necessary to research and introduce the technology of producing food products with regulatory functions using seabuckthorn (Hippophae rhamnoides L.) seeds.

Biologically active additives of animal and plant origin are widely used in production to increase the output of meat products, to increase their variety and to improve their quality. In addition to improving the biological value of these products, they have the technological value of combining with muscle tissue protein to ensure the colloidal balance of the liquid part, as well as the economic value of increasing product output and saving the amount of meat [2].

Therefore, we used seabuckthorn seeds, which are rich in biologically active compounds, in jam sausage, a meat product, with the goal of increasing the nutritional and biological value of food.

Aims and objectives of the research work:

- Investigate sensory and physico-chemical characteristics of minced meat and boiled sausage with the addition of seabuckthorn seed flour and determine the optimal amount;
- To study the biological value of boiled sausage with the addition of seabuckthorn seed flour;
- Investigation of microflora parameters and changes during storage of sausages supplemented with seabuckthorn seed flour

Innovative aspects and practical significance of the research work:

- It is important to increase the use of seeds, which are high-quality by-products from the production of seabuckthorn oil and juice.
- It has been established that the addition of seabuckthorn seed flour to meat products improves the technological characteristics of the product and increases the output, which is an innovative aspect and practical significance of this research work.

I. RESEARCH SECTION

Research materials, raw materials, objects, methods, methodology

Beef and pork carcasses, pork back fat, garlic, salt, nitrite, pepper spices, "Vitaminnaya" variety seabuckthorn seed flour (0.3 mm grain size, W=9% moisture) were used as research materials. Analytical, comparative and traditional standard methods of analysis were used in the research. The experiment was carried out in the laboratories of "Food Chemistry-Technology" and "Nutrition Science" of the School of Technology in Darkhan of Mongolian University of Science and Technology.

II. RESULTS OF RESEARCH AND TESTING

1. Buckwheat seed's flour's ability to bind water and oil was studied in comparison with other wheat and other seed flours. The amount and quality of polysaccharides have a major effect on the structure and mechanical properties of minced meat. Structural mechanical properties represent the internal structure and composition of matter [3].

Table 1. Indicators of water and oil binding capacity of seabuckthorn seed flour

Raw materials	Water binding capacity, %	Oil binding capacity, %
Wheat flour	152	62
Seabuckthorn seed flour	203	90
Oat flour	58,45	30,2

Table 1 shows that the water and oil binding capacity of wheat flour added to boiling sausage production is 51% and 28% lower than that seabuckthorn seed flour. Starch, a polysaccharide in the chemical composition of wheat flour, binds with water and improves the structure and mechanical properties of minced meat [4]. However, fiber and pectin, which are polysaccharides in the chemical composition of seabuckthorn seed flour, greatly increase the ability to bind oil in addition to water [5].

2. Evaluation of sensitivity, pH, moisture content, water binding capacity and output of seabuckthorn supplemented with seabuckthorn seeds were determined by standard methods. When adding seabuckthorn seeds to the minced meat, they were ground into flour, sifted through a 0.3 mm sieve, and added at 5, 10.15% of the weight of the meat.

Table 2. Physicochemical parameters of minced meat

Indicator	Control	% with added seabuckthorn seeds		
		5	10	15
pH	6.0	6.4	6.7	6.9
The moisture of minced meat, %	66,51	67,95	69,61	72,60
The water binding capacity of minced meat, %	72,6	69,61	67,95	66,51
The elasticity of minced meat, %	72,15	73,23	74,15	78,26
Minced meat output, %	107	108,3	112,5	113,8

Table 2 shows that the pH of minced meat with the addition of seabuckthorn seeds increased by 0.4 - 0.9. When the water binding capacity of starch is high, the pH of the environment increases and the product output increases. Seabuckthorn seeds interact with meat proteins and

increase the amount of water associated with adsorption by increasing the number of charged groups or water-attracting groups in the protein, thus increasing the output of the product. Here, the water binding capacity of the minced meat with the addition of 15% seabuckthorn seed was higher than the control sample and increased by 6.11%, and the product output was 4.54% higher on average.

3. When a large amount of seabuckthorn seeds was added to minced meat, the sensory parameters of the product (apparence, taste, smell) became unpleasant. When seabuckthorn seeds are added to the minced meat, carbohydrate-water and carbohydrate-oil interactions take place. As a result of this effect, the product does not lose weight during heat treatment, and the output increases [6]. Figure 1 shows the sensitivity evaluation profilogram of seabuckthorn -supplemented minced meat.

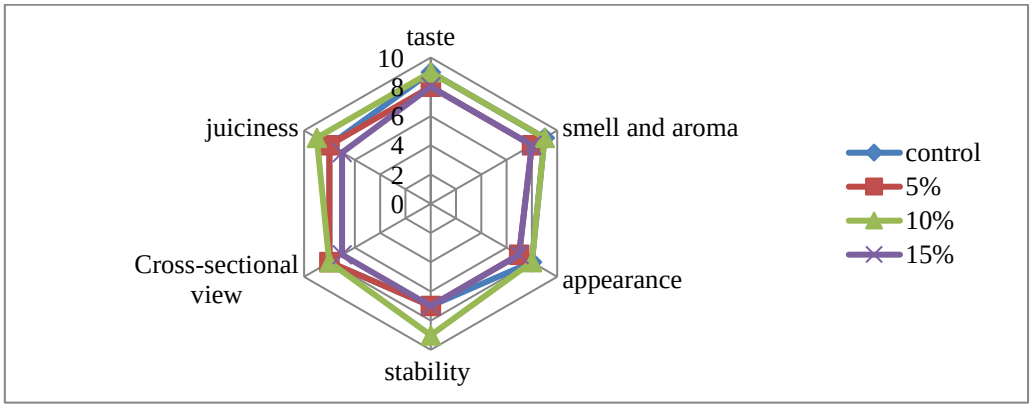

Figure 1. Evaluation of sensitivity of seabuckthorn supplemented minced meat

As shown in Figure 1, adding 5% of seabuckthorn seeds to minced meat slightly increased the product's elastic grip, and adding 15% increased the structural damage of the minced meat and reduced the technological characteristics. However, the flexibility of the structure of the minced meat with the addition of 10% of seabuckthorn seeds met the standard requirements. In order to optimize the amount of seabuckthorn seeds to be added to the fertilizer, sensory evaluation was evaluated with 10 points: appearance, cut, smell, taste, physicality, stability, and juiciness. From the profilogram 1, it was determined that the highest sensitivity rating of minced meat with 10% seabuckthorn seed addition was the optimal regime. (Based on Tasting Member Ratings)

1. By adding 10% of seabuckthorn seeds to the boiled sausage, the technological parameters of the product, such as sensory parameters, color stability, the content of biologically active substances, and microflora changes during storage, were determined in comparison with the control sample of boiled sausage without seeds. Figure 2 shows the sensory parameters of boiled sausages supplemented with seabuckthorn seeds compared to control samples.

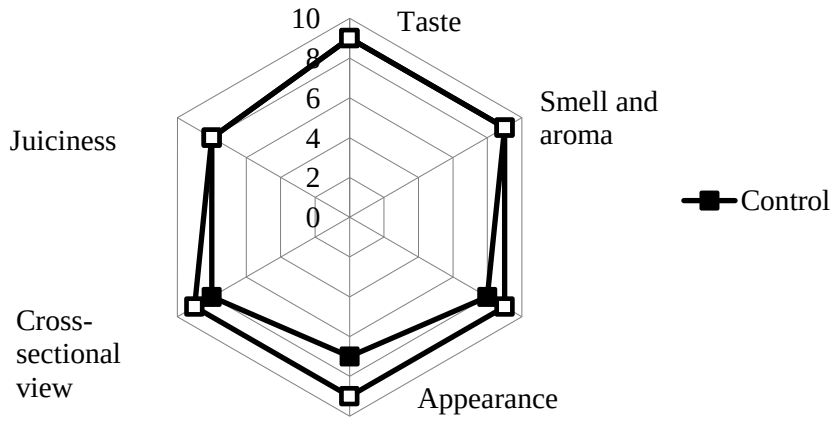

Figure 2. Sensory evaluation of boiled sausage with seabuckthorn seed addition

As shown in Figure 2, the color, aroma, taste, juiciness and cut appearance of boiled sausages supplemented with seabuckthorn seeds were rated higher compared to the control sample. (Based on tasting members' ratings)

Figure 3. Boiled sausage and control samples with 10% addition of seabuckthorn seeds

Table 3. Color stability of boiled sausage

Specifications	Control	Boiled sausage with the addition of seabuckthorn seeds
Color stability, %	89,3±2,1	95,8±1,9
Residual amounts of sodium nitrite, %	0,0040±0,0001	0,0020±0,0001

It can be seen from Table 3 that the color stability of the boiled sausage with the addition of seabuckthorn seeds increased by 4.5-5% compared to the control sample, which is related to

the content of tocopherol, flavonoids and ascorbic acid with high reducing activity contained in seabuckthorn seeds [7]. Table 4 shows the biochemical parameters of boiled sausages supplemented with seabuckthorn seeds.

Table 4. Biochemical parameters of boiled sausage

Indicator	Standard method	Control	10% boiled sausage with the addition of seabuckthorn seeds
Protein, %	MNS 5035:2001	15.8	20.6
Oily, %	MNS 342:84	3.6	4
Minerals, %	MNS 5035:2001	0.8	1.9
Caloric, kcal	MNS-5035:2001	495	512

Table 4 shows that the amount of protein, fat and mineral content of the boiled sausage with the addition of seabuckthorn seeds increased compared to the control sample. Table 5 shows the changes in microflora during the storage of boiled sausages.

Table 5. Indicators of changes in the microflora of boiled sausage

Specifications	2 days		4 days		6 days	
	Control sample	Test sample	Control sample	Test sample	Control sample	Test sample
Number of mesophilic aerobic and non-polar anaerobic microorganisms, colony-forming units per 1 g	$7,5 \cdot 10^2$	$7,6 \cdot 10^2$	$7,7 \cdot 10^2$	$7,6 \cdot 10^2$	$7,6 \cdot 10^2$	$7,8 \cdot 10^2$
Number of bacilli of the intestinal group, per 1 g	not detected	not detected	not detected	not detected	not detected	not detected

Str.Aureus, per 1 gram	not detected	not detected	not detected	not detected	not detecte d	not detected

Table 5 shows that tocopherols, β-carotene and flavonoids contained in seabuckthorn seeds prolong the shelf life of boiled sausages as natural antioxidants.

CONCLUSION

1. It was determined that when seabuckthorn seeds are added to minced meat, the physical chemistry and technological parameters of the product are improved. Technological parameters show that it is more suitable to add 10% of seabuckthorn seeds to the boiled sausage.
2. The color stability of the boiled sausage with the addition of seabuckthorn seeds increased by 4.5-5% compared to the control sample, which is related to the content of tocopherol, flavonoids and ascorbic acid with high reducing activity contained in the composition of seabuckthorn seeds.
3. Seabuckthorn seeds not only improve the output and quality of meat products, but also reduce the amount of meat in the recipe by 10-15%, which shows its economic significance.
4. According to the indicators of changes in the microflora of boiled sausages with the addition of seabuckthorn seeds, tocopherols, β-carotene and flavonoids contained in seabuckthorn seeds prolong the shelf life of boiled sausages.

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9. THE EFFECT OF ORGANIC AND INORGANIC MULCHES ON THE WEED OF SEA BUCKTHORN

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ABSTRACT

*This study was conducted in order to determine how the use of organic (straw, sawdust) and inorganic (Polyethylene, woven fabric) mulches affect weed species composition and weed seed bank in sea buckthorn field. The number and species composition of weeds in the years of the study differed significantly depending on the mulching types. In spring and May, polyethylene and woven fabric versions completely suppressed weeds, while control-2, which didn't fight weeds, had more weeds growing by 34-203 per/m2 in 2021 and 56-192 per/m2 in 2022. The yield of one bush was 44.8 c/ha in the version with woven fabric version, which was 8.6-43.5 c/ha more than the other versions. fruit yield had a strong negative correlation with the number of weeds P=-0.81, and weed biomass had a weak negative correlation with fruit yield P=-0.62. In other words, when the number and weight of weeds increases, the yield decreases. 40-69.3 % of weed seed bank in the soil were contained in the 0-10 cm deep stratum and decreased from spring to autumn. Weed seed bank were reduced by 1.1-2.6 times in the mulched versions compared to control 2, and increased by 1.3 times in control 2. Buckthorn field variants significantly differed in weed seed bank in 0-10 cm depth $P_{0.05}$= 0.0212 *. Versions with woven fabric and synthetic film mulch had significantly lower weed seed bank than the other Versions, $P_{0.05}$=0.03.*

KEY WORDS: O*rganic, Yield, Weed seed bank, Biomass*

INTRODUCTION

In recent years, following the growing number of organizations and individuals who are interested in gardening with decorative trees and shrubs in their surroundings in foreign countries and domestically, and engaged in family farming and fruit production, new types of fruits and the technology for their cultivation have been updated and intensively changed in the ecological direction. Especially, in regions with limited soil fertility and moisture supply, the use of organic and inorganic materials as soil mulch in order to improve the yield of fruit and berry farming creates an opportunity to efficiently use water and moisture and fight weeds effectively [Tretyakova G.Yu, 2010].

The technological operations of fruit cultivation, such as weed control and irrigation, are carried out manually, which limits the possibility of their efficient cultivation in large quantities on many hectares. A lot of research work has been done in the central agricultural region to test fruit varieties, develop agrotechniques, and produce seedlings, but there has been no research on weeds, especially in fruit orchards with various mulches. In Mongolia, it is one of the most

important problems to operate fruit and berry orchards for the production of organic and ecologically clean products as much as possible. Therefore, this work was carried out in order to determine in detail the distribution and species composition of weeds spread in the sea buckthorn field, and to determine how the use of various mulches affects the weed species composition and weed seed bank.

MATERIALS AND METHODS

We conducted this research at a sea bucktorn orchard (49°50[1] N, 105°88[1] E) at the field of experience Institute of Plant and Agricultural science, Darkhan-Uul province, between 2020 and 2022 (Figure 1).

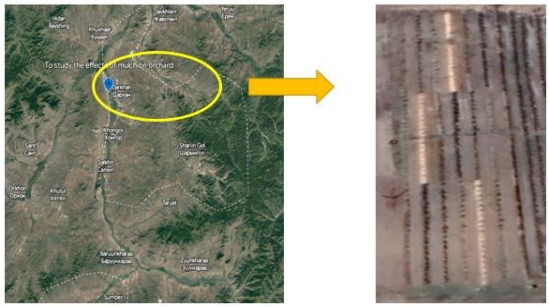


Figure 1. Sea buckthorn fields were covered with organic mulch (straw, sawdust) 1 m wide and 10 cm thick, and inorganic mulch (polyethylene, woven fabric) was studied in comparison with control 2 (no weed control).

The major weeds in the orchard are ranunkelruta *(Leptopyrum fumarioides),* broadleaf plantain ***(Plantago major)***, flixweed **(*Descurainia sophia)***, field penny ***(Thlaspi arvensis L.)***, artemisia sieversiana ***(Artemisia sieversiana Willd)***, sow thistle ***(Sonchus arvensis L.)***, *canada thistle* ***(Cirsium Arvense)***, stork's-bill ***(Erodium stephanianum Willd)***, quackgrass ***(Agropyrum repens)***, little Lovegrass ***(Eragrostis minor)***, silverweed ***(Potentilla anserina L.)***, lamb's quarters **(*Chenopodium Album L.)***, dwarf mallow ***(Malva neglecta)***, *black bindweed* ***(Polygonum convolvulus)***, *red-root pigweed* ***(Amaranthus retroflexus)***.

Before planting, the field was plowed to a depth of 30 cm and leveled with a GQN-125 rotor. After that, 180 2-year-old saplings of sea buckthorn Chuiskaya variety, meeting the standards of MNS 0916:2011, were planted in pots with a distance of 2 meters between holes and 4 meters between rows, with a hole digger of 1w-70 brand at a depth of 50 cm with a diameter of 60 cm, with 6 versions and 3 repetitions. It was planted in a 720 m^2 area by simple method. The distribution and density of weed population in plots were evaluated by using I.I.Liberstein and A.I.Tulikov's method for defining weed distribution. Number of weed species and weed plants in m^2 , placed on 4 different randomly selected locations within each plot, were counted. Overall weed infestation of plots was rated on 5-point scale, with 1 being least and 5 being critically infested. Weed density m^- was sampled randomly at four places with the help of one square meter and dry weed biomass m^2 at harvest were recorded. The weed control efficiency

(WCE) was calculated by using the formula (Kondap and Upadhyay, 1985). Weed seed bank contained in the soil were determined in the laboratory by taking mixed samples from the depths of 0-10 cm and 10-20 cm in spring and autumn for each scenario, and the total number of weed seeds was transferred to ha and expressed as millions (M.Z. Stankov, B. .A. Dospekhov, 1987). Depending on the condition of weeds between the rows during the growing season, weeding was done with a GQN-125 rotor.

RESULT AND DISCUSSION

When determining the distribution and species composition of weeds spread during tillage before planting in the study area, 9 species of weeds from 6 families were noted, when considering weeds by biological group classification, annuals accounted for 42.9 %, biennials 5.0 %, and perennials 52.1 %. The number of weeds in the years studied varied greatly depending on the mulching types.

In the spring of 2021 and 2022, there was no weed growth in the woven fabric version, as the woven fabric effectively blocked sunlight and killed the weed's white germination. Compared to control-2, which did not fight weeds at all, the mulching versions had less litter by 34-203 per/m^2 in 2021 and 56-192 per/m^2 in 2022, respectively.

1. Weeds of experimental versions, per/m^2

2020-2022, May

Year	*Version*	*weed, per/m^2*			*Total*
		Annual	Biennial	Perennial	
2020	Before planting	200	23.5	243	466.5
2021	Control-1	93	1	75	169
	Control-2	56	28	119	203
	Polyethylene	0	0	0	0
	Woven fabric	0	0	0	0
	Sawdust	5	2	55	62
	Straw				
2022	Control-1	21	29	86	136
	Control-2	111	42	39	192
	Polyethylene	0	0	22	22
	Woven fabric	0	0	0	0
	Sawdust	0	0	13	13
	Straw	0	2	20	22

Between the rows of sea buckthorn trees, before the first tillage, there was an average of 228 per/m^2 weeds in 2020-2022. We double-identified weeds for all experimental versions during inter-row processing. The options with woven fabric and Polyethylene mulches achieved 1-2 per/m^2 of weeds, indicating that these mulches reduced weed infestation.

The sawdust version had the highest weed growth than the other mulch versions. However, it was relatively low compared to controls 1 and 2. All study processes in control 1 and control 2 without mulch had a score of 5 or were very weedy. In determining the weed species composition, there were 7.5 families and 10 species on average for 3 years in the control-2 field, which was almost the same in terms of families and species as weeds between the rows. In the woven fabric version, it was seen that the growth of weeds was completely limited by the absence of weeds at this time of the research years.

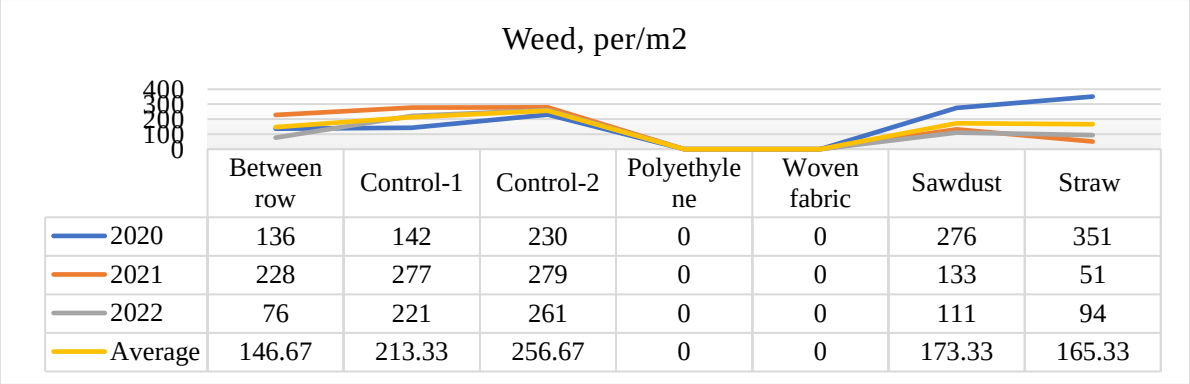
2. Weed growth in versions during the first tillage between rows of sea buckthorn trees, per/m^2

2020-2022, June

Хувилбар	Weed, per/m^2			
	2020	2021	2022	Average
Between row	*508*	*176*	*210*	*228*
Control-1	313	137	261	237
Control-2	314	425	310	349
Polyethylene	1	-	-	1
Woven fabric	2	-	-	2
Sawdust	32	85	156	91
Straw	26	8	98	44

After identifying weeds, weeds were destroyed and leveled with a Kubota-50 tractor with a GQN-125 rotor. All inter-row weeds are 100% killed.

Before the 2nd tillage between the rows of sea buckthorn trees, in July, 146.67 weeds grew m^2 on average for 2020-2022, and the pattern was the same as the first tillage. Since the cultivation was done once between the rows, mostly annual weeds such as ***Chenopodium album***, ***Polygonum convolvulus***, ***Eragrostis minor***, and ***Artemisia scoparia*** grew. Weeds were not counted in non-organic versions of woven fabric and polyethylene, but weed counts increased in versions with sawdust and straw organic mulches.



	Between row	Control-1	Control-2	Polyethylene	Woven fabric	Sawdust	Straw
2020	136	142	230	0	0	276	351
2021	228	277	279	0	0	133	51
2022	76	221	261	0	0	111	94
Average	146.67	213.33	256.67	0	0	173.33	165.33

Figure 2. Effect of options on spread weeds before 2nd tillage between rows, per/m^2

Weed density m^2 was sampled randomly at four places with the help of one square meter and dry weed biomass m^2 at harvest was recorded. The weed control efficiency (WCE) was calculated by using the formula (Kondap and Upadhyay, 1985).

The yield in the version with woven fabric was 44.8 c/ha 8.6-43.5 c/ha more than in other versions. But the Control 2 version has 5 points or 256-380 per/m^2. It created conditions for minimum yield.

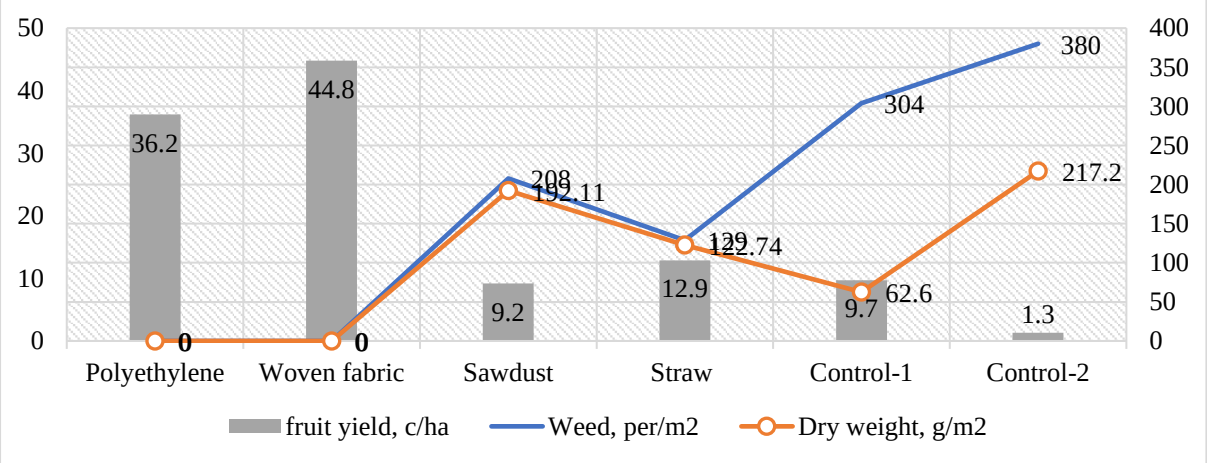


Figure 3. Weed biomass and yield, 2022

Sea buckthorn yield decreases as the number of weeds increases. There was a strong negative correlation between yield and weed number P= -0.77, and a weak negative correlation with weed biomass yield P= -0.5. No differences in weed species composition were observed among the mulch versions.

When determined the weed seed bank in the experimental versions, 69.3 % in 2020, 41-77 % in 2021, and 40-67 % in 2022 were contained in the stratum 0-10 cm in the soil. In mulched versions, the weed seed bank decreased from spring to autumn. In the spring of 2020, the weed seed bank in the depth of 0-10 cm in the experimental area was 65.6 million/piece, while in the autumn it was increased by 1.1-3.6 times in the control versions without mulch and decreased by 1.2-1.3 times in the 4 versions with mulch.

On the average of 2020-2022, in control 1 and control 2 versions, the seed bank increased by 2.2-33.2 million/piece, while in the version with sawdust mulch, 14.7 million/piece, plastic film 10.7 million/piece, woven fabric 10.0 million/piece, straw 2.8 million/piece was reduced by respectively.

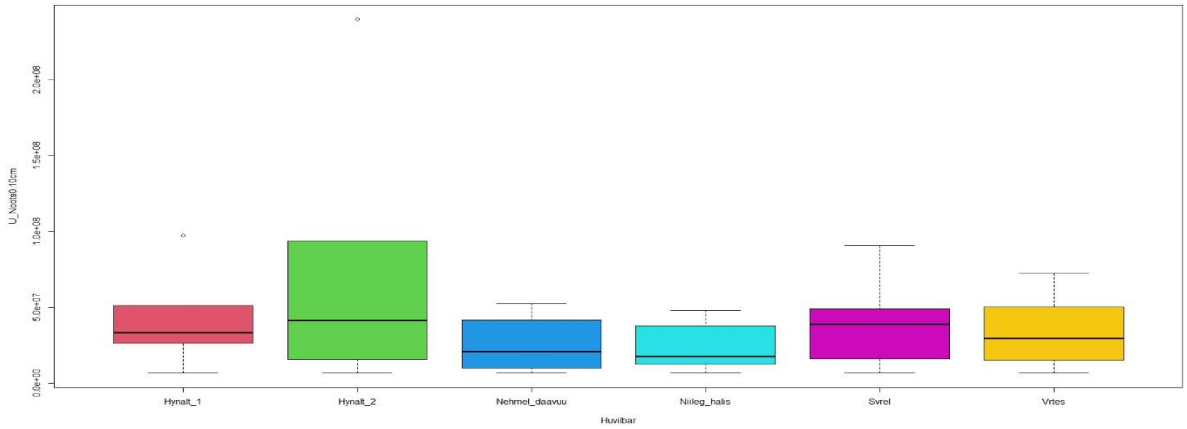


Figure 4. Effect of mulching on weed seed bank at 0-10 cm depth in sea buckthorn field.

In statistical processing, the mulch versions differed significantly in weed seed bank. According to the results of the research, weed seed bank of 0-20 cm depth decrease in the versions where mulch is created from spring to autumn. Compared to the 2021–2022 average for the first year of the study, seed bank was 1.1–2.1 times lower in mulched version, and 1.3 times higher in the control 2 version in the spring of 2020. In the autumn, mulching versions were also reduced by 1.9-2.6 times.

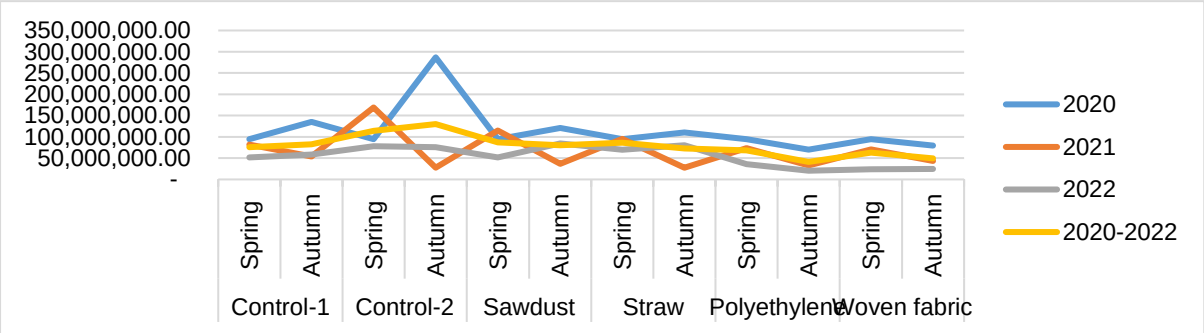


figure 5. The effect of mulch on the reduction of the weed seed bank in sea buckthorn field, million/ piece.

According to the study, there was a significant difference between the 0-20 cm depth of weed seed bank and mulching between 2020 and 2022. Polyethylene and woven fabric versions limit the growth of weeds and reduce the content of their seed bank. $P_{0.05}$= 0.0141* variants are significantly different.

CONCLUSION

According to the results of Dr. Gene Hogue's research, conducted in Canada, which shares a similar climate with Mongolia, weeds in fruit fields were controlled by mulching shredded paper and tree trunks, as well as by planting alfalfa, mustard, winter rye, and clover. Control weed was 340 per/m^2, tree bark 30 per/m^2, paper 28 per/m^2, control weed biomass was 19 g/m^2, tree bark 15 g/m^2, paper 3 g/m^2. Studies have shown that paper and tree bark have good weed-suppressing properties. Since 2007, in the 1 ha mother garden of Haskap at the Plant Genetic Resources Sector of the Institute of Plant and Agricultural Science, we have been using woven fabric mulch made in China, which reduces irrigation frequency by two times and inhibits weed growth. /Atarsaikhan T, 2018/. In a comparison of mulches such as black plastic film, woven fabric, dolomite, etc., in the mother garden of Blue Dam film, it was found that plastic film mulch is positive for plant growth and reduces the growth of weeds, but woven fabric material is better than plastic film in terms of durability. /Uuganbaatar N, 2019/. In the years of the study, the polyethylene and woven fabric mulching versions produced 44.8 c/ha in the woven fabric mulching version, or 8.6-43.5 c/ha yield more than the other versions, and the weed seed bank was reduced by 1-2.6 times, which is similar to the research work of the above researchers.

RESULT

1) In the first year of the study, 9 species of weeds from 6 families were recorded during tillage before planting. In 2021-2022, depending on the type of mulch, the number of weed families and species is decreasing. The woven fabric version completely suppresses weeds.
2) In the spring, polyethylene, woven fabric, and straw mulches limit the growth and development of weeds, impairing their respiration and reproduction, and the results of the study showed that weeds did not grow at all. The sawdust version had an average of 53-75 per/m^2 of weeds, which was the highest compared to the mulched versions.
3) The yield in the version with woven fabric was 44.8 c/ha, or 8.6-43.5 c/ha more than in other versions. But the Control 2 version has 5 points or 256-380 per/m^2. It created conditions for minimum yield.
4) Sea buckthorn yield decreases as the number of weeds increases. There was a strong negative correlation between yield and weed number P= -0.77, and a weak negative correlation with weed biomass yield P= -0.5. No differences in weed species composition were observed among the mulch versions.
5) Weed seed bank in the experimental versions, 69.3 % in 2020, 41-77 % in 2021, and 40-67 % in 2022 were contained in the stratum 0-10 cm in the soil. In mulched versions, the weed seed bank decreased from spring to autumn.
6) Seed bank compared to the average of 2021-2022, spring mulched versions decreased 1.1-2.1 times, while the control 2 version increased 1.3 times in soil 0-20 cm depth of 2020.

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10.RESEARCH RESULTS ON HARVESTING METHODS FOR SEA BUCKTHORN (*HIPPOPHAE RHAMNOIDES* L.)

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ABSTRACT

Sea buckthorn (Hippophae rhamnoides) is a plant that has been used in traditional medicine and cosmetics for its various health benefits. Sea buckthorn contains many nutrients and bioactive compounds, such as vitamins, carotenoids, polyphenols, fatty acids, and phytosterols. In recent years, the demand for sea buckthorn fruit has been increasing, and according to Mongolian statistics for 2023, 1,964,855.42 kg of sea buckthorn fruit were harvested from 3,139.36 ha of sea buckthorn. It is estimated that when the fruit is harvested by hand, more than 90 percent of the total work of the orchard is spent on the harvest alone (Balgan 1990). Therefore, the main goal of our research work is to optimally plan the planning of the orchard of the sea buckthorn, to compare the different methods used for harvesting (hands, forceps, shaking technology) and to increase the work productivity.

Key words: harvest, harvesting method, forceps, vibration, Sea buckthorn

INTRODUCTION

Producing fruit and berries requires years of diligent work, financial investment, expertise, and specialized skills. Mongolia has a vast territory, natural and climatic hazards, and a negative climate. More than 60 types of natural fruits and berries are grown. Researchers have developed agro-technologies for growing, localizing, and multiplying various types of fruits and berries.

The fruit industry in our country is developing in both household and enterprise forms, and although a legal framework for fruit cultivation is in place, there is a lack of field organization and qualified human resources at the professional level. Therefore, simplifying the harvesting of fruit orchards, improving organization, and properly planning human resource management are among the pressing issues, and little has been resolved so far.

Therefore, in this study, we have conducted research on the proper planning and problem-solving in human resource management for the optimal organization of orchard planning.

RESEARCH MATERIALS AND METHODS

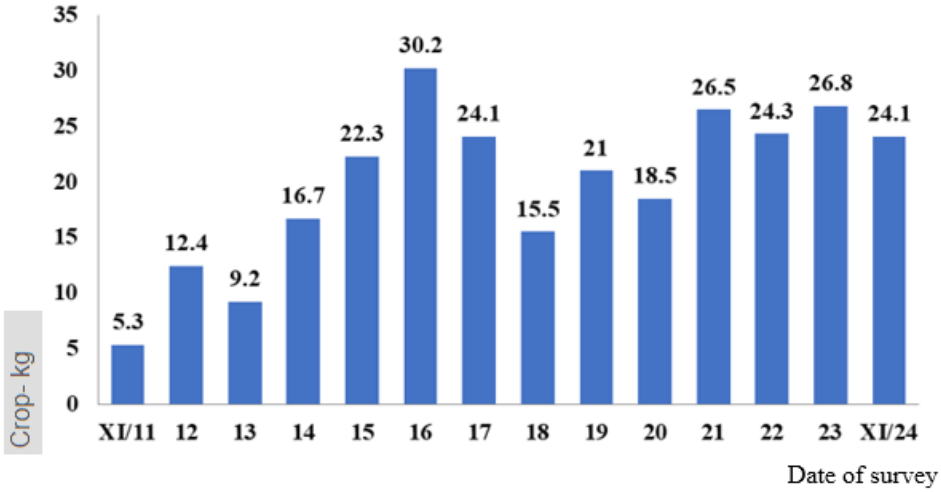
The research was conducted in the fruit garden area of "Bayanburd Green Grove" LLC, 21st district, Songinokhairkhan district, Ulaanbaatar city. Sea buckthorn harvesting by hand and vibration during freezing was conducted in September, October, and December 2021-2023 with the participation of 10 people over 14 days. The research was conducted using a combination of observation methods (chronometry), quantitative research methods, and qualitative research methods.

RESULTS

1. Results of research on the productivity of manual picking of sea buckthorn fruits

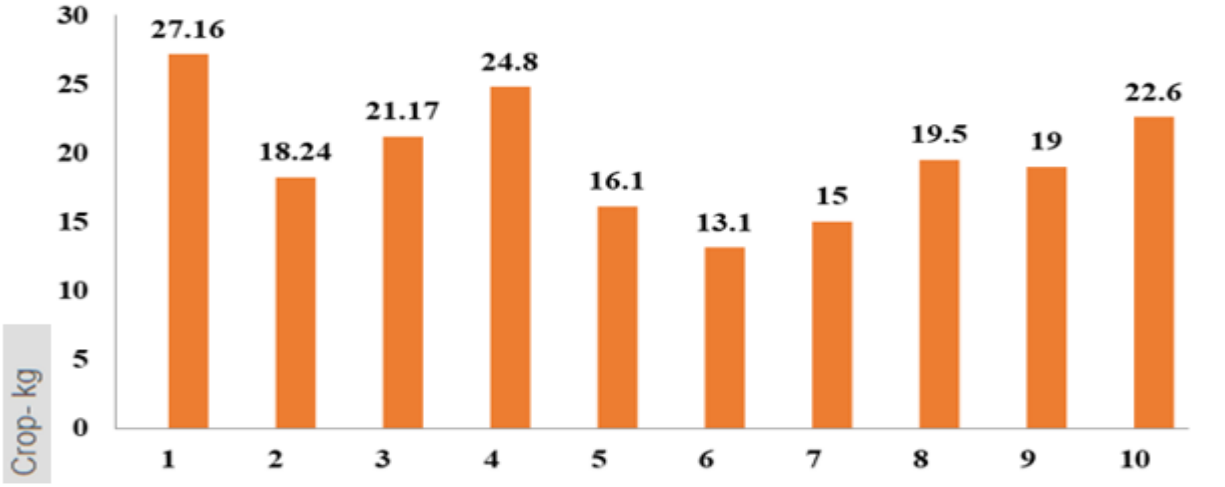
Harvesting sea buckthorn is done when the fruit is fully ripe. Fruit ripening can vary depending on the orchard's location and climate. Ripening period - classified as early ripening (late summer), medium ripening (early autumn), late ripening (autumn) (D. Khandsuren 2021). Manual fruit harvesting is best done at the end of August and beginning of September, and we did it between September 11th and 24th.

Sea buckthorn berries have sharp thorns, which is one of the reasons hand picking is slow. To protect your hands from thorny branches during the harvest, it is advisable to wear gloves and long-sleeved clothing. The fruit can be picked by moving from the stem to the tip.



Picture 1. Average daily yield of all workers during manual fruit harvesting, kg/ha

A total of 10 workers participated in the study, and the graph shows that the average yield on the first day was 5 kg. However, after 5 days, on September 16, it increased to 30 kg, indicating that the working techniques are being acquired. Fall harvest work is time-sensitive and requires getting more done in less time. As a result, there is a legitimate requirement that harvesting workers be provided with occupational safety guidance and information prior to harvesting.

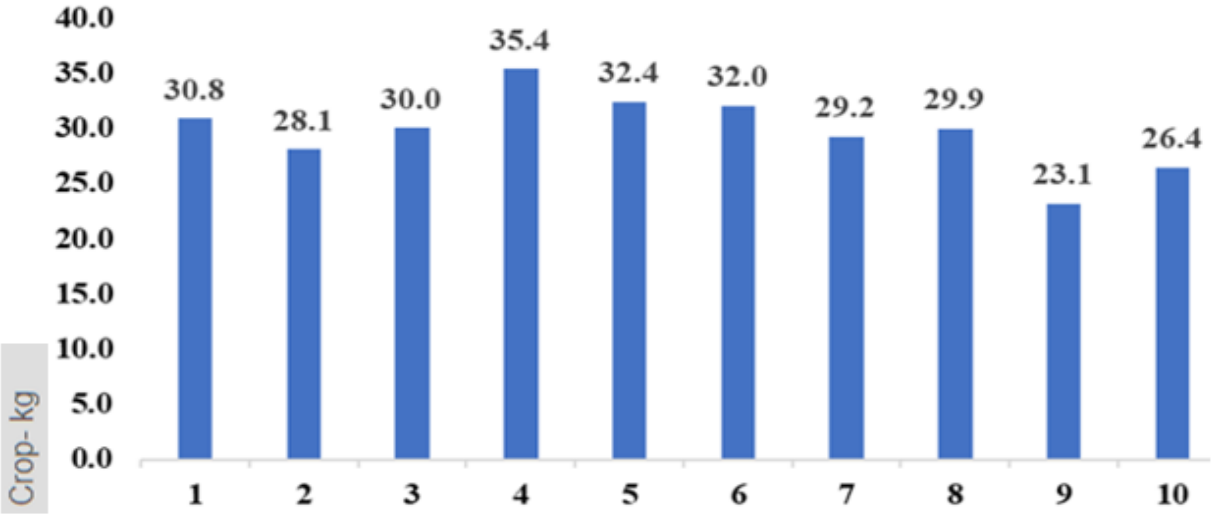


Picture2. Kilograms of Fruit Harvested by Hand
(Shows an average of one person's 14-day daily harvest of fruit)

2. Productivity of picking the fruits of sea buckthorn with forceps

A. Pick fruit with straight hook forceps

To harvest the fruits of the sea buckthorn with straight-hooked forceps, pull the fruiting branch 2-4 times. The study's results show that labor productivity is improved by 1-2 times compared to manual harvesting (Figure 3). When harvesting fruit with forceps, a significant amount of leaves and debris is cut off, making it necessary to work again.

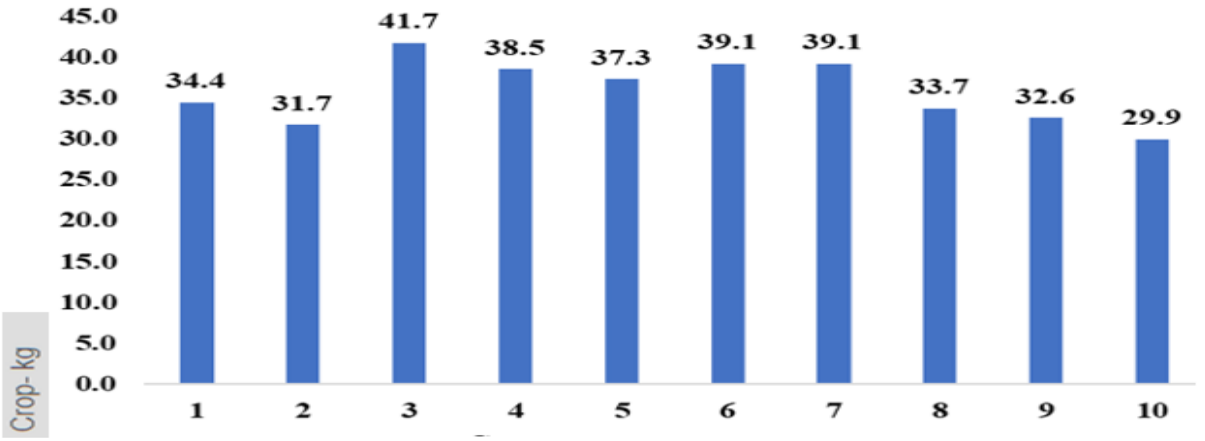


Picture 3. Fruit harvested with straight toothed forceps, kg
(Shows an average of one person's 14-day daily harvest of fruit)

B. Picking fruits with straight and curved combined forceps

The fruit was harvested by swiping over the sea buckthorn branch several times with a pair of straight and crooked forceps. If there was little branch growth on the fruiting branch, it was suitable to harvest the fruit with a straight hook, if the branch grew a lot with a crooked hook.

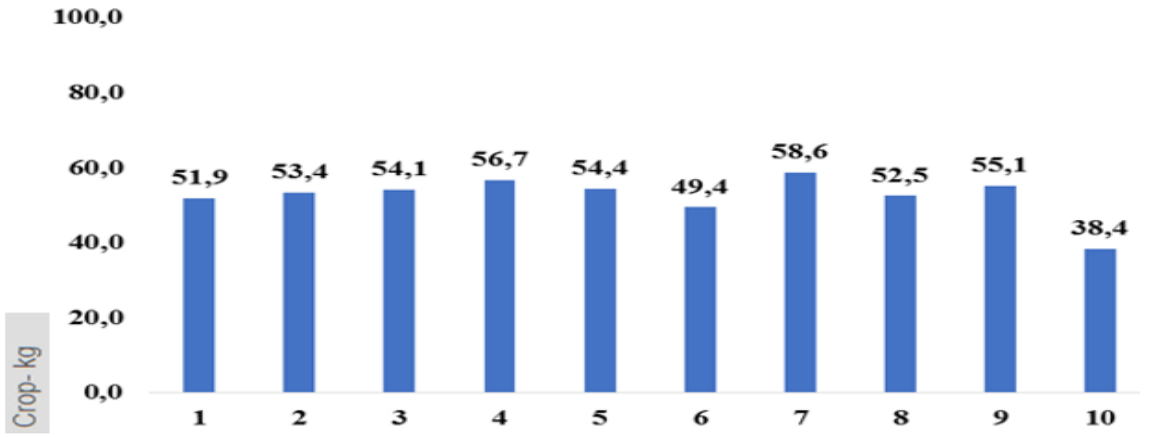
Due to the combination of straight and crooked teeth, the labor productivity increased by 2-3 times compared to straight toothed forceps.



Picture 4. Fruits harvested with straight and curved pair of toothed forceps, kg
(Shows an average of one person's 14-day daily harvest of fruit)

C. Harvest fruit with crooked toothed forceps

When picking fruit with crooked-toothed forceps, it is possible to harvest most of the fruit on the branch in one swipe. The research results show that the curved forceps are more productive than the straight and curved combined forceps. However, labor productivity increased 3-4 times compared to harvesting fruit by hand.

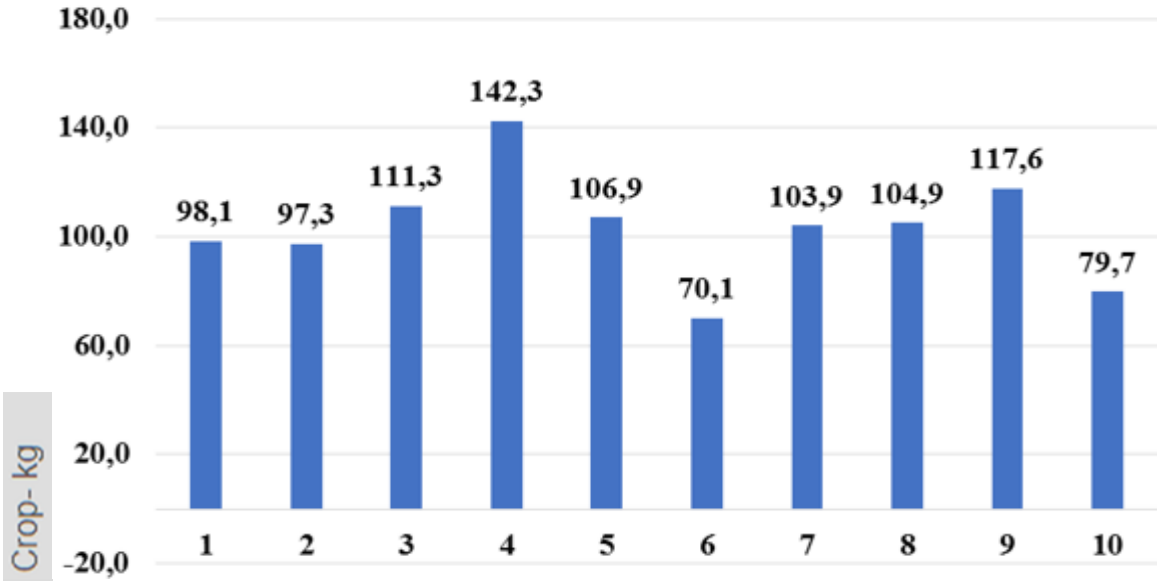


Picture 5. Fruits harvested with crooked forceps, kg
(Shows an average of one person's 14-day daily harvest of fruit)

3.The results of the research on harvesting frozen sea buckthorn by shaking

In order to harvest sea buckthorn fruits by shaking, after the air temperature rises above -16C, after the fruit freezes, a special mat 2-2.5m wide is laid around the fruit tree, and when the fruit branch is hit with a stick, the fruit falls off the branch (Ch. Avdai 2021, D. Nasanjargal, G. Chimed-Ochir, G. Turmunkh 2021). When we carried out our research in December 2021, the air temperature was above -25C at night. If you hit the fruiting branches with a 1-2 meter stick, the fruit will be blown off the branch and fall on the mat. Then, the fruit is harvested by packing it in specially prepared sacks. Since the survey will be conducted at night, the visual

environment during photography and video recording is limited, the equipment freezes, and the possibility of normal operation is impaired. Harvesting of sea buckthorn fruits by shaking them with a stick is usually done at night. This method increases labor productivity by 4-5 times compared to manual harvesting. This method is widely used in Uvs, Zavkhan, and Selenge provinces, Russia's Siberia, Altai Region, Tuva, Buriad, and China's Xinjiang (Ch. Avdai 2021), where there are large sea buckthorn fields in our country.



Picture 6. harvested by vibration method, kg

(Shows an average of one person's 14-day daily harvest of fruit)

2nd photo. Harvesting sea buckthorn by shaking

Table 1. Sea buckthorn fruits harvested by different methods, in kg

№	Fruit harvesting method	Harvested fruit kg		
		Average daily fruit harvest for 1 person, kg	1 person's 14-day fruit harvest average, kg	Total fruit harvest for 10 people in 14 days, kg
1.	Manually	19.6	274.4	2750
2.	With straight-toothed forceps	29.7	415.8	4132
3.	With straight and curved toothed forceps	35.8	501.2	5014
4.	With crooked-toothed forceps	52.4	733.6	7343
5.	Method of beating the fruit with a stick after freezing	103.2	1444	14450

According to the results of the above research, a difference exists between the time spent harvesting sea buckthorns with various fruit harvesting tools and the corresponding labor productivity (Table 1).

The methods of preparing and growing seedlings required for the establishment of a sea-buckthorn garden have been thoroughly studied. Theoretical research has been carried out to make a mechanized harvesting machine to make harvesting easier for the human body, and specific results were achieved in 1990 (Ch. Avday, B. Balgan 1990). In our country, all tasks other than harvesting sea buckthorn have been largely completed. However, since research on facilitating the work of harvesting its fruits has not been conducted, more than 90% of the labor required for fruit production in orchards is spent solely on harvesting. Balgan 1990/. Research shows that picking fruit by hand and with forceps is a time-consuming and labor-intensive task. During the cold season, workers who work outside at night face great difficulties when harvesting sea buckthorn fruits by shaking them with a stick. Ch.Avdai and B.Balgan said in their 1990 study that it is necessary to introduce harvesting machinery into the industry. Our research also shows this.

CONCLUSION

1. When picking sea buckthorn by hand, the average daily average of one person was 19.6 kg, while the productivity of 10 people in 14 days was 2750 kg.
2. Harvesting fruits with straight-toothed tongs increased labor productivity by 1-2 times compared to manual harvesting. The average productivity of one person per day was 29.7 kg, and the productivity of 10 people in 14 days was 4132 kg.
3. When harvesting fruit with straight and curved toothed tongs, the labor productivity of the combined hook was 2-3 times higher than that of straight toothed tongs, and the average of one person per day was 35.8 kg, while the total of 10 people was 5014 kg in 14 days.
4. Harvesting of fruit with curved toothed forceps was more productive than straight, straight and curved forceps. The fruits of the tip part of the shoot with few branches

were obtained well, and labor productivity was increased by 3-4 times. When evaluating the work productivity of 10 people for 14 days, a total of 7343 kg of fruit was harvested, and the productivity increased.

5. Harvest sea buckthorn berries by shaking them with a stick when they are frozen. This method increases labor productivity by 4-5 times compared to manual harvesting. Research has shown that one person collects 103.2 kg per day on average. When determining the work productivity of 10 people in 14 days, a total of 14450 kg of harvest was determined.

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11. RESEARCH ON TYPES AND SPECIES OF INSECTS PARASITIZING THE PUPAE OF THE SEABUCKTHORN FLY (*RHAGOLETIS BATAVA* HERING, 1958)

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ABSTRACTS

We carried out research on the detection and species identification of insects that parasitize the pupae of the seabuckthorn fly, which is the primary pest of seabuckthorn in Mongolia, in the Ulaan-Uul area (N50^{0}00”52 E92^{0}00”46., Height:914m), Ulaan-Uul area (N50^{0}00”52 E92^{0}00”46., Height: 914m) N49^0 59”53 E92^{0}02”53., Height: 972m), in the seabuckthorn field of Buyant river valley (N48^{0}00”01 E91^{0}35”39., Height: 1410m), Jargalan Sum, Khovd province. The research period spanned from the third to the tenth of May to the first to the tenth of June, and from the first to the tenth of September in 2021 to the first to the tenth of September in 2022. A total of 4125 samples of pupae from 0-5 cm of the soil were collected twice from 30 points and observed in laboratory conditions for 60 days. Parasitic insects of Hymenoptera *Habrocytus sp* and *Opius rhagoleticola* were detected. The density of pupae in the soil was 25.5 in Uvs province and 22.8 in Hovd province square meter. The host-parasite ratio was 1:1.

KEY WORDS: *Rhagoletis batava, Habrocytus sp* and *Opius rhagoleticola*

INTRODUCTION

In Mongolia, the species richness and distribution of Diptera have been relatively well studied. Of these, more than 80 species belonging to the genus Tephritidae Newman, 1834 have been recorded in our country [3].

In the second ten days of June in spring, when the air temperature rises above 18^{0}C degrees, the flies start to fly out of the pupa. But when it reaches 22-23^{0}C degrees, the number of actively flying and spreading will increase [11].

Adult fly body length 4-6mm, black, yellow, wings transparent, with 3 distinct black transverse stripes on the wings. The average body length of female flies is 5.51mm, and that of males is 4.99mm. Eggs are about 0.6-0.7mm long, oblong, and gradually become spotted. Larvae are transparent white, tapering towards the anterior end of the body, mouthparts are black, mature larvae are 6.5-7.5mm long. The pupa is located in a false home (cocoon). Germs are pale yellow in color and approximately 4-5 mm long [10]. The larvae feed on the soft tissue inside the fruit for 2-3 weeks. It hibernates at a depth of 1-5 cm under the crown of the buckthorn tree and under the haggrass. It reproduces in one generation per year [10].

The species composition of sea buckthorn pests and their destructiveness have not been uniformly studied in each natural area where sea buckthorn is grown, and there has been no study of parasitic insects. Therefore, research work was carried out to detect and identify species of insects that parasitize sea buckthorn flies.

RESEARCH MATERIALS AND METHODS

1. Method for detecting fly pupae from the soil: Fly pupae were collected twice from 30 points from the depth of 0-10 cm under the crown of the sea buckthorn tree.

a-number of detected pupae

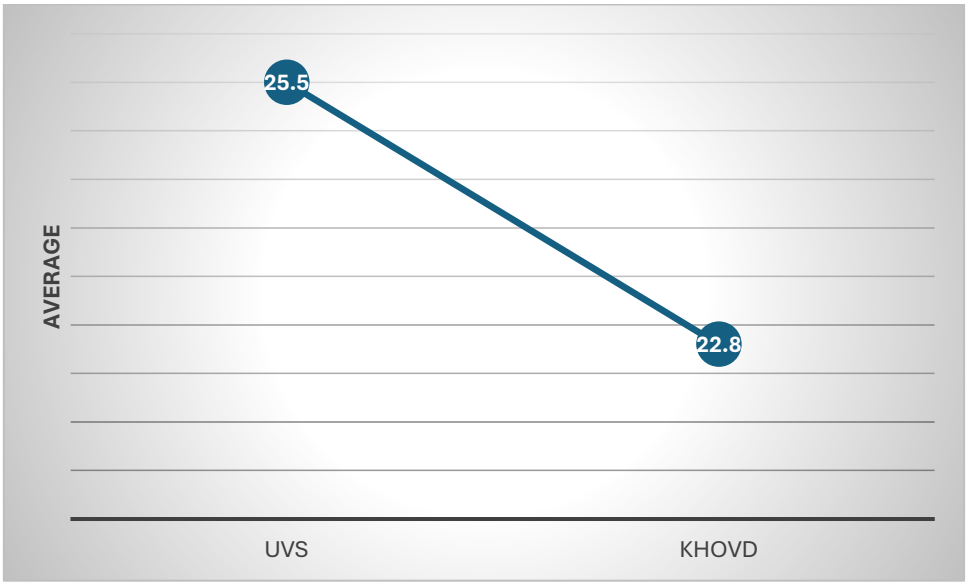
c-number of points

x-average density

2. Parasitic insect detection method: Place 5 cm of soil (70% moisture) in a plastic container and observe 100 pupae on it (Total 4125 pupae in 41 insect cage) Fig. 1.

RESEARCH RESULTS: We collected 4125 pupae samples from 30 points in the first ten days of spring in the first ten days of the 6th month in the field of seabuckthorn cultivation in Jargalan, Hovd province, and Ulagom sum, Uvs province. When calculating the density of pupae in the soil per square meter area, 25.5 were counted in Uvs province and 22.8 in Hovd province.

Graph 1. Average density of seabuckfly pupae per square meter area



When the pupae were placed in the laboratory twice for 60 days (at 22^0C, 60% humidity, with normal lighting), 51.7% of the total 4125 pupae matured. 48.2% of the total number of pupae was reduced. The number of parasites per host insect was 1:1.

$$X = \frac{4a}{B}$$

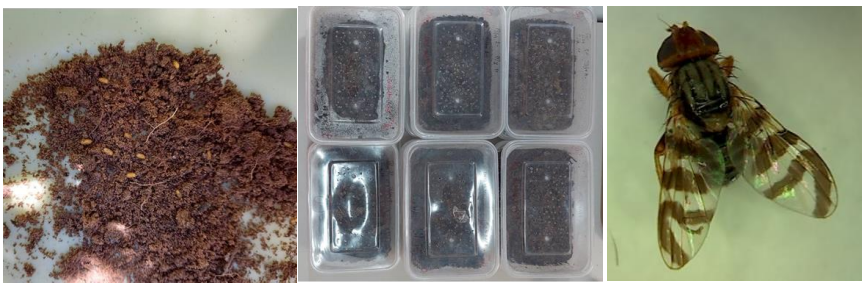


Figure 1-4. 1. Pupa, 2. 70% moist soil 3. Insect cage (16x11x5) 4. Sea buckthorn fly

One species of the genus Habrocytus of the family Pteromalidae and one species of the genus Opius of the family Braconidae were found from the observed pupae. They were identified as Habrocytus sp, Opius rhagoleticola species.

Habrocytus sp: Length of body length 1.68mm. The front of the thorax is dark brown, and the belly is brown. The legs are light yellow, the front part of the paws is dark, and the whiskers are 8-layered, brownish-brown. The wings are transparent and have a clear stripe on the leading edge with transverse stripes (Figure 5).

Opius rhagoleticola: Body length 1.68mm. The front part of the chest is dark brown and the belly is brownish brown. It has very distinct stripes on its wings. Beard has 16 syllables. The diameter of the medicinal egg is 0.1 mm. (Figure 6). *Opius rhagoleticola* is a major parasite of fruit flies, distributed from western Europe to Kazakhstan.

Figure 5. *Habrocytus sp* Figure 6 *Opius rhagoleticola* Achtleben, 1934

DISCUSSION

In our country, for the first time Davaa M (1971-1976), 3 species of 3 genera of flies were observed in Orkhon of Selenge province, West of Uvs province, Ulaangom, Bulgan and Buyant of Hovd province, and Tes sum of Zavkhan province. [1].

Dorjderem et al. (2011) noted that sea buckthorn flies spread in the forest steppe, and barren areas of our country and reduce the yield by 15-90%. Sea buckthorn fly larvae usually eat 1-2, sometimes 5 fruits during their development period [2].

Chuluunjav (2014) conducted a study on the distribution, harmful effects, and control methods of sea buckthorn fly in cultivated sea buckthorn orchards near Ulaangom, Uvs province. *Rhagoletis batava* species spread to Ulaangom, Tes sea buckthorn field, Govisumber provinces of Zavkhan province, the third ten days of June and July. It is written that in the first and second ten days, the larvae feed on the soft tissue of the fruit.

Sainzaya et al. (2014) observed that sea buckthorn flies emerge from the pupal stage in late June-early July, mate in mid-July, and start laying eggs in late July. According to the survey of the number of flies in the sea buckthorn field, the flight of sea buckthorn flies begins in the third ten days of June, the peak flight occurs in the second and third ten days of July, the intensity of flight decreases from the first ten days of August, and then it ends in the first ten days of September. discovered. When he conducted research on the relationship between sea buckthorn fly flight and temperature in the air and soil, he determined that /R^2=0.934/-/R^2=0.942/ is strongly related, and its output and distribution are weakly related to the amount of precipitation /R^2 = 0.324/ the rain that fell during the flight. Research has confirmed that it has a direct effect on crop loss by weakening the protective force used against flies [11].

According to Munkhtsetseg (2019, 2021) study, in the first ten days of September, the spread of larvae reached 96.8% and fruit damage reached 85-95% in a 10m2 area in the mother of the black bush in Durvaljin Sum, Zavkhan Province, and 63.3% spread in Ulaan Buraa grove reached 80%. [5]. Also, in Jargalan Sum of Khovd Province, after the first ten days of July, when we calculated the density of flies, 96-101 individuals were caught on one side of one trap, or 75-100% were uniformly caught in one trap [3].

The study of the parasites of sea buckthorn flies has not been conducted in our country, and the study of this aspect was conducted by the Soviet scientist Kandybina (1977) who recorded 5 species parasitic on pupae (*Opius rhagoleticola*, Thyridanthrax after, *Habrocytus sp*, Phygadenon sp., Gelis sp) [4,12]. Among the above species, Ophis rhagoleticollis Sacht hawk bee infects 50-70% of fly pupae, according to Shamanskaya L. D. (2014). In a year with wet rainfall, sea buckthorn flies' pupae become sick and their morbidity rate reaches 40%, and the number of sea buckthorn flies decreases 2-6 times due to flooding of sea buckthorn fields and freezing of the surface soil due to low snow cover in winter [4,12]. During our study, 2 species, Habrocytus and Opius rhagoleticola, were detected among the above 5 species of parasites.

CONCLUSIONS

1. When calculating the density of pupae in the soil of the western region of Mongolia, the number of pupae per 1 meter in early spring was 25.5 in Uvs province and 22.8 in Khovd province, and the number density was 2.7% higher in Uvs dry steppe zone.
2. Parasitic bees of 2 species of Hymenoptera, Habrocytus sp and Opius rhagoleticola, were found in pupal samples taken during the study.

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12.STUDY OF FIGHTING METHODS AGAINST WEED SPECIES IN SEABUCKTHORN FIELD

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ABSTRACT

Weeds provide conditions for the pathway of pests, so experiments with different weed control options were carried out in the production area. The composition, distribution and density of weed species spread in the sea buckthorn field was carried out on a total 6000m^2 of 43 hectares of fruit plantations "Polivit" LLC in Batsumber Sum, Central Province, and 17 family, 28 genus, and 33 species of weeds were identified in the total area, with weed level of 3-5 points. When classifying weeds by biological group, 30.3% are annuals, 6.1% are biennials, and 63.6% are perennials. Tornado 50% herbicide (chemically method) used by against weeds spread in field showed 97.6-100% results when tested at 2.5-3.0L/ha twice during the growing season. Also, by applying black synthetic film, wood shavings and biochar (biological method), the result was calculated as weed reduction at 100%. Weeds in the ditches of sea buckthorn were pulled by hand and mowed (mechanical method) 3 times during the growing season with a mechanical mower between the rows.

KEY WORDS: WEED, SEA BUCKTHORN, HERBICIDE

INTRODUCTION

As a result of the implementation of the "Sea buckthorn" national program by the Government of Mongolia, the cultivation and production of fruits and berries has increased 4-6 times, the size of orchards has reached 6.07 thousand hectares, and about 2560 tons of fruits are harvested annually. However, it provides less than 1.5 percent of the physiological needs of the population, and imports 18-22 thousand tons of fruits and berries every year. Sea buckthorn accounts for 92% of all cultivated fruits and berries, and other fruits and berries account for 8%. 300.0000 seedlings worth 682.82 million MNT to plant on 240 hectares in the spring of 2012 in order to support fruit and berry seedling breeders and increase cultivation due to the growing demand for fruits and berries in the food consumption of the population and the increasing interest in sea buckthorn and natural fruit products in the foreign market. Sea buckthorn seedlings were purchased from 3 domestic producers through an open tender, and the "Sea Buckthorn Seedling Loan" project was selected, and 279 citizens, enterprises, and organizations from 16 provinces were granted loans for a period of 5 years. A project was selected for the purchase and loan of saplings, and it was given to 233 citizens and enterprises in 19 provinces and the capital. Therefore, choosing the optimal option for fighting weeds in the sea buckthorn fields by biological, mechanical and chemical methods will be the basis of our research work.

AIMS AND OBJECTIVES

One of the many factors that reduce the quality of the crop in sea buckthorn production is the distribution of weeds in the field, which creates the environment for the spread of pests, which leads to the loss of the crop. The purpose of the research work is to determine the distribution and density of common weed species and to develop an optimal method of combating them.

The following goals were set, including:

1. To determine in detail the distribution and density of weeds species in the sea buckthorn field.

2. Developing optimal methods of fighting.

MATERIALS AND METHODS

1. A total weed species and density of the experimental fields was determined by methods of E.I.Liberschtaine and A. Tulikov.

2. V.I. Grubov, G. Tserenbaljids Identification books used by to identify weed species

3. In the chemical control of weeds, Tornado 50% herbicide was used in 2 doses, 6 variants, and 390 sea buckthorn bushes were counted in 1 variant, and 100 liters of working fluid was calculated for 1ha in a total area of 6000m^2. On the 7th, 14th, and 21st days before and after spraying herbicides, a frame was placed on a 0.25m2 area in each field, and the weeds were classified by biological species and the technical results were calculated.

$$A = \frac{100 * T2 - 100}{T1}$$

- A – herbicide result /percentage (%)/
- T1 – number of weeds before the herbicide application
- T2 – number of weeds after the herbicide application

4. The number of weeds in 0.25m2 of each variants was calculated by biological method before and after applying black synthetic film, wood shavings, and biochar on days 7, 14, 21, and 30.

5. In mechanical method, during the growth period of the plants, the weeds in the tree pot and in the strip were pulled by hand and mowed 3 times with a mechanical mower.

Table 1. Experiment scheme

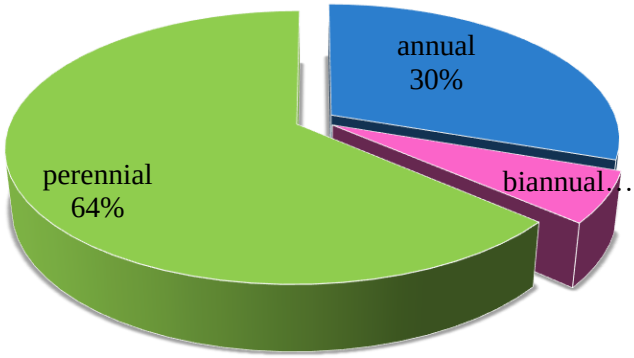
Black synthetic film	Black synthetic film	Control	Black synthetic film
Control	Wood shavings	Wood shavings	Wood shavings
Biochar	Control	Biochar	Biochar
A field fought for mechanical (mowed) method			
Tornado, 50%, 2.5l/ha	Tornado, 50%, 2.5l/ha	Tornado, 50%, 2.5l/ha	Control

Control	Tornado, 50%, 3l/ha	Tornado, 50%, 3l/ha	Tornado, 50%, 3l/ha

RESEARCH RESULT

Research experiment on chemical, biological and mechanical control of weeds in the sea buckthorn field was carried out covering an area of 7000m2, and in the experimental area, 17 families, 28 genus, and 33 species of weeds (*Chenopodium album*, *Chenopodium acuminatum, Chenopodium aristatum, Potentilla anserine, Agropyron repens, Thlaspia arvensis, Brassica juncea L, Artemisia palustris L, Artemisia anethifolia, Sonchus Arvensis L, Cirsium arrvense, Crepis tectorum L, Serratula centauroides, Tribulus trestris, Plantago major, Spahallerocarpus gracilis, Silene repens, Medicago falcate, Melilotus dentatus, Cannabis rudralis, Eroduim Stephianum etc..*) were identified to be widespread. It is believed that because sea buckthorn was first planted by plowing the soil, the natural native plants were reduced and the spread of the main weeds in the field was increased. In the experimental field, 33 species of weeds were distributed by biological group, 30.3% of annual, 6.1% biannual, 48.5% of perennial weeds, and 15.2% of perennial segmented weeds (Diagram-1). The level of weeds in the researched area is 3-5 points

Diagram 1. Ratio and percentage of biological groups of weeds in sea buckthorn field

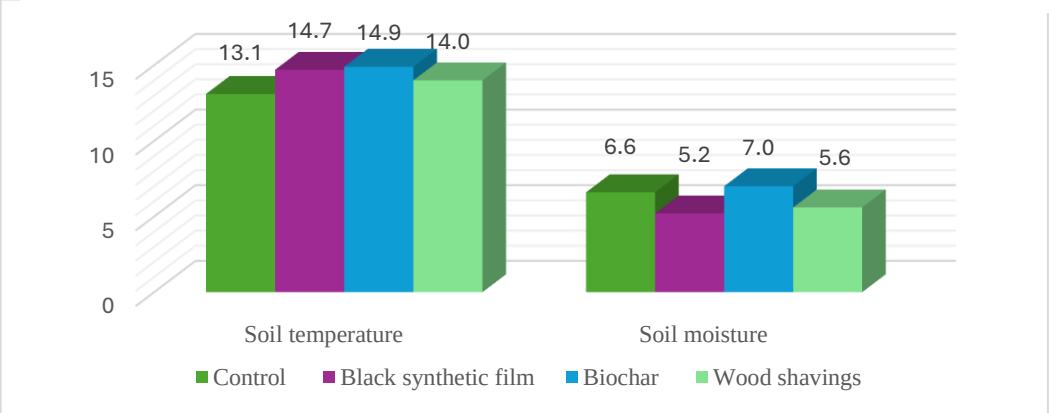


Results of using biological methods against weeds in the sea buckthorn field: In the biological control of the weeds growing near the sea buckthorn bushes, we covered them with black synthetic film, wood shavings, and biochar to limit the growth and development of the weeds.

Figure 1- Covering experimental area

Before mulching, 16-37 weeds were counted per 1 m^2 area, but after 30-40 days, the number of weeds growing in the area was reduced by 100%. This inhibited the growth of weeds. Also, the changes in soil temperature and moisture were analyzed 10, 30, 40, and 60 days after the application of the black synthetic film, and compared to the control variant, the temperature of the soil increased by 0.9-1.8 ^{0}C and moisture was retained (Graph 1).

Graph 1- Soil moisture and heat rate of covered variants



Result of chemical method (herbicide) against weeds in sea buckthorn field:

In the spring field of sea buckthorn, in the third ten days of May, weed count was 42-109 weeds per 1 m^2, among which there were *many Chamaenerion angustifolium (L.) Scop, Agropyron repens, Cirsium arrvense, Sonchus Arvensis L. Chenopodium album* etc.. weeds level at 4-5 points. The result of herbicide application was 97.6-100% in Tornado 2-3 l/ha version, with yellowing of weeds and stunted growth from the 14th day.

Result of the mechanical method against weeds in the sea buckthorn field:

To control weeds growing in ditches, measures were taken to reduce the spreading density by hand-pulling and using a mechanical mower in the strip field to mow three times during the growing season. In this way, by limiting the spread of diseases and insects, and by altering the habitat of certain rodent species, a reduction in their distribution was observed due to environmental changes. There were 4 types of fungal diseases spread in the field (M. Gantuya, IPP, 2016-2018), and it was determined that these diseases are usually transmitted when the roots of sea buckthorn

Figure 2- Herbicide effect and weed count

are damaged. Some types of rodents were recorded in the study area, which usually feed on rhododendrons, stems, leaves, seeds, green parts, and some species of insects. Also, it was observed that the

harmful rodents in the field damaged the roots of the sea buckthorn tree, causing the green mass above the soil to dry up and die (G. Munkhchuluun, IPP, 2016-2018) therefore believed that the mechanical control of weeds in the experimental field reduces the rodent population.

Effect of control methods on crop yield:

The yield of sea buckthorn, calculated as the average yield of 1 tree and transferred to ha, was on average 10.9-31.2% higher for the variants compared to the control (table 2).

Table 2. Yield

№	Variants	Average yield t/ha	Additional yield t/ha	Additional yield, %
1	Control	6.4	-	
2	Black synthetic film	7.6	1.2	18.7
3	Wood shavings	8.1	1.7	26.5
4	Biochar	8.4	2	31.2
5	Tornado 50%	8.2	1.8	28.1
6	Mechanical mower	7.1	0.7	10.9

Analysis of variance on the effect of experimental error and mulching on yield showed that the P value was less than 0.05, indicating that control method had an effect on yield.

Table 3. Analysis of Variance when calculating the P value

Experimental error	0.046
Error of mean difference	0.039
P value	<0.05

DISCUSSION

1. Work has been achieved by using herbicides between the rows of fruit and berry fields, with the results of Basta herbicide at a dose of 3.0 l/ha showing 90.2% effectiveness and Roundup herbicide at a dose of 4.0 l/ha achieving

83.0% effectiveness, respectively. The results obtained by the researchers Ariunaa. O. and Otgonsuren.M on the topic "Development of weed control methods in the field of blackberry" (2001-2003) are similar to the results of our herbicide test.

2. In 2003-2005, when Roundup herbicide was sprayed against weeds in the sea buckthorn field at the Weed Research Laboratory of the Institute of Plant Protection, it had a greater effect on perennial weeds such as *Agropyron repens, Lactuca tatarica, Medicago falcate, Sonchus Arvensis* L. 70-87.6% of the technical results were calculated when the first spraying was done on 11/VI at a dose of 2 l/ha, and 91.3% of the weeds that grew in the field after 21 days after spraying the herbicide when the second spraying was done on 12/VIII had a full effect on it. This is because the effect of Roundup herbicide is gradually manifested, and after 14 days of counting, the weeds such as *Agropyron repens* and *Carex duriuscula* were yellow from the edges and some of them were yellow even to the root. After 21-30 days, 45-80% of the plants at the census point were yellow and died (SCIENCE AND TECHNOLOGY PROJECT REPORT 2003-2005 5.7.4), the results of one of our researches, herbicides, showed that the weeds grown in the field turned yellow from the 14th day the growth and development was stagnant, comparable to the results of 97.6-100% of 2.5-3.0 l/ha dose of Sprout extra herbicide, 100% of Grader 250g/l, and 96.4-100% of 2-3 l/ha variants of Tornado and Roundup herbicides.

3. When determining the distribution and species of weeds, 12 species of weeds from 7 families were noted. When considering the weeds by biological group, annuals accounted for 25%, biennials for 19%, and perennials for 56%. According to Institute of Plant and Agriculture Sciences doctor Atarsaikhan.T and other researchers experiment "Effect of covering for cultivation friut and berries" (2020-2022), during the determination of the biomass of weeds in the fields planted with honeysuckle and sea buckthorn, the number of weed species that grew in the scenarios was 8 genus and 16 species. The results are similar to the results of our research, that more perennial weeds grow in sea buckthorn fields.

4. Damage to the roots of crops is an easy way to get infected with verticillosis of sea buckthorn, and these wounds occur naturally even in healthy plants due to soil friction on the roots. Verticillosis has been observed to penetrate roots directly, but these infections rarely penetrate through transmission bundles, especially through root hairs (Garber, R.H. (1973) US Department of Agriculture Publication 1. ARS-S-19. pp. 69-77 .), the risk of this disease is increased by damaging the epidermis of the sea buckthorn tree when the number of rodents increases. Therefore, it is similar to our research that it is appropriate to manage weeds by changing rodents living conditions.

CONCLUSION

1. It was considered that perennial weeds were the most widespread in the sea buckthorn fields of "Polyvit" LLC in Batsumber Sum, Tuv Province, which created the conditions for increasing the spread of harmful organisms.

2. In addition to 100% result showed in variants of black synthetic film, wood shavings and biochar covers for weed control, the crop was increased by 10.9-31.2% due to the retention of soil moisture.

3. The biological results of 97.6-100% were shown in the fight with Tornado herbicide against perennial, root and rhizomatous weeds spread in the sea buckthorn fields.

4. During the growth period, depending on the height of the weeds, weeding was done mechanically 3 times, which limited the spread of rodents.

5. Comparing the weed control options, it was found that the biological method, combined with black synthetic film mulching, was more effective and had the advantage of facilitating human labor over other mechanical and chemical methods tested.

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13. SEABUCKTHORN LEAVES - FROM PLANTATION TO COMMERCIAL APPLICATION 10 YEARS RESEARCH AND DEVELOPMENT IN GERMANY

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ABSTRACT. Sea buckthorn leaves are described as a highly valuable raw material for human nutrition, feed and cosmetics. Over the last 10 years, we have investigated seabuckthorn leaves from 15 different countries and various harvesting seasons, with a particular focus on polyphenol and flavonoid content.

The leaves of female plants are a high-volume by-product of European berries harvesting technology whereas the male leaves are side stream of the pruning process.

In detail the influence of origin, time of harvest and post-harvesting processes on the quality of the leaves will be presented. Further it will be discussed the investigation of extraction procedures focusing on different molecules like polyphenols and flavonoids.

Finally the presentation will present commercialised results of various research projects focusing on the use of sea buckthorn leaf extracts in animal feed, cosmetics and technical applications such as textiles.

Key words: seabuckthorn leaves, post-harvesting technology, polyphenols, flavonoids, extraction, application

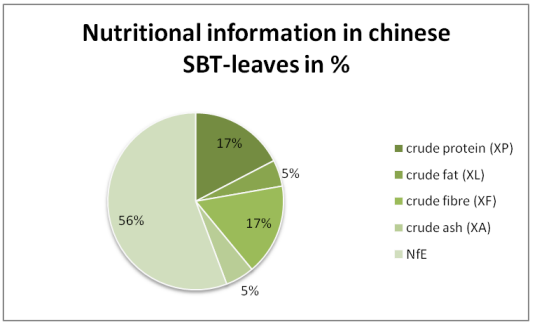
INTRODUCTION

While there is extensive international literature on the analysis of sea buckthorn fruits and the specific differences between the species and subspecies, there are much less studies on sea buckthorn leaves. The scientific examination of the leaves has, with a few exceptions, been conducted outside of Central Europe, particularly in Russia, China, India and Canada. For different subspecies or species, Lu Rongsen describes the following main constituents.

Seabuckthorn species	Proteine **in % DM**	FAT **in % DM**	Fibre **in % DM**	Ash **in % DM**	N – free Extrakt **in % DM**
H. rham. ssp. Sinensis	16,59	4,41	15,20	9,02	57,78
H. rham. ssp. Yunnanensis	19,28	4,36	14,28	5,06	48,26
H. rham. ssp. Turkestanica	15,18	5,61	17,37	5,10	56,76
H. rham. ssp. Gyantsensis	22,92	6,10	16,52	6,20	48,36

H. salicifolia	18,79	4,08	16,43	4,57	56,13
H. tibetana	16,44	5,46	16,66	3,36	58,08
H. neurocarpa	11,47	3,68	19,72	3,38	61,03

The table also shows significant differences in the main components of the leaf mass. The comparison with red clover [Lu Rongsen][1] is particularly interesting. While the protein content is nearly the same (17%), the fat content in sea buckthorn leaves is about 50% higher. The crude fiber and ash content is considerably lower than in red clover. This composition is very interesting for its use as animal feed.



Picture 1: Nutritional information in seabuckthorn leaves taken from chinese varieties (Rongsen, L., 1992, p. 21)

In addition to the main components, the minor components of the leaves are particularly interesting, such as flavonoids, tannins, B vitamins, carotenoids, and allantoin. Novruzov [2006][2]. Xuifeng Wen [2003][3]: Barl et al.[2003][4].

Especially the flavonoids are of interest for pharmacological applications like Adiposity[5] or protection against virus diseases[6].

The influence of organic farming methods on the flavonoid content in two Finnish varieties has been published. Fourteen hydrolysable tannins and other phenolic components were analyzed using HPLC.[7]

Russian researchers [8] have developed the preparation Hiporamin, which is based on extracts from sea buckthorn leaves and bark. This preparation has a broad spectrum of action against

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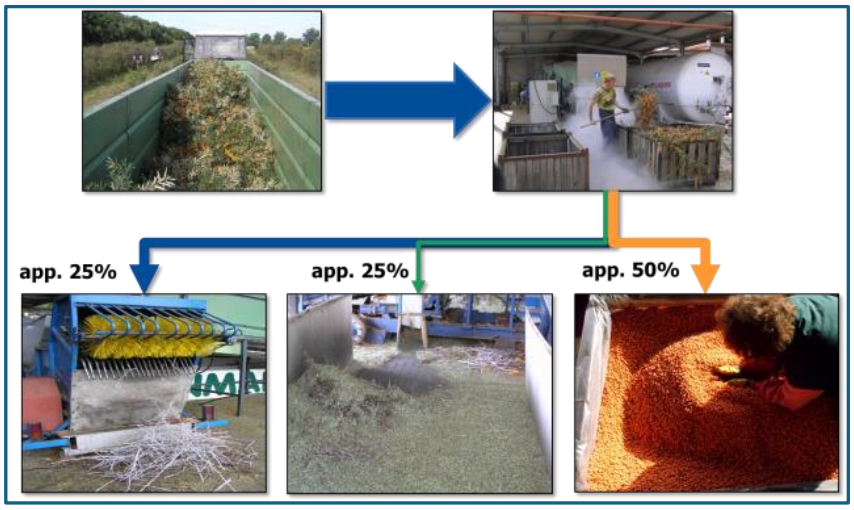
viruses, including various strains of herpes and influenza. The active components of this medication are gallotannins and ellagitannins.

Dr.Mörsel[9] published the first studies on the content of allantoin in leaves of german varieties, an antagonist for pigment formation in the skin and therefore valuable for products for ageing skin.

Indian and Chinese scientists have also extensively studied the secondary metabolites of seabuckthorn leave and its utilisation for medical, food and feed applications [10],[11],[12],[13].

The publications impressively demonstrate the efficacy of sea buckthorn polyphenols, highlighting their potential for immune stabilization in both humans and animals, as well as their use in combination with flavonoids as a preparation for cosmetic applications.



Picture 2: Cutting-freezing-shaking harvest

Beside the pharmacological, food and feed oriented research the application of seabuckthorn leaves extract as antimicrobial treatment of textiles[14] have described.

The harvesting of seabuckthorn berries in Germany and other European countries is realized by cutting/freezing/shaking of branches. In addition to approx. 50% seabuckthorn berries and 25% seabuckthorn branches, 25% seabuckthorn leaves are incurred by this technology.

NIG has started the research on seabuckthorn leaves in 2012 with different partner focusing on the commercialization of side streams of seabuckthorn production for following applications.

- Food
- Cosmetics
- Functional food
- Medical products
- Textile
- Leather
- Feed

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- Adhesive

We have investigated different post-harvesting procedures to conserve the quality of seabuckthorn leaves as raw material side stream of berries harvesting in Germany.

Discussing the question of quality it has to consider the final appropriation of the leaves. For instance the color and microbiological quality would important for leaves tea production. Further for food and feed application the environmental pollution with e.g. heavy metals or polyaromatic hydro carbons or pesticides residues are important quality parameter.

The conservation of target molecules during post-harvesting procedures is one key target for the production of leaves extracts, like proteins, flavonoids or polyphenols.

The most important quality parameter for our investigations was the content of polyphenols in the leaves.

METHODS

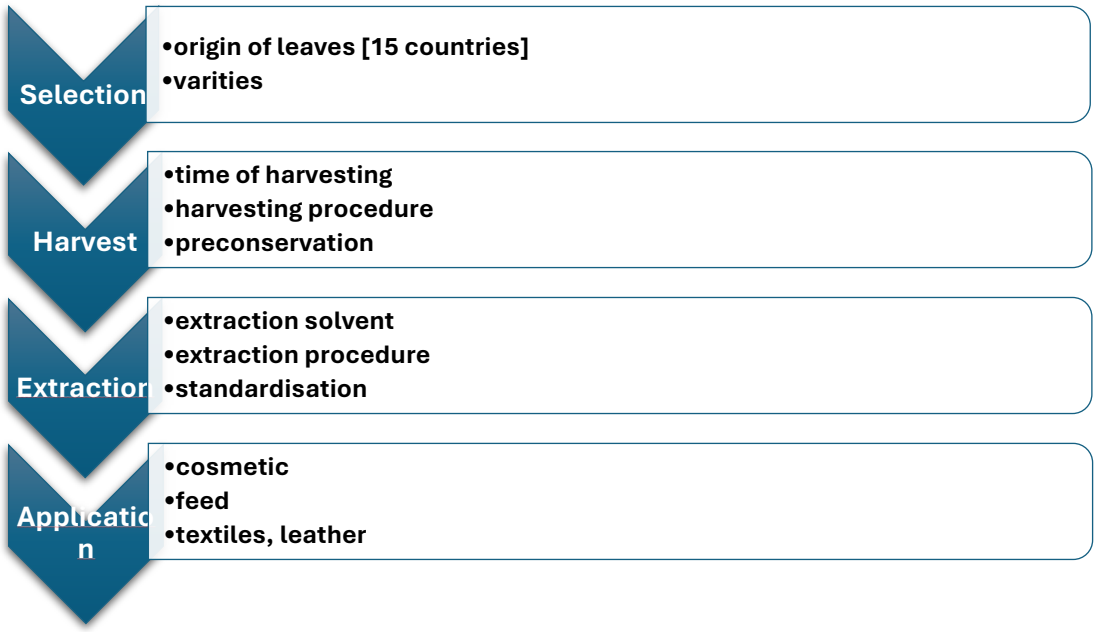
Polyphenols (PP) were determined with a modified method using Folin-Ciocalteu reagent according to Singleton-Rossi. The method was modified by adding hydrogen peroxide to inactivate ascorbic acid in leaves and leaf extracts. The flavonoids were analyzed using a self-developed HPLC method on an RP18 column.

The influence of different preservation method like freezing, lactofermentation and drying at 40°C, 60°C and 90°C on the target molecules was investigated.

Leaves from 15 different countries and different harvesting times were analysed.

Extraction processes using different extraction methods were investigated.

In summary the research project was carried out in following sub-projects



Picture 3: Sub-projects of the research

RESULTS

Extraction processes need leaves with high content of target molecules, like polyphenols and for industrial scale up raw material resources in bigger volumes. Just from starting German leaves were compared with leaves from different countries, what means too different subspecies or varieties.

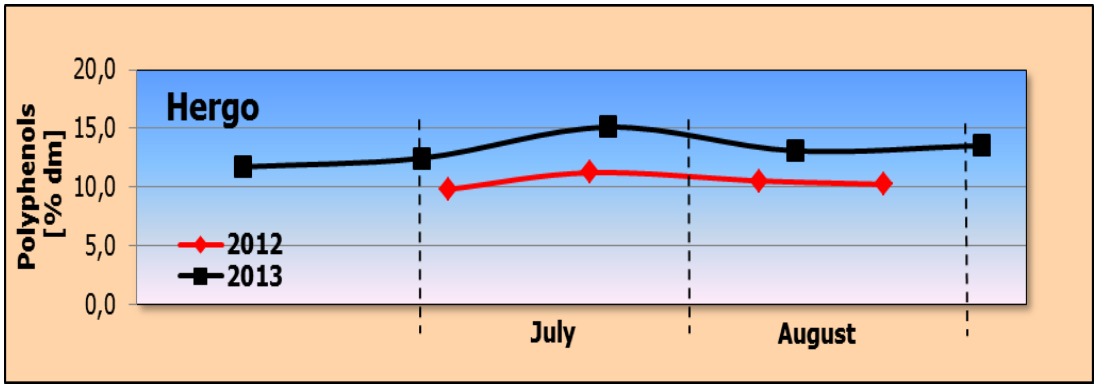
Following picture shows some selected results. All leaves were dried with 40 °C and analysed as described.

	Average PP content	Max PP content	Species/Subspecies	Yariety
Germany	9,6 %	14 %	Ssp. rhamnoides	Hergo
Russia	14,1 %	16,3 %	Ssp. mongolica	Gnom
China	12,1 %	20,6 %	Ssp.sinensis	Wild collection, 2900 m
Latvia	15,6 %	20,3 %	Crossing	Tatiana
Romania	8,2 %	12,1 %	Ssp. carpatica	Wild collection
Mongolia	10,6 %	13,2 %	Ssp.mongolica	Maslichnaya

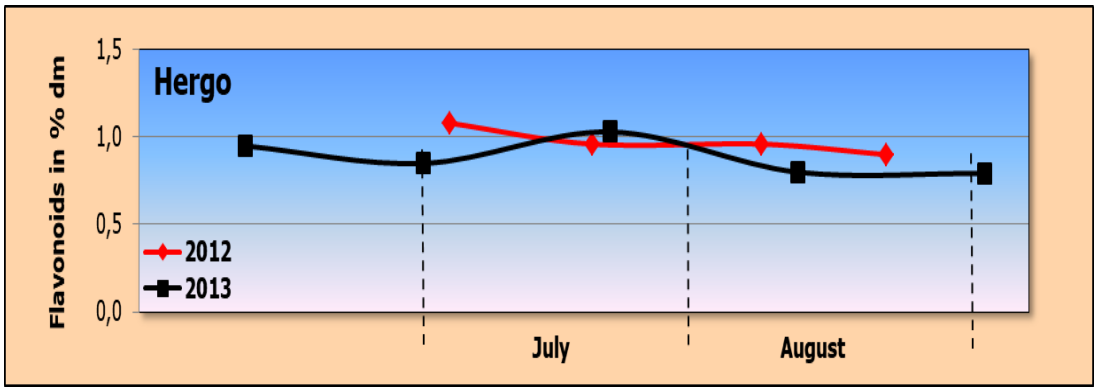
Picture 4: Selected results of polyphenol analyses of different origin

The result in picture 4 show that the leaves from wild collected ssp sinensis (attitude 2.900m) and the variety Tatiana contains the highest amount of polyphenols. Focussing on the average results considering the results of 3 years ssp. Mongolica from Russia and Tatiana from Latvia would be the favourite material for processing. At this stage, it is impossible to postulate the reason for the differences. More detailed studies are needed to answer the question of the influence of subspecies, cultivation or climatic conditions and the combination with breeding.

One of the main questions it the right harvesting time focussing on leaves production. Especially for the extraction of polyphenols, respective flavonoids it could show, the best time for leaves harvest is before berries are full ripen.



Picture 5: Polyphenol concentration in dried leaves of var. Hergo depend on picking time

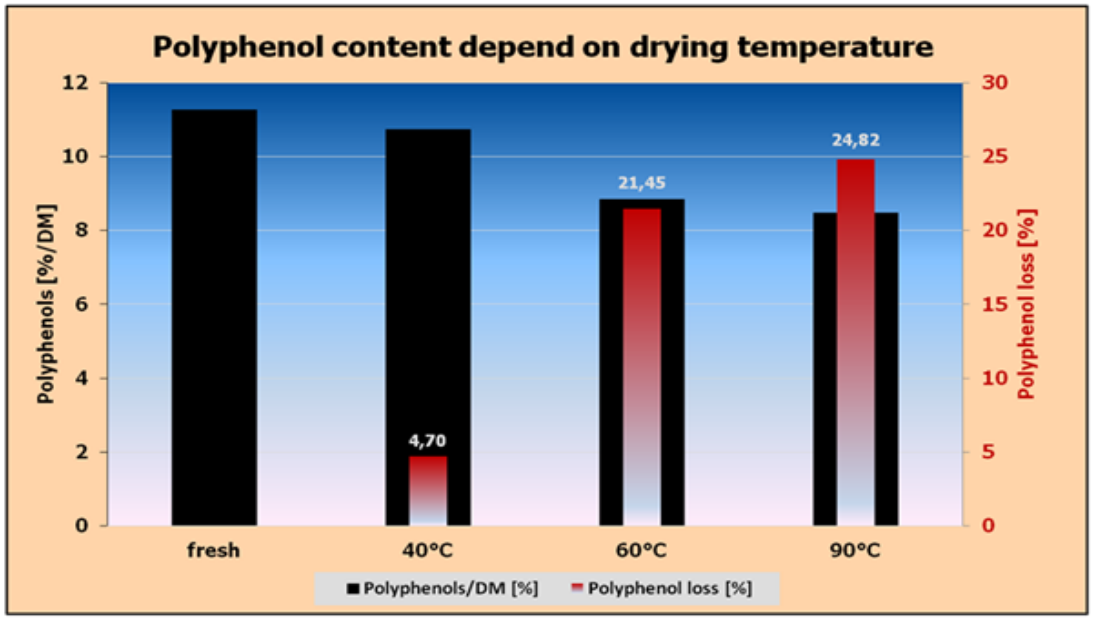


Picture 6: Flavonoid concentration in dried leaves of var. Hergo depend on picking time

For conservation of the leaves we have investigated drying, freezing, combination of freezing and drying as far as lactofermentation of leaves

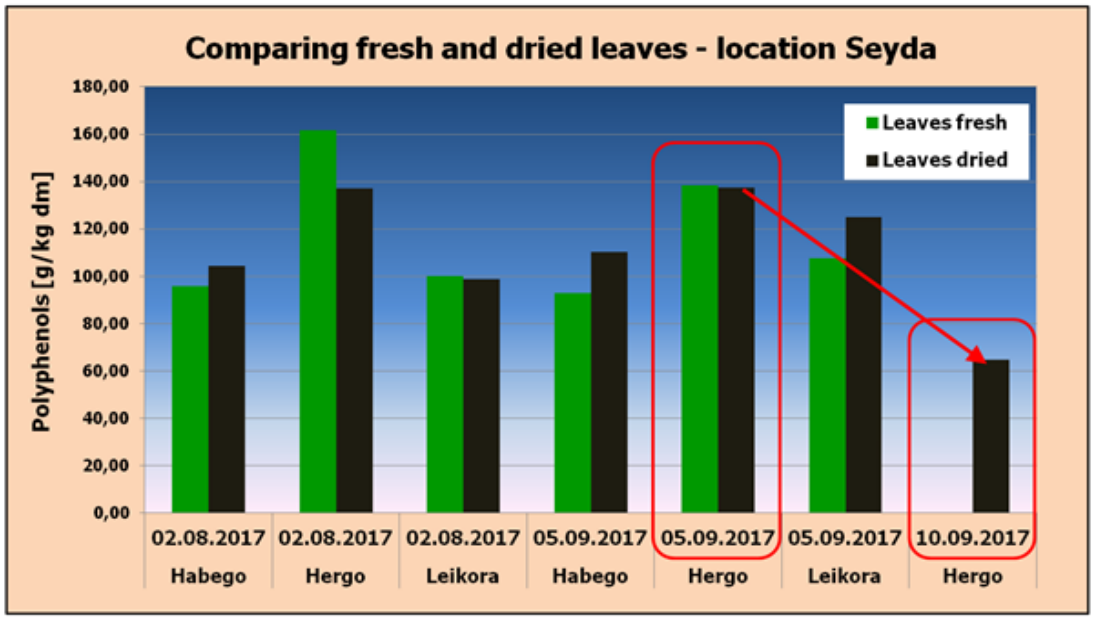
The loss of polyphenols during drying was published by different authors, like Cenkowski[15]. We found similar results for German varieties. Based on our figures we recommend a technical drying of seabuckthorn leaves at temperatures of 40°C max, preserving the polyphenols.

[15] Cenkowski, S. el al. 2005, Effect of drying on the nutritional quality of seabuckthorn leaves. In Journal of food science, Vol. 70, Nr.. 9



Picture 7: Polyphenol content and loss in leaves depend on drying temperature

Following picture 5 shows the comparison of polyphenol concentration in fresh leaves and at 40°C dried leaves.

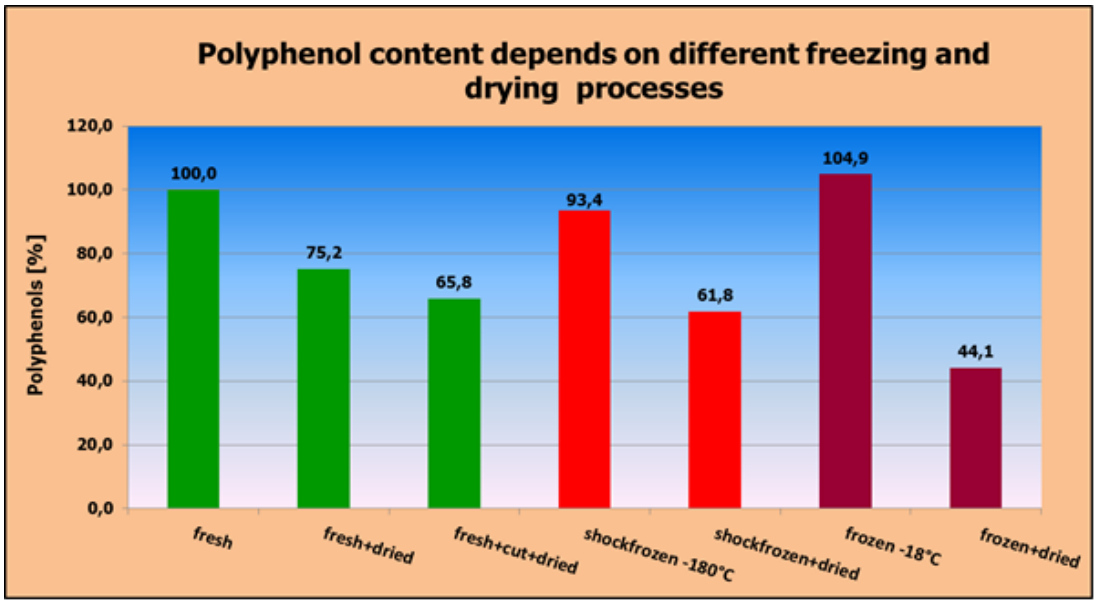


Picture 8: Polyphenol content in fresh and 40°C dried leaves

Comparing the polyphenol concentration in dried leaves of Hergo picked on 05th of September with Hergo leaves we got after berries harvesting 5 days later we found a loss of nearly 50 % of polyphenols (red marked columns).

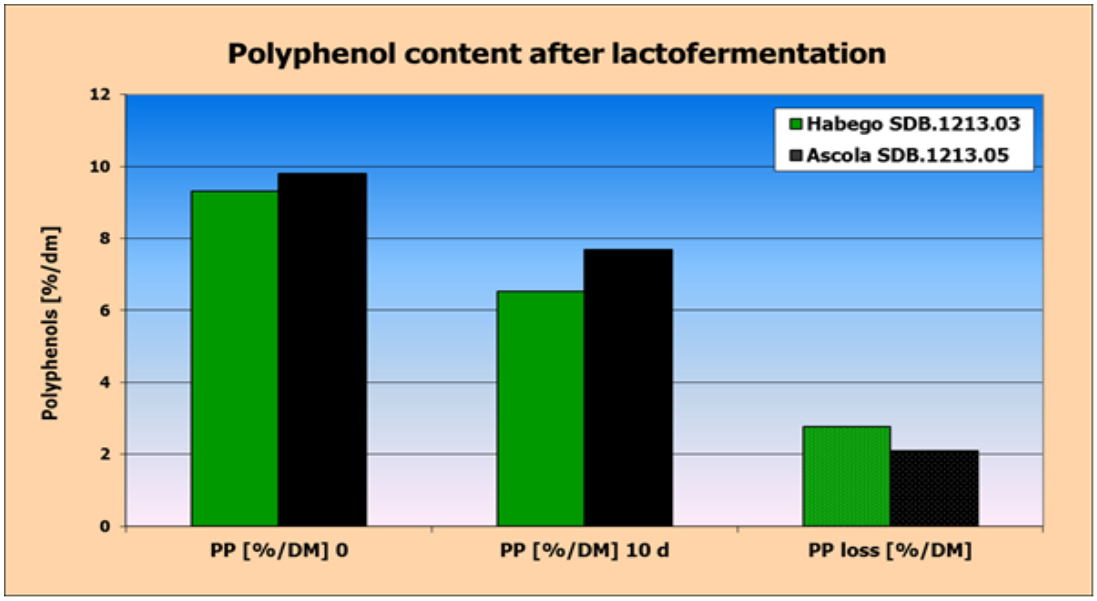
After these surprisingly result we analysed the influence of freezing on dried seabuckthorn leaves. Results are shown in picture 6. We have dried the leaves at 80 °C to induce a remarkable loss showing the differences of pre-drying procedures. We found a 25 % loss of polyphenols, a comparable result for high temperature drying shown in picture 7. Depend on freezing method

there is a clear difference between rapidly shock freezing, loss app. 40 % and slowly freezing in freezing chambers, loss app. 60 %. In general the loss of polyphenols after pre-freezing before drying is higher than in fresh dried leaves at same drying temperature. The reason for such loss in frozen leaves could be enzymatically degradation or oxidation of polyphenols through destroying of cell walls. Shock freezing for berries harvesting is recommended if leaves want be used as by-product of berries harvesting.



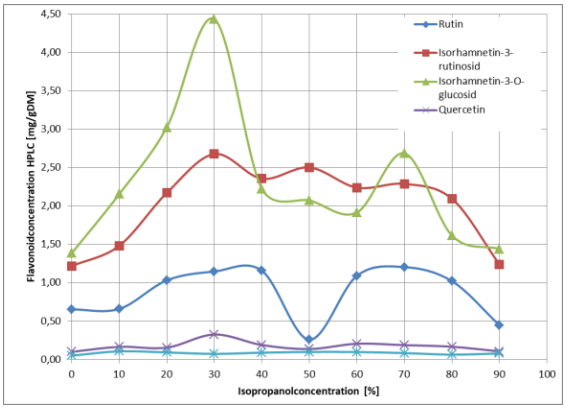
Picture 9: Polyphenols depend on different freezing procedures, drying at 80 °C

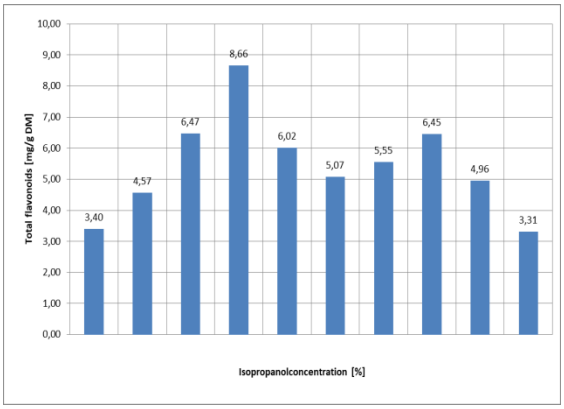
A widely used conservation method of green biomasses for fodder production is lacto-fermentation in a matter of silage. A classical fermentation test was executed under following test design measuring the pH of the biomass. For the fermentation test, 200 g of frozen leaves were used, which were treated with 80 ml distilled water and the lactic acid bacteria culture BIOSIL at a dosage of 1 g/t leaves. The fermentation temperature was set on 30 °C. The pH decreased within 48 hours through lactic acid production from 5,5 to 3,7. Lacto-fermentation of leaves is possible but a considerable loss of polyphenols has been observed.



Picture 8: Ensilage test with Ascola and Habego leaves

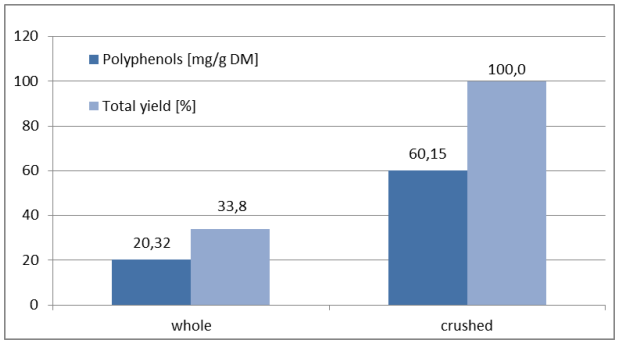
The selection of the right solvent for the extraction of task molecule (flavonoids) is an important factor for the efficiency of the extraction. Different solvents for the extraction of flavonoids like water and ethanol or isopropanol in different concentrations were investigated.





Picture 9 und 10: Solvent selectivity for single flavonoids and total flavonoids

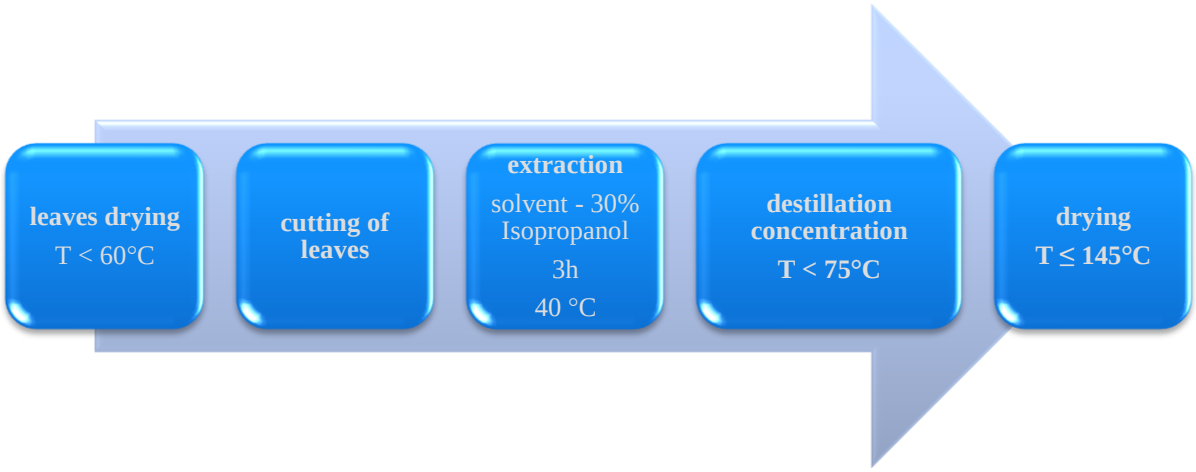
Extraction with 30 % isopropanol proved to be more selective than with other isopropanol concentrations, the extraction temperature was 40 °C and the extraction time 3 hours.



Another important question for the extraction yield is the particle size of the raw material. Surprisingly, it was found that even with sea buckthorn leaves with a thickness of < 0.1 mm, crushing the leaves leads to a higher extraction yield.

Picture 11: Extraction yield depend on particle size

Taking into account the various research results, a standard operation protocol for processing sea buckthorn leaves into extract powder was developed and patented, which includes the following steps.



Picture 12: SOP for seabuckthorn leaves processing into extract powder

The above described results have scaled up into pilot and industrial scale. The produced leaves extracts have been tested in cosmetic, feed, textile and leather applications and for medical products.

Developed Applications

Especially the antiinflammatory, antiviral, antioxidant and antibacterial properties of NIG seabuckthorn leaf extracts have been verified and have been presented in ISA conference 2015. In vitro the extracts showed antioxidant, antiinflammatory effects and did not show photo- and cytotoxic properties in the studied concentrations. In different concentrations the extracts were emulsified in a cream base. The preparations with concentrations of 0,2% extract plus antioxidants had soothing properties. All creams were well tolerated on skin and phototoxic potential couldn't be determined. The extract is offered for cosmetic applications.

There is a demand for natural hair care and hair dyeing products. NIG has investigated the potential of the developed leaves extract for hair dyeing. In combination with chelating ligand binding minerals the leaves extract produce interesting and unique color shades as alternative to synthetically hair colors.

Picture 13: Human air swatches dyes with seabuckthorn leave extract (right samples of the pairs are died)

The natural dyeing of wool and cotton textiles is nearly similar to hair dying. We have tested the application in different textile substrates. On one site it works well as dyestuff itself and on the other side as fixing auxiliary in cotton dyeing process due the high content of tannins.

Picture 14: Cotton dyed with seabuckthorn leave extract

Together with a British company NIG developed a special product against gastric ulcer problems especially for racing horses but also as pet food. The formulation contains different special extracts, oils and seabuckthorn leaves powder. The product is well used also in the tournament and racing season, as the formulation is suitable for use in this season, without regard to quarantine as with some pharmaceutical products.

The antiviral potential of sea buckthorn leaves and leaf extracts is frequently described in the scientific literature. The idea of developing lozenges with sea buckthorn leaf extract was realized during the COVID pandemic. Together with a German company, various formulations were tested and today lozenges with NIG sea buckthorn leaf extract are on the European market. The lozenges are sold as a medical device and not as a pharmaceutical product. This is an important difference in Europe in terms of approval.


The developed and patented tanning process for leather industry is a highlight of NIG leaves research of the last 10 years and combines the idea of creating additional income in rural areas, soil improvement, combat desertification and CO_2-bindig with sustainable leather production. With the new process it is possible to create a pale color allowing for white and many bright colors to be made. The extracts can be used for leather tanning and re-tanning process without pickling (salt free).

SUMMARY

Over the past 10 years, the NIG has studied the entire process of seabuckthorn leaf production and processing from cultivation to application. In detail, we have determined different origins, subspecies and varieties, harvesting, post-harvesting and extraction processes. There are seabuckthorn leaf extracts for various applications available, e.g. for cosmetic products (creams, hair coloring), textile dyes, medical products and the leather industry and last but not least for animal feed.

14.DISTRIBUTION OF SEABUCKTHORN (*Hippophae spp*. Linn) AND MARKET POTENTIAL IN NEPAL

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The genus *Hippophae* L. (Elaeagnaceae) comprises about seven species commonly known as Seabuckthorn. The review of herbaria voucher specimens of Nepal recorded three species of Seabuckthorn in Nepal: *Hippophae salicifolia* D.Don, *H. tibetana* Schlecht and *H. rhamnoides* L. However, the former two species have frequently been collected and used. *H. salicifolia*, and *H. tibetana* hold significant ecological and socio-economic value due to their multiple use values, including ecological, nutritional and medicinal properties. These species are familiar to mountain people and are used by traditional healers and marketed by local vendors since decades. We assessed distribution and use (subsistence and market) of *H. salicifolia*, and *H. tibetana* following ethnobotanical and market surveys, focus group discussions, interview with herders and forest products collectors, and MaxENT modeling. The MaxENT result verified the distribution of species from 18 districts, while the ethonobotanical study revealed it uses only from 14 districts. Despite the potentiality of a number of products, very limited products like; raw and concentrated juice, jam, tea etc. have been marketed and bartered in local and border markets in 10 districts. The result reported the huge data, research and documentation gap urging the detailed study on present and potential production, distribution and use of *Hippophae* at national level. Precise and pragmatic data and information of production, distribution and uses of *Hoppophae* is useful for decision makers, especially for those whose conservation and management activities scale for national level. Moreover, there is a growing market for natural products including the Seabucktohrn juice in local, national and international markets, hence, Seabuckthorn should be focused on conservation, products diversification and marketing projects.

Keywords: Modelling, mountains, conservation, distribution & marketing

15.SEA-BUCKTHORN: COMPLEX PROCESSING

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ABSTRACT

In the Baikal region, sea buckthorn is an industrial berry crop. The annual harvest of sea buckthorn fruits is up to 600-900 tons. The existing methods of processing sea buckthorn fruits have a number of significant disadvantages. The purpose of this work is to develop an innovative method for the complex processing of sea buckthorn fruits using microwave EMF (ultrahigh frequency electromagnetic field). The object of research was frozen and fresh sea buckthorn fruits, dried sea buckthorn, juice, pulp oil, seed oil. Standard methods were used in conducting experimental studies. The optimal parameters of the main technological operations determined experimentally: defrosting and dehydration, separation of pulp from bones, pressing, made it possible to select equipment and develop a technology for complex processing of sea buckthorn fruits, the possibility of practical implementation of which was carried out on the basis of LLC "SIC" BaikalEkoProdukt ". As a result of the tests, 12 types of products were obtained. It has been established that the proposed technology ensures high quality of the products obtained and significantly reduces the duration of the technological process. A patent for the invention has been obtained.

Keywords: sea buckthorn, waste-free technology, microwave electromagnetic field, quality indicators, optimal parameters.

INTRODUCTION

In the Baikal region, the industrial fruit and berry crop is sea buckthorn, known for its unique chemical composition and the content of valuable biologically active substances. The areas occupied by sea buckthorn only in the Republic of Buryatia amount to more than 800 hectares, and the potential of existing gardens annually allow growing and harvesting up to 600-900 tons of sea buckthorn fruits [1].

Existing technologies and methods of processing sea buckthorn fruits have a number of significant disadvantages. The scheme of complex processing of sea buckthorn fruits, known from literary sources, provides for the production of a lipophilic complex in encapsulated form

based on absolute sea buckthorn oil of sea buckthorn fruits [1]. However, this scheme assumes a significant duration of the technological process, and is also not resource-saving, since the potential of valuable sea buckthorn raw materials is partially used. The technology of processing sea buckthorn fruits using microwave EMF and CO_2 extraction does It does not fully use the capabilities of microwave EMF when processing sea buckthorn fruits [2]. The scheme of complex processing of local vegetable raw materials, although it contributes to expanding the range and increasing the value of food products, however, involves the use of a diffusion method for obtaining sea buckthorn oil, which does not allow to fully extract valuable sea buckthorn oil, and the question of rational use of oil pomace remains open [3]. The well-known method of processing sea buckthorn fruits allows to increase the functionality of processing sea buckthorn fruits by obtaining four types of products: sea buckthorn oil, clarified transparent juice, vitamin fruit paste, whole viable seeds, as well as to improve the quality of the products obtained, however, it is time-consuming, long-lasting, having low process efficiency, accompanied by losses of biologically active substances (vitamins, amino acids, etc.) [4]. The existing technological line for waste-free processing of sea buckthorn, along with the possibility of obtaining freshly squeezed low-fat sea buckthorn juice using a gentle pasteurization regime, has a high metal and energy consumption of the technological line, which is economically inefficient [5]. The well-known sea buckthorn berry processing line requires the use of special ultrasonic equipment, gas-liquid extractors, vacuum evaporation and vacuum freeze dryers, precise implementation of the specified technology and highly qualified service. In this regard, this method can only be used in large specialized enterprises for mass processing of berries [6].

Thus, traditional methods of processing sea buckthorn fruits have a number of significant disadvantages: energy, metal consumption and complexity of equipment, reducing the economic benefits of production; duration of the technological process, uneven drying, prolonged exposure to high temperatures, leading to significant losses of biologically active substances, deterioration of organoleptic and physico-chemical parameters, which generally negatively affects the quality of the finished product.

Since microwave EMF has been increasingly used in recent years to intensify the processing of plant raw materials [7], [8], it is of scientific interest to study the use of microwave EMF in the complex processing of sea buckthorn fruits.

In connection with the above, it is relevant to create a new method of complex processing of sea buckthorn fruits using microwave EMF, which allows minimizing production waste and reducing the duration of the technological process along with increasing the quality of products and product range expansion.

MATERIALS AND METHODS

The purpose of this work was the scientific substantiation of the development of an innovative method for the complex processing of sea buckthorn fruits using microwave EMF.

To achieve this goal, the following tasks were solved:

- to determine the optimal parameters of the main technological operations of processing sea buckthorn fruits carried out using microwave EMF;

- to develop a technological scheme for the complex processing of sea buckthorn fruits.

Sea buckthorn fruits fresh from the autumn harvest and sea buckthorn fruits frozen from the winter harvest (frozen naturally on the bush with a gradual decrease in ambient temperature to minus 25^0C) collected in the Selenginsky district of the Republic of Buryatia, as well as the main types of products obtained during the complex processing of sea buckthorn fruits using microwave EMF: dried sea buckthorn, juice, oil from the pulp, oil from the seeds. Before the experiments, after harvesting, sea buckthorn fruits were fresh stored for 3-5 days at a temperature of 5-7^0C, the fruit the frozen sea buckthorn fruits were stored for 6-9 days at a temperature of minus 18-20^0C.

In industrial testing, technologies used Russian and imported standard universal, partially specialized and innovative technological equipment. Standard universal process equipment: inspection conveyor KRI-10-01, bubbler bath, piston liquid dispenser Bag in Box SIFA 1TS dispensing machine, vacuum closure unit UU-5N, semi-automatic bottle closure device UU-3, Dexing MG-1000-1 packing and packaging apparatus, stainless steel production tables, stainless steel barrels and containers, plastic boxes, scales. Partially specialized process equipment: microwave vacuum unit "Monsoon-2," infrared dryer IKO 55, convective dryer K 300, vacuum evaporator VD-6, extractor DK-SO2, mill MF 50, air separator VS-0,06. Innovative technological equipment is a device developed by the authors and designed for pressing fresh or dried sea buckthorn fruits to produce sea buckthorn oil or juice [9].

The quality of the products was evaluated based on the study of their organoleptic characteristics, microbiological and safety indicators, which were determined according to standard generally accepted methods.

The degree of separation of the pulp from the seeds of dried sea buckthorn fruits was determined by a method, the essence of which is based on the separation of the remaining pulp particles from the sample and weighing.

The study results were processed using Statistica and Excel software packages. The data are presented in the form of $M \pm t$, where M is the selective average of the measured values, t is the standard error, $n = 5$.

RESULTS

At the first stage of experimental studies, the optimal parameters of the main technological operations of processing sea buckthorn fruits using microwave EMF were determinutesed: defrosting, dehydration and pressing.

Preliminutesary experiments carried out by the authors showed that dehydration of sea buckthorn fruits in microwave EMF should be carried out to a moisture content of 25-30%, and subsequently dried by another method to a humidity of 4-6% to separate the pulp from the bones. In this regard, the first task was to achieve humidity of sea buckthorn fruits of 25-30% by dehydrating fresh fruits and preliminutesary defrostation and subsequent dehydration of

frozen sea buckthorn fruits. Defrostation and dewatering were performed in the «Monsoon 2» microwave vacuum unit at the following parameters: temperature from 35 to 55^{0}C, pressure from 8,2 to 9,4 kPa, specific microwave power from 100 to 500 W/kg, duration of fresh fruit dehydration from 65 to 85 minutes, duration of defrostation of frozen fruits from 4 to 12 minutes, duration of dehydration of fruits after defrostation from 63 to 83 minutes. All experiments were carried out in five repetitions, the average values of the results of the studies are shown in Table 1.

Table 1. Optimal parameters of defrosting, dehydration and pressing

Parameters	Experience number				
	1	2	3	4	5
Defrosting and dehydration (apparatus with microwave energy supply and vacuum)					
Temperature, ^{0}C	35	40	45	50	55
Pressure, kPa	8,2	8,5	8,8	9,1	9,4
Specific microwave power, W / kg	100	200	300	400	500
Duration of fresh fruit dehydration, minutes	85	80	75	70	65
Duration of defrostation of frozen fruit, minutes	12	10	8	6	4
Duration of fruit dehydration after defrostation, minutes	83	78	73	68	63
Product moisture (final),%	35±0, 12	30±0,13	25±0,12	20±0,12	15±0,13
Pressing (hydraulic press with microwave energy supply)					
Temperature, ^{0}C	35	40	45	50	55
Specific microwave power, W / kg	200	250	300	350	400
Duration, minutes	25	20	15	10	5
Oil yield,% - from pulp - from seeds	 80±0,12 70±0,14	 80±0,13 70±0,12	 80±0,12 70±0,14	 75±0,13 65±0,14	 75±0,12 65±0,13

The data obtained (Table 1) indicate that the optimal duration of defrosting and dehydration of frozen raw materials was 81-88 minutes, the duration of dehydration during processing of fresh sea buckthorn fruits was 75-80 minutes. In experiments No. 2 and No. 3, the best results of pressing the pulp and bones were obtained.

Dehydrated sea buckthorn fruits with a humidity of 25-30% were dried in an infrared dryer ICO 55 to a humidity of 4-6%. The choice of this dryer is due to low energy consumption per 1 kg of evaporated moisture, low drying temperature (40-50^{0}C) and the required drying speed.

The dried sea buckthorn fruits were fed to the MF 50 mill, which allowed them to be brought down quickly. The mill was selected taking into account the preservation of the integrity of the bones, the rate of collapse and energy efficiency. The collapsed sea buckthorn fruits were fed into an air separator VS-0.06 to separate the pulp from the seeds. The pulp and bones were separately sent to a device developed by the authors specifically for implementation the proposed technology for pressing in order to obtain oil.

At the second stage of experimental research, the task of fully equipping the formed production line for the integrated processing of sea buckthorn fruits was solved. The selection of equipment was carried out based on the power of the Monsoon-2 microwave vacuum plant, available at MIP BaikalSoundProduct LLC, taking into account the properties of thermolabile biologically valuable sea buckthorn raw materials, energy efficiency, cost. As a result of the work, the following Russian and imported equipment was selected and integrated into the technology: the inspection KRI-10-01 conveyor, washing bathtub with the bubbler, the liquid batcher the piston, device Bag in Box SIFA, installation of vacuum packing UU-5N, the semi-automatic device of packing of bottles UU-3, the packing and packing device Dexing MG-1000-1, tables production of stainless steel, a barrel and capacity from stainless steel, boxes plastic, scales, the convective dryer K 300, the vacuum and evaporating device VD-6, DK-CO_2 extractor. Process diagram of waste-free processing of sea buckthorn fruits is given in Fig. 1.

According to Fig. 1, fresh or frozen sea buckthorn fruits, after acceptance, are sent to the preparation department, where they are inspected for the presence of foreign and vegetable impurities. Foreign impurities are removed and sent for disposal, and plant impurities in the form of twigs, needles, leaves are sent for drying, which is carried out in a convective dryer at a temperature of 50-80°C for 30-40 minutesutes to a moisture content of 4-6%. After drying, the vegetable impurities are ground in a mill for 6-8 minutesutes to a particle size of 1000-5000 microns and sent for packing, packaging, labeling and storage. The obtained product has high biological value and can be recommended for use as a plant fodder additive in the diet of agricultural and unproductive animals, birds, as well as raw materials in the production of feedstuffs.

After inspection, sea buckthorn fruits are sent to washing, which is carried out in washing baths using sieves or trays under running water at a water temperature of 8-10°C for 10-12 minutesutes.

The prepared sea buckthorn fruits are placed in an apparatus with a microwave EMF and vacuum, where the fruits are dehydrated at an electromagnetic field frequency of 2450 ± 50 MHz, a pressure of 8.5-8.8 kPa, a temperature of 40-45^{0}C, a specific microwave power of 200-300 W / kg to a humidity of 25-30% within 75-80 minutesutes. When using frozen sea buckthorn fruits as raw materials, at the first stage, defrosting is carried out in this apparatus at a temperature of 40-500C.

After dehydration, 2 products are obtained: dehydrated sea buckthorn with a moisture content of 25-30% and cell juice. The dehydrated sea buckthorn is sent for drying to a moisture content of 4-6% in an infrared dryer, and the cell juice is fed for concentration to a vacuum evaporator, where a cell juice concentrate and aromatic water are obtained, which are sent for filling into a filling and capping machine, marking and storage.Dried sea buckthorn with a moisture content of 4-6% after infrared drying is sent to an air separator, where the pulp is separated from the seeds.

The pulp and seeds are separately fed for pressing, which is carried out on a hydraulic press with a microwave energy supply [9]. Pressing the pulp and seeds is carried out at an electromagnetic field frequency of 2450 ± 50 MHz, a temperature of 40-45^{0}C, a specific microwave power of 250-300 W / kg for 8-10 minutesutes until the oil leaves the pulp 75-80%, from the seeds 65-70 %.

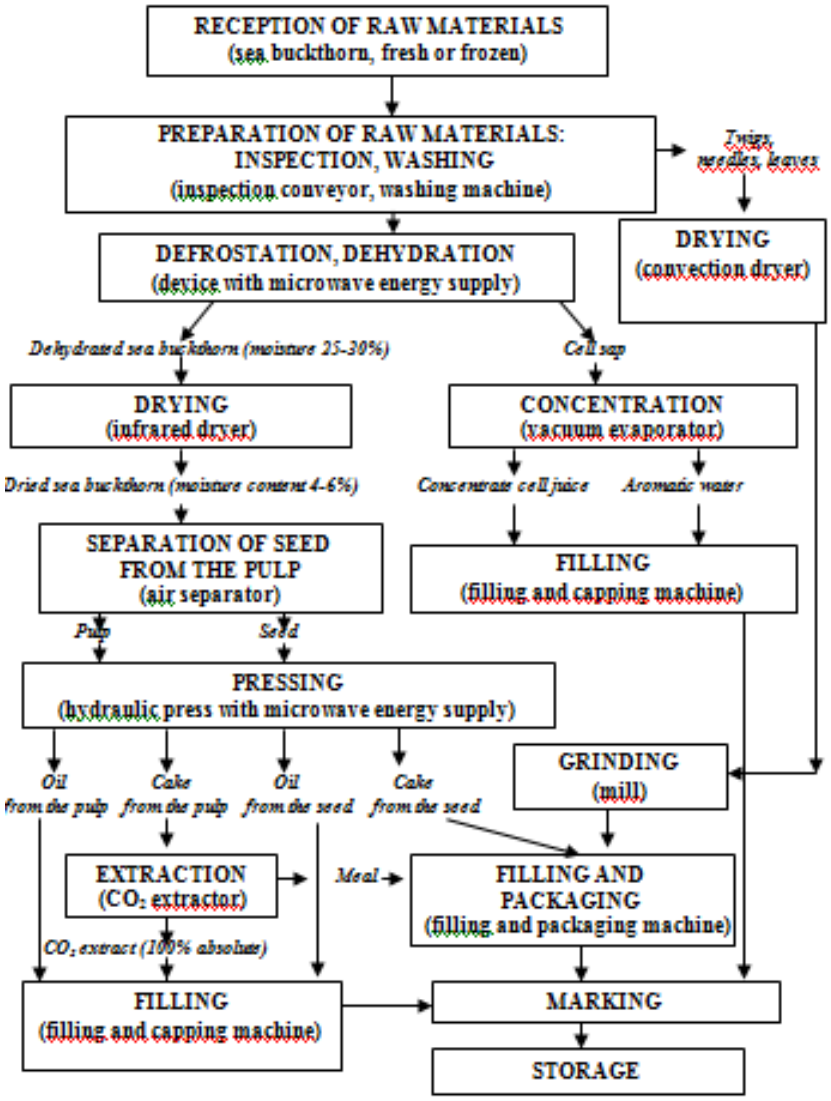

Fig. 1. Technological scheme of complex processing of sea buckthorn fruits

After pressing the pulp, oil and cake are obtained. The oil from the pulp is fed into the filling and capping machine, then for labeling and storage. The pulp cake is sent for extraction to a

CO_2-extractor, where a CO_2-extract (100% absolute) and meal are obtained at carbon dioxide pressure 350 atm, temperature 55^0C for 130 minutes. Process parameters were selected based on literature data with temperature and duration adjustments [40]. CO_2 extract (100% absolute) is fed for filling into a filling and capping machine, and meal for filling and packing into a filling and packaging machine. Packaged and packaged CO_2-extract (absolute) and meal are marked and sent for storage.

After pressing the seeds, oil and cake are obtained. The seed oil is fed into the filling and sealing machine, and the seed oil cake is fed into the filling and packing machine. Packaged and packaged seed oil and cake are labeled and sent for storage.

According to the developed technological scheme, industrial testing of the proposed technology for complex processing of sea buckthorn fruits was carried out on the basis of SIC BaikalEcoProduct LLC (Russia, Republic of Buryatia). The technological process was carried out both on commercially available food equipment and devices, and using special innovative equipment developed by employees of the East Siberian State University of Technology and Management [9]. As a result of tests, according to the developed technology, 12 types of products were obtained, four of which are the main ones: dried whole sea buckthorn with a moisture content of 4-6%; cell juice; sea buckthorn oil from pulp; sea buckthorn seed oil; and related, which include: vegetable feed additive from twigs, needles and leaves; CO2 extract (100% absolute); concentrated cell juice; aromatic water; dried sea buckthorn pulp; sea buckthorn seeds; seed cake; pulp meal (Fig. 2).

Fig. 2. Sea buckthorn products produced according to the developed technology

The quality indicators of dried sea buckthorn, oil from the pulp, oil from the seeds of sea buckthorn fruits and cellular juice - the main products obtained as a result of industrial testing of the technology of complex processing of sea buckthorn fruits using microwave EMF - were studied. Organoleptic parameters, physico-chemical parameters, and safety indicators were studied. Experimental studies of the quality indicators of sea buckthorn products have shown that the quality of the main products obtained during the complex processing of frozen or fresh sea buckthorn fruits is high and meets the requirements of regulatory documents.

DISCUSSION

The conducted studies have proved the possibility of using microwave EMF in the complex processing of sea buckthorn fruits not only as an auxiliary effect, but also at the main stages of the technological process: defrosting, dehydration, pressing the pulp and seeds, which significantly reduces the duration of the entire technological process and has a positive effect on the quality of the resulting products.

The optimal modes of microwave processing of sea buckthorn raw materials selected as a result of experimental studies provide not only high quality of the products obtained, but also allow to significantly reduce the duration of defrosting and dehydration of sea buckthorn raw materials, and also improve the structural and mechanical characteristics of sea buckthorn fruits, which facilitates the subsequent separation of the pulp from the seeds at the mill, significantly reducing the separation time to 9-11 minutesutes. Experimental studies have shown that in the fruits of sea buckthorn dehydrated using microwave energy supply, the flesh is well and quickly separated from the seeds, while in the fruits dried by the authors according to traditional standard methods (by convective and conductive methods), the separation of the pulp from the seeds is difficult, complete separation is almost impossible to achieve due to the special structural and mechanical characteristics of the fruits (pulp and seeds are firmly joined in dried sea buckthorn fruits by sticking) and their separation time is from 40 to 80 minutes.

Studies have found that under the influence of the electromagnetic microwave field, the process of extracting oil from the pulp and from the bones is significantly intensified due to heating and liquefaction, which increases the yield of pure oil, while diffusion methods based on extraction with cheap vegetable oil or using chemical reagents as solvents are used for traditional extraction of valuable oil according to the literature (hexane, petroleum ether), the removal of which is long and incomplete, which, firstly, does not contribute to the complete recovery of oil, and secondly, the problem of recycling the oil press arises.

The proposed technology for complex processing of sea buckthorn fruits, in comparison with traditional processing technologies, allows obtaining the following advantages:

1. Minutesimization of production waste;
2. Is energy and resource saving;
3. Reducing the duration of the technological process;
4. Receiving a wide range of high quality products.

CONCLUSION

As a result of the research carried out, the scientific substantiation of the development of an innovative method for the complex processing of sea buckthorn fruits using microwave EMF is presented.

It has been established that the use of microwave EMF at individual technological stages in the complex processing of sea buckthorn fruits is expedient, since it allows to reduce the total duration of the technological process and reduce the processing temperature of thermolabile sea buckthorn raw materials.

The optimal parameters of the main technological operations of processing sea buckthorn fruits, carried out with the use of microwave EMF, have been determinutesed. It has been proved that it is the claimed combination of experimentally determinutesed microwave EMF modes that ensures the high quality of the products obtained.

It has been experimentally proven to reduce the duration of defrosting processes (when using frozen raw materials), dehydration, pressing, separation of seeds from pulp, which leads to a decrease in energy consumption of production.

A technological scheme for the complex processing of sea buckthorn fruits has been developed, including standard and innovative equipment, which makes it possible to obtain a wide range of products - 12 items.

The developed technology has been tested and introduced into production at SICBaikalEcoProduct LLC. Serial production of products has been established. The normative and technical documentation has been developed, which allows the successful sale of finished products and make a profit for the manufacturing enterprise.

A patent application "Method for the complex processing of sea buckthorn fruits".

Thus, the possibility of complex processing of sea buckthorn fruits with the use of microwave EMF, which minutesimizes production waste, is energy- and resource-saving, has been scientifically substantiated, which allows not only obtaining products with a low cost, but also ensures the rational use and preservation of the species biodiversity of wild plants in the region.

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16. EXTRACTION AND STUDY OF THE BIOLOGICAL ACTIVITY OF FLAVONOIDS FROM ALTAY REGION SEABUCKTHORN EXTRACTION CAKE

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INTRODUCTION

Nowadays, no-waste fruit and berry processing, including seabuckthorn processing, is a global tendency. These tendencies make manufacturers focus on plant raw material advanced processing technologies with intense methods to obtain valuable biologically active substances to use in food, cosmetics, pharmaceuticals, and other products. One of the large tonnage waste products of seabuckthorn processing is fat-free extraction cake.

Seabuckthorn extraction cake composition, obtained in manufacturing conditions of Altayvitaminy JSC during 2018-2022, is summarized in Table 1.

Table 1 – Fat-free seabuckthorn extraction cake composition, %

Component	Content, %
Protein	24,60–24,80
Fiber	17,50–21,50
Hemicellulose	10,30-12,40
Total sugars	2,30–2,50
Pectic substances, including soluble ones	1,50–1,60
Flavonoids	2,70–4,10
Tannins	0,82–0,84
Organic acids	2,70–4,65
Ash	2,60–3,70
Moisture	3,50–7,00

Seabuckthorn flavonoids, which serve as raw materials for dietary supplement and pharmaceutical substance manufacturing, are of great interest of the whole spectrum of seabuckthorn extraction cake biologically active substances. Due to the low solubility of

flavonoids in solvents used in the Russian Federation as extraction solvents when obtaining seabuckhorn oil, the bulk of flavonoids are left in fat-free extraction cake, which is a large tonnage waste of manufacturers processing seabuckthorn in Altai Region. Therefore, seabuckthorn extraction cake processing and flavonoids extraction make it possible to solve the problem of manufacturing waste decrease by their advanced processing, and the development of intensive technology for obtaining flavonoid complex is an important task.

In accordance with a series of experimental studies, we have developed a seabuckthorn extraction cake processing flow chart, which includes the following critical stages: enzymatic raw material pre-processing, water-alcohol extraction, separating flavonol fraction by preparative chromatography, drying, and micronization of purified flavonoid fraction to a particle size not more than 1.5 μm. After the micronization, the experimental samples were centrifuged and dried in an ultrasonic dryer.

Micronization is essential to increase accessibility of poorly water-soluble biologically active substances. Reduction of size to micron and nanoscale range significantly improves physico-chemical and performance characteristics of micronutrients and food quality. Micronization technologies are fast-growing areas in the pharmaceutical industry as a factor of increasing active substance bioavailability [1].

The above-mentioned defined **the aim of this study**: practicability assessment of obtaining seabuckthorn extraction cake micronized flavonoid fraction and efficiency assessment of its application.

MATERIALS AND METHODS

Seabuckthorn extraction cake flavonoid fraction, obtained with the patented technology, was considered as the study subject [2];

Flavonol fraction values were determined similar to dihydroquercetin flavonoid in accordance with GOST 33504. Food additives. Dihydroquercetin. Specifications.

Moisture mass content in the flavonol faction samples was determined by titration by Fischer semi-micro-method in accordance with GPM.1.2.3.0002.15 Determination of water. General Pharmacopoeia Monograph with *Mettler Toledo V20S* autotitrator (Switzerland) with *DM143-SC* electrode.

Phenolic substances mass content was determined by Folin-Ciocalteu method in accordance with GOST R 55488-2013.

Qualitative and quantitative analysis of flavonoids composition was performed by the HLPC method with photometrical detection using *Shimadzu «LC-20 Prominence»* (Japan) apparatus, followed by computer processing of the results obtained [2].

Flavonol fraction particle morphology study and their content (%) was performed using MICMED-5 microscope (Russia) equipped with a binocular adjustment.

Flavonol fraction sample dispersion analysis was performed using *OLYMPUS OMEC DC130* microscope (Japan), and the data obtained were analyzed with *OLYMPUS Particle Image Processor* (*PIP* 9.0) software.

Bioactivity computer-assisted prediction was performed online using the *PASS* program based on "structure-activity" relationship analysis for a wide-range sampling of known biologically active substances.

Flavonol fraction sample antioxidant activity was determined by amperometrical method using «TSVET YAUZA-01-AA» liquid chromatograph in accordance with GOST R 54037, quercetin standard, and in *in vitro* experiments using glutathione reductase (GR) and catalase (CAT) specific enzymatic biotest systems.

GR and CAT reaction rate was determined spectrophotometrically using *Clima MC-15* semi-automatic biochemical analyzer (Italy).

Antimicrobial activity was determined by common microbiological methods regarding *Staphylococcus aureus* ATCC 6538 (209-P), *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 9027 and yeast-like fungi *Candida albicans* ATCC 10231 [3].

Hemostasis system status was evaluated using an integral method – thromboelastography, a method of blood clotting and fibrinolysis processes graphic recording. The study was conducted in 30 male Wistar rats with body weights of 150-270 g, kept in vivarium standard conditions with a natural light-dark cycle and easy access to water and food (standard pellet all-in-one feed in accordance with GOST 34566-2019 for laboratory animals after 14 days of quarantine).

The studies were performed in accordance with the rules adopted by the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes (Strasbourg, 1986) and in accordance with the Order of the Ministry of Health of the Russian Federation dated 01.04.2016 №199н: On Approval of the Rules of Good Laboratory Practice and Guidelines for Experimental (preclinical) Studies of New Pharmacological Substances.

Animals were divided into 3 groups, 10 animals in each. During the study, animals of all the experimental groups were kept in similar conditions. Experimental group animals received seabuckthorn extraction cake flavonoid suspension in isotonic sodium chloride solution at a dose of 25 mg for 14 days; control group received an equivalent volume of isotonic sodium chloride solution; intact group was not exposed. At the end of the dosing period, the experimental animals subjected to anesthesia with Telazol beforehand were weighted, blood samples were taken. Stabilized with sodium citrate whole blood was used to evaluate blood clotting system condition using an integral method – thromboelastography with the addition of a clotting process activator (calcium chloride 0,2 mol/L). Thromboelastogram recording was performed using «RotemGamma» (Rotem, Germany) apparatus in Natem mode for 40 minutes with «Star-tem» activator.

Experimental researches were performed in triplicate for each of the experiment and control variants with 0,95 confidence coefficient. *In vitro* research data analysis was conducted using *Statistica* 10,0 statistical analysis software package (*StatSoft*, USA).

Student t-test was used to evaluate the significance of differences between samples with close to normal distribution. Critical significance level *P* upon statistical hypotheses examination was set equal to 0,05.

RESULTS AND DISCUSSION

The purpose of the research is to develop an effective way to obtain flavonoid complex from fat-free seabuckthorn extraction cake while keeping a native structure of biologically active substances. The main step of the process is a flavonoid complex extraction with ethanol. According to the traditional method of extraction, maximum phenolic compound extraction from fat-free seabuckthorn extraction cake can be reached with a minimum amount of solvent, the amount of which is limited by the extractor volume only, and the end product yield is 3,00±0,05 %.

For the manufacturing process intensification was considered an enzymatic treatment of raw material with *Ultraflo XL* (a multi-active product of β-glucanase, xylanase and cellulose; manufacturer: *Novozymes A/S*, Denmark) and *Brew Zyme BGX* (cellulose; manufacturer: Suntaq, China) cellulolytic action preparations in a dose of 0,05 % to the raw material weight at the preparation ratio 1:1. The end product yield was 3,35±0,05 %. Flavonoid complex was obtained in the form of yellow-brown powder, its identification was confirmed by the Folin-Ciocalteau technique; as a result of HLPC analysis, the main components are flavonoids – quercetin, kaempferol, isorhamnetin and quercetin glycoside – rutin. Intensification factor usage (raw material enzymatic hydrolysis) allows to increase flavonoid sum output by 11,7% without chemical composition significant change and reduce extraction time by half.

Seabuckthorn extraction cake flavonoid fraction was recovered from previously prepared raw material by continuous extraction with ethanol at a concentration of 86-96%, followed by a concentration process and washing the viscous, syrupy vacuum-concentrate mass with water at the ratio of 1:3 to eliminate hydrophilic ballast substances, including carbohydrate substances, which then provides a crystalline precipitate formation of flavonoid complex, which is filtered under vacuum and dried. The research has shown that from 1 tonn of seabuckthorn extraction cake may be obtained up to 40 kg of flavonoids in powder form with 5-6% humidity, as per Figure 1.

Quality parameters of seabuckthorn extraction cake flavonoids sample are given in Table 2.

Table 2 – Quality parameters of seabuckthorn extraction cake flavonoids

Parameter	Characteristics
Appearance	Yellow-brown powder
Flavour	Neutral, slightly sour
Odour	Low, characteristic to seabuckthorn berries
Flavonoid content, %	92,0
Including rutin, %	17,8
Moisture, %	5,5
Ash weight, %	0,2
Impurities (mineral, organic)	Absent

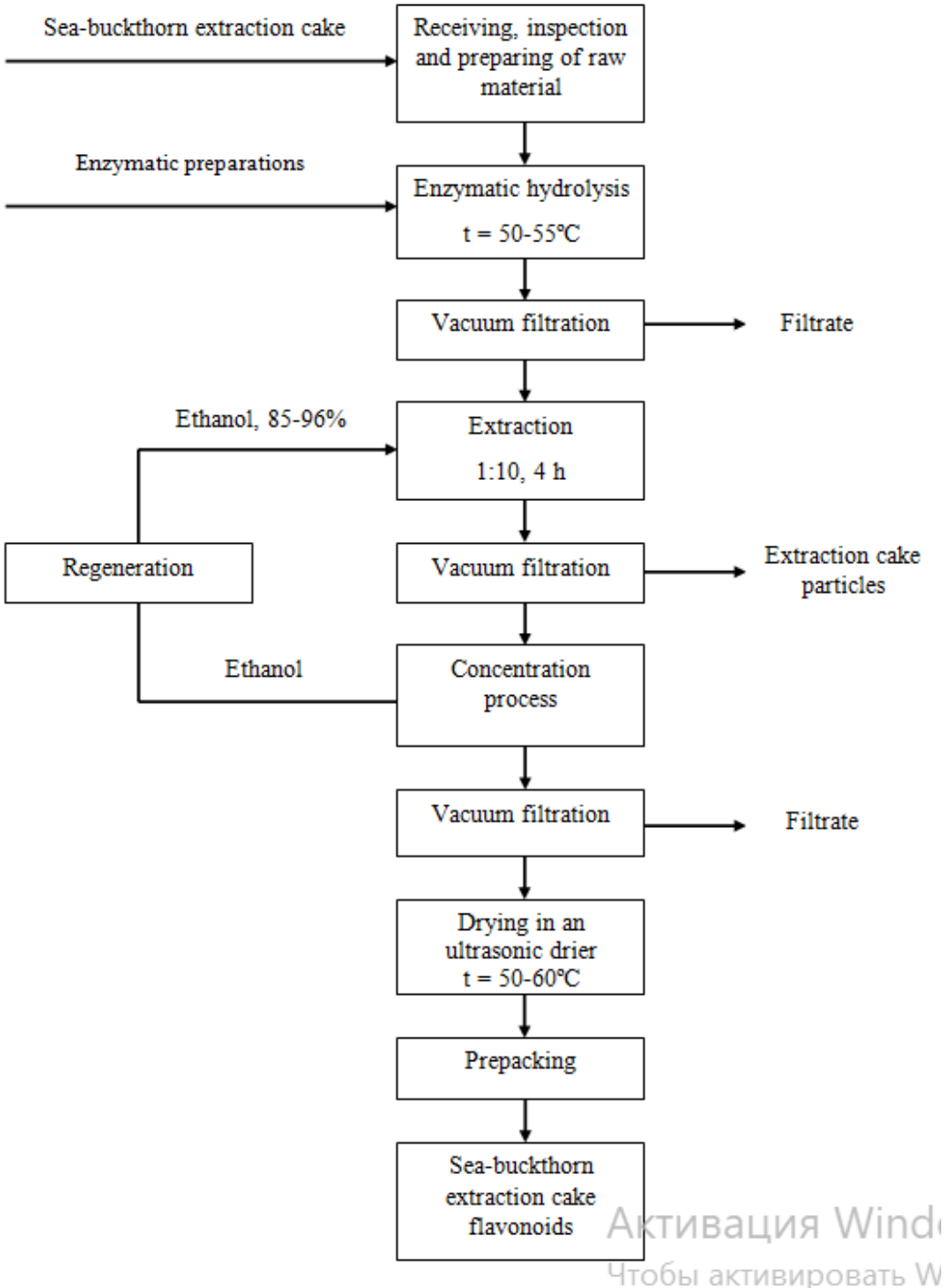


Figure 1 – Flowchart of seabuckthorn extraction cake flavonoids

During reversed phase HPLC, the flavonoid complex was found to consist of, %: rutin (17,82), quercetin (31,70), kaempferol (2,16), isorhamnetin (48,32) [2].

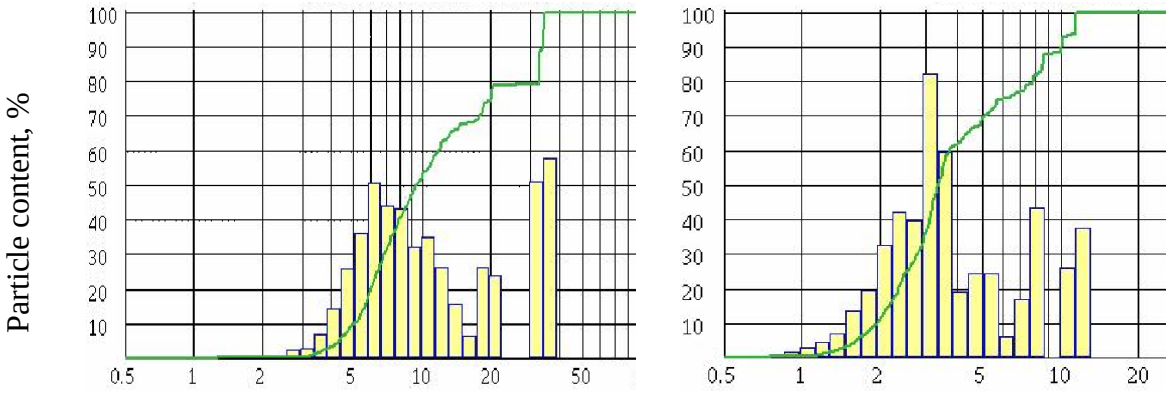
Some seabuckthorn cake flavonoids are a main active substance in many pharmaceuticals of different pharmacological effects: Ascorutin, Troxerutin, Kapilar, Antistaks, and others, and

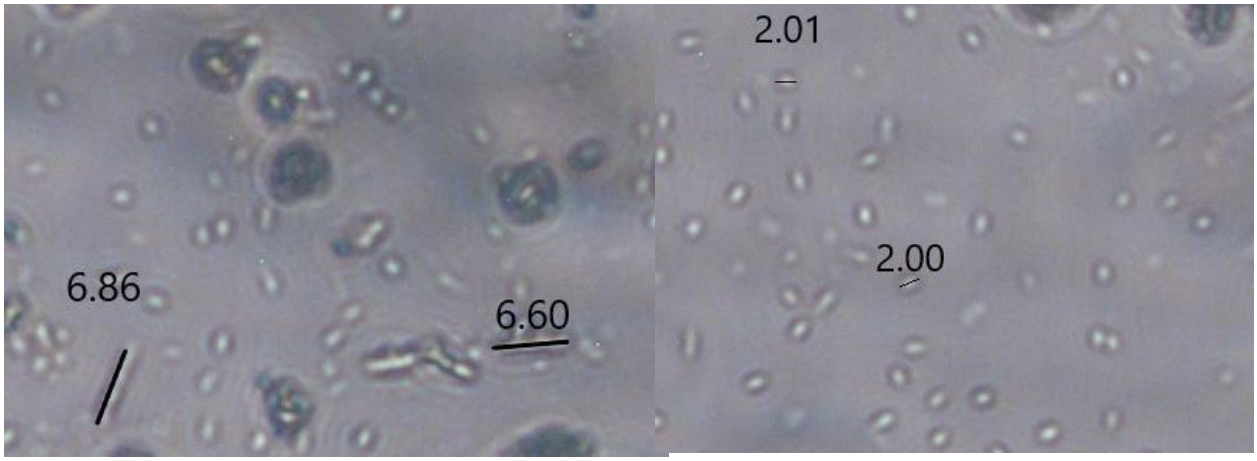
dietary supplements, except for isorhamnetin. Isorhamnetin efficacy was proved in *in vivo* studies in treatment of severe vascular inflammatory conditions [4].

Separation of the flavonoid complex obtained in groups of related compounds, specifically flavonol fraction extraction, is performed by the adsorbent column silica gel chromatography method with ethyl alcohol elution and reducing concentration for 4 h, as per Figure 2. Purified fraction was found to consist of flavonols, %: isorhamnetin – 69,97, quercetin – 29,56 and kaempferol – 2,47 [5].

In order to increase bioavailability, flavonols obtained were subjected to ultrasonic micronization. For flavonol micronization was used Volna UZTA-0,4/22-OM apparatus ("Ultrasonic Technologies Center" LLC, Biysk), based on the principle of conversion of electrical power to mechanical ultrasonic vibrations using piezoelectric effect [6]. Micronization of 0,5% seabuckthorn extraction cake flavonol water suspension was performed at 22±1,65 kHz frequency, 15 W/cm^2 intensity, 135±5 W acoustic power at a temperature of 40 °C for 10 min, followed by the solid fractions separation by centrifugation and drying of precipitate to 5% humidity at a temperature not more than 60 °C. Ultrasonic micronization rational mode of 10 min processing at 50 W was determined taking into account the performance capabilities of an ultrasonic reactor.

As a result of a series of experimental studies, micronized seabuckthorn extraction cake flavonols in the form of yellow homogeneous fine powder with particle size not more than 2 μm were obtained (Fig. 2).





а – before micronization *б* – after micronization

Figure 3 – Results of seabuckthorn extraction cake flavonols analysis by size (×100)

Microscopic observation showed that as a result of micronization, flavonol fraction particle size reduces to 2 μm; control sample particles are big and irregularly shaped, gathered in groups, while the micronized sample particles have a close to spherical form and are distributed evenly by volume, which improves their processing properties and increases flavonols bioavailability. The content of isorhamnetin 64,2%, quercetin 34,3%, kaempferol 0,8%, narcissine 0,3%, myricetin 0,3% and rutin 0,1% was determined by the HLPC method.

According to the results of bioactivity prediction of major seabuckthorn extraction cake flavonols (isorhamnetin and quercetin) in the PASS program, they have a wide range of potential biological activities. It is most likely that isorhamnetin will have pronounced antioxidant, antimutagenic, cardioprotective and vasoprotective activities. Quercetin is likely to have antioxidant, vasoprotective and anti-inflammatory activity.

In order to confirm the accuracy of the predicted results in *in vitro* studies, it was established that micronized seabuckthorn extraction cake flavonols have antimicrobial and antioxidant effects, mild fungistatic and pronounced anti-inflammatory activity, which was also confirmed in *in vivo* experiments.

In the microbiological study it was established that flavonol samples have antimicrobial (bacteriostatic) activity against gram-negative *Escherichia coli* ATCC 25922, *Pseudomonasa eruginosa* ATCC 9027 and gram-positive *Staphylococcus aureus* ATCC 6538 (209-P) bacteria and fungistatic activity against *Candida albicans* ATCC 10231 yeast-like fungi at a concentration of 1 000–3 000 μg/cm^3 (Table 3).

Table 3 – Micronized flavonol samples antimicrobial activity, μg/cm^3

Strains	**Before micronization**	**After micronization**
Escherichia coli ATCC 25922	3000	3000

Staphylococcus aureus ATCC 6538 (209-P)	2000	2000
***Pseudomonas aeruginosa* ATCC 9027**	**3000**	**2000**
Yeast-like fungi: *Candida albicans* ATCC 10231	1000	1000

According to the data in Table 3, micronization doesn't show significant effect on seabuckthorn flavonols antimicrobial activity against opportunistic pathogens, except for Pseudomonas aeruginosa, which necessary flavonols concentration for bacteriostatic effect demonstration reduced by 1,5 times, indicating an increase of micronized sample efficacy against these microorganisms.

The efficacy evidence of seabuckthorn extraction cake flavonols micronization are the results of its antioxidant activity (AOA) research, presented in Table 4, before and after micronization in comparison with the control sample (without flavonols).

Table 4 – Seabuckthorn flavonol samples antioxidant activity ($M \pm m$, $p \leq 0,05$)

Parameter	**Without flavonoids**	**Before micronization**	**After micronization**
AOA, mg/g	0	0,125	0,500
GR reaction rate: - μmol/(min per mg of protein) - %	 2,92±0,06 100	 4,41±0,10 151*	 4,35±0,21 144*
CAT reaction rate: - μmol/(min per mg of protein) - %	 1,50±0,02 100	 1,56±0,02 104	 1,85±0,09 123*
* - the values are true at p<0,05			

In the presence of the micronized flavonol sample, the glutathione reductase reaction rate significantly increases in comparison with control, and the catalase reaction rate increases by 23% in comparison with control and by 19% in comparison with a non-micronized sample, indicating a demonstration of antioxidant effects and a fourfold increase of AOA of the micronized sample.

The micronized flavonol sample effect on the free-radical oxidation processes was confirmed in *in vivo* study on an inflammatory response model caused by a formalin-induced rat hind leg edema at an intragastric dose of 25 mg/kg in comparison with a micronized rutin (Table 5).

Таблица 5 – Rat blood oxidant and antioxidant status values

Sample	TOS, %	TBRP*, μm	CAT, %	SOD, %	TAS, %
Control (water)	48,7	2,8	22,4	28,3	86,2
Rutin	32,1	2,1	11,2	22,9	82,8
Seabuckthorn extraction cake micronized flavonols	28,0	2,3	2,6	22,8	84,1

* Thiobarbiturate-sensitive products

Therefore, flavonols prevent lipid peroxidation, reducing oxidative breakdown product level and decreasing inflammation.

It was also discovered that an intragastric course intake of seabuckthorn flavonols at a dose of 25 mg/kg a day for 14 days causes partial hemostatic system activation in rats, accelerating the start of a blood clotting initiation phase. In *in vivo* experiments in male Wistar rats, a maximum dose of micronized seabuckthorn extraction cake flavonols administration was not more than 25 mg/kg of body weight.

CONCLUSION

Based on a series of experimental studies, a process flowchart of micronized seabuckthorn extraction cake flavonoids fraction obtaining was developed, optimal modes at every step for further use in the manufacturing process were chosen. When scaling seabuckthorn extraction cake reprocessing technologies with a preliminary enzymatic hydrolysis, flavonoids complex output of 4,00% may be achieved.

Methods of purification, extraction and micronization of seabuckthorn extraction cake flavonols were examined.

All the obtained results of the quality, safety and functional properties study proves the possibility of using seabuckthorn extraction cake flavonoids as a basis for dietary supplement manufacturing with antioxidant and anti-inflammatory activity.

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17.SEA BUCKTHORN: A PROMISING NEW INDUSTRIAL CROP FOR PAKISTAN

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ABSTRACT

Sea buckthorn (*Hyppophae rhamonides*) is a universal, highly valued plant species for its multiple uses for growing in various parts of the world. In Pakistan, mostly in the Gilgit, Ghizar, Ganche, Astore, Skardu, Baltistan, and Hunza besides Kurram Agencies, Chitral and upper Swat. Efforts to introduce it in other parts of the country as a minor crop can turn it into a very valuable industrial crop simply because of its multiple uses. For example, berries and leaves contain vitamins and antioxidants which are bio active ingredients in demand in the nutraceuticals, cosmetic, and pharmaceutical industries and, essential fatty acids. Also, given the reason that it grows in relatively extreme conditions and environments, it can be a candidate for use in soil conservation and land reclamation against further degradations and desertification. It may enhance rural income within the developing states by opening new markets for producers and firms of the higher value products. The uses in healing due effects such as anti-inflammatory and cardiological are as valuable as the health impacts achieved in public health and first application in medicine. However, to encourage the success of such crops there is little research work carried out, limited ways of production and limited marketing strategies. The inclusion of sea buckthorn into the agriculture sector of Pakistan has a positive implication for sustainable development, qualitative enhancement to production systems, capacity building particularly in the rural area, and lastly the ecological point of view of the country.

Key words: Sea buckthorn, industrial crop, Neutraceutical, plantation

INTRODUCTION

Sea buckthorn (*Hippophae rhamnoides* L.; 2n = 24; family Elaeagnaceae) is an eatable and useful, hardy deciduous shrub that bears nutrient dense berries that can be used for many purposes. It is found between 27° and 69° N latitude and 7° W and 122° E longitude (from Spain to Mongolia), having its major origin on the Qinghai-Tibet Plateau. Native to Europe and Asia, it thrives in arid and semi-arid regions, making it an ideal candidate for Pakistan's diverse climates (Nawaz, 2020). It is dioecious, wind pollinated shrub or tree that can grow from 1 to 9 meters tall and can be vegetatively propagated through cuttings. It is a leading specie that can be grown on marginal soils across a wide variety of dry temperate and cold environments. (Zeb, 2004) with a requirement of at least 250 mm of annual rainfall. Sea

buckthorn has a specialized root system capable of fixing nitrogen through the formation of Frankia-actinorhizal error nodules (Kato et al., 2007). This characteristeic of sea buckthorn improves soil structure, making it a species for land reclamation and improving wildlife habtats (Enescu, 2014). The plant is valued for its high content of vitamins, antioxidants, and essential fatty acids, contributing to its potential as a high-value industrial crop (Wang et al., 2022).

1.1 Flowering and Fruiting Characteristics of Sea Buckthorn

Flowering of the plant begins around mid-April and May, before development of foliage. About pollen grains, germination of pollen grains occurs within the next two to three days and can remain viable upto 10 days after anthesis. The general time line is that pollen tube should have developed approximately 72 hours after pollination (Ali et al., 2015; Mangla et al., 2015). Stigma remains receptive for three days after anthesis. Although fruits yields depend on number of fruits and this number is determined by growing conditions of the previous year besides formation of flower buds (Mangla&Tandon 2014). From the propagation point of view sea buckthorn takes about 3 – 4 years to come into bearing for the first time depending on the method of production that is either by seeds or by cuttings. A plant gives berries which are of apricot color, yellow or red and has a size of between 6-9mm in diameter and contains only one seed (Shah et al., 2007). It is possible to find correlation between the berries color and the content of tannins like Proanthocyanins (Yang et al., 2016). It is a shrub that grows well in growth conditions where it is dry, very salty and hot temperature varying between -40 ˚C and 40 ˚C. Also, sea buckthorn plantation is efficient in regulating the rate of soil erosion and soil nutrients conservation which are deemed important (Fatima et al., 2012).

1.2 Economic Potential.

The area of the world used to grow sea buckthorn is not easy to determine, and data by country are absent or make use of non-uniform evaluations. However, in China the natural production range is spread over more than 10, 000 Km^2 (Durst et al, 1994) the natural range is 29000 Km^2 in UVS province only for the data available at cross section of the present period of time (Lecoent et al, 2010) former USSR is 472 km^2 (Rongsen, 1992) and in India naturally grown sea Sea buckthorn berries offer various prospects in different products: employs it in cosmetology especially in Russia and china while its extensive use is in the food industry in Europe. Large area of sea buckthorn, extending over tens of thousands of hectares exist in the natural state in the Gilgit and Baltistan region of Pakistan; but less than a quarter of this potential is being exploited (Shah et al., 2007). Still, they harbor huge unrealized economic and social opportunity, including plant bioresources that could improve livelihoods in developing regions.

1.2.1 Medicinal Properties and Health Benefits of Sea Buckthorn

The species possesses a number of special medicinal properties: it has been found to be rich in antioxidants, triterpenoids, phospholipids, coumarin, leucoanthocyanins, flavanol, alkaloids, sertnin, and unsaturated fatty acid (Fan et al., 2007). These physicochemical characteristics qualify the species as a potential source of nutraceuticals and drug remedies for several human diseases and ailments, including immune system conditions, burns, obesity, diabetes,

cardiovascular disease, cancer, ulcers, inflammation, and radiation sickness (Upadhyay et al., 2009; Ansari, 2003).

1.2.2 Industrial Applications of Sea Buckthorn

There is huge economic potential of sea buckthorn for Pakistan. Sea buckthorn is extensively cultivated in Giligt- Baltistan and Chitral. However, due to limited awareness of its economic, medicinal, and nutritional benefits, the plant is primarily utilized for fencing and fuel (Jabeen et al. 2015). Given the country's vast arid and semi-arid lands, sea buckthorn can be an effective solution for soil erosion control and land reclamation (Kumar & Sinha, 2020). Furthermore, its berries and its leaves have several applications in different industries including nutraceuticals, cosmetic and food products (Mehta et al., 2022). Based on the potential yields from this plant the development of sea buckthorn could go a long way in enhancing the economic status of most rural producers. Besides, other products like oil and extract have a great potential in export, which would support Pakistani agriculture and economy (Ali et al., 2023).

1.2.3 Therapeutic Uses and Challenges in Sea Buckthorn Cultivation

The treat is used to manage duodenal and gastric ulcer, diarrhoea, hypertension, anaemia and gout. With the increase in the consumption of this fruit, there is bound to be a rich supply of bioactive compounds that support activities such as sharpening of vision, the aging process and boosting the immune system (Lipowski et al., 2009). Pest and diseases that affect sea buckthorn are quite few though there are fusariosis and verticillium wilt diseases. These conditions are due to fungi's such as Fusarium spp. Heterotrophic vulnerable plant pathogens that are usually associated with necrotic WPM included Alternaria species|, pythium, and Botrytis (Patel et al., 2012). Other challenges include lack of appropriate germplasm, inadequate management practices adapted to the climate conditions in the country and the lack of well suitable processing technologies for the country's produce. New studies are required for pest and disease management concerning sea buckthorn (Khan et al., 2022).

1.2.4 Strategic Approaches for Sea Buckthorn Commercialization

In the same process, policy support is required for the promotion of investment in sea buckthorn plantation as well as its processing. Forming a broad supply chain and market for this crop will be very important as it determines the market success of this crop. For the purpose of realizing the developmental profit of sea buckthorn, several measures are as follows in the first place, increasing the investment on the scientific and technical exploration to search for the liional cultivation techniques suitable for different geographical area and enhance the yield and quality. Secondly to create awareness among the farmers as well as the stake holders regarding the cultivation of sea buckthorn and its utility. Thirdly, Promotion of Government incentives, and support to enable development of sea buckthorn industries. Fourthly, development of infrastructure for processing and marketing to address domestic and international markets is necessary in order to turn this crop into efficient product.

1.2.5 Integration of Sea Buckthorn in Food Industries and Product Development

Food industries have been growing interest in adding functional ingredients in the final product offering. Sea buckthorn has lots of potentials as it is rich in Ascorbic Acid, carotenoids,

tocopherols and other bioactive compounds while a lipid profile of sea buckthorn is found in the berry pulp, seed and peel. It has also found useful in products such as cheese, yoghurt and in drinks. Besides, sea buckthorn can be used as a supplementary feed to enhance the production of final products including poultry and fish as their feed source is considered for this purpose. However, the chances of adding the sea buck thorn in formulation of some food products is still a one that is under looked hence there is room for new innovations (Moskalets et al., 2021).

1.2.6 Challenges and Opportunities in the Sea Buckthorn Industry

There are several problems for the sea buckthorn industry, there is not much knowledge of its possibilities; the duration of harvest is short, and the natural moisture content in fruits is high, posing challenges to agricultural practices and the production of added-value products. This crop would further help the horticulture industry when improvements are made to the production parameters of this plant. For the spread of sea buckthorn there is possible to strengthen government support and creating corresponding policies, to introduce high standards for the production technology and production on the basis of promising varieties of planting material (Sethunath et al., 2024).

It must be admitted that Sea buckthorn can help the improvement of the livelihood opportunities of the inhabitants, however, people still do not know this wonderful plant. Consequently, there is failure to tap the full capable production potential of sea buckthorn owing to absence of awareness campaigns, training centers, and secure market. Therefore, it is imperative that the government would be coming up with proper policies that would help in improving the livelihood and employment opportunities through sea buckthorn.

CONCLUSION

Sea buckthorn being a strong and multipurpose shrub needs special focus for its possible uses in economic uplift, protection of natural resources and improvement of people's health in Pakistan. Although it has been growing wild in some areas such as Gilgit-Baltistan and Chitral, the plant has not been very popular for use because people are not fully informed of the plant's numerous benefits such as medicinal, nutritional, and economic benefits. Due to the opportunities of utilizing sea buckthorn in the arid and semi-arid conditions because of highly valued nutrient-rich berries and the ability to improve the soil, it can become an applicable eco-rich plant for the reclamation of the barren or eroded land.

For Pakistan to realise the full benefits of sea buckthorn it requires strategic interventions in terms of research, enhancing farmers' knowledge about the crop and processing facilities. Regional practices for growing hedion will have to be also developed as well as technologies for processing the material that may considerably improve the yield and quality of hedion products. The other factors that may be important for encouraging investment in the sea buckthorn industries include: Government incentives and policies; Supportive policy environment; and market infrastructure.

If addressed these challenges Pakistan can exploit domestic and international markets, can develop the rural economy and ensured sustainable agricultural growth. In addition, the

nutrients or the bioactive compounds available in sea buckthorn provide avenues for the nutraceuticals, cosmetics, and food industries that will have a tremendous impact economically.

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18.STUDY RESULT OF SEABUCKTHORN, OTHER FRUITS AND BERRIES WHICH ARE CULTIVATING IN MONGOLIA

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ABSTRACT

Species of fruit and berry were increased, which are cultivated in Mongolia, 9 integrated varieties were collected, which are adapted in Mongolia soil and climatic condition, a comparative research was done with their biological and economical properties.

Vitamin C content of seabuckthorn varieties were 70.4-147.8 мг/%, in natural forms it was fluctuating between 52.8 and 257,0 mg/%; number of natural seabuckthorn SB-15-2-18, SB-12-5-18, SB-15-1-18, SB-15-5-18, SB-17-28-18, SB-21-10-18, SB-21-93-18 had the highest content of vitamin C (more than 200 mg/%); they are selected. Sugar content was the highest (6.8-7.0%) in Altaiskii variety and SB-5-2-18 number, they had sweet taste. According to the evaluation of frost tolerance for new varieties of berry crops, Sokrovishe, Yadrenaya, Drujnaya, Elbeg, Shedraya varieties of black currant and Martin, Thiessen, Smoky, Honey wood varieties of Saskatoon berry had 0 score and they were resistant. As a result of this study, we selected Sokrovishe, Yadrenaya varieties of black currant, which had with big berries, abundant yield and resistant to winter, frost and drought, and nominated to Committee of Variety Testing and Steadfast variety of raspberry was certified as a progressive variety.

Key words: *Variety, number, hybridization, resistance, biochemistry*

BACKGROUND

Mongolia located at the mountainous area of the North Asia, it is classified as cool region according to general climatic classification. In other words, our fruit and berry husbandry is fruit and berry husbandry of the cool region and it is under several factors of nature and weather besides human factor, has limited property. Extreme, long winter, short summer, low precipitation, dry climate and high fluctuation of day and night temperature. Seasonal conversion is immediate and changeable. Other peculiarity is sudden frost in spring and fall seasons this causes frostbite and damage specially to fruit and berry plants and delay to growth and development. It is one of the severe factor which causes meaningful negative impact.

There are grown over 70 species of fruit and berry in wild form, over 10 species of fruit and berry in cultivated form in Mongolia, we have historical custom to use them appropriately. This became a basic of developing fruit and berry husbandry with a scientific background.

As result of conducting intensive research in the regions by the IPAS scientists, main issues such as growing, introduction of fruit and berry plants, creating new varieties, growth agro-technology, propagation technology are solved successfully; created 4 varieties of seabuckthorn, 2 varieties of black currant, which are adapted in Mongolian nature and climatic

condition; certified 60 varieties of 9 fruit and berry crops, introduced 5 varieties of 4 types of decorative plants, successfully.

Although, field amount of fruit and berry plantation was reach to 7.1 thous. hec. in 2022, yield was 4000 tons, field amount was increased by 3 times and yield was increased by 6.7 times since 2010, only less than 2% of the population's annual need was supplied if we count by physiological norm, remaining 98% is imported. 88% of total fruit and berry plantation is seabuckthorn, 12% is other fruit and berry. This shows that it is necessary to increase species of fruit and berry cultivars, increase growing and production, mechanization of harvesting, to supply domestic needs and substitute imports. One of the main factor of obtaining high yield from an agricultural crop id to grow a variety which has a good quality, high yield, resistant to drought, disease and pest. In modern time, variety significance is becoming higher in agricultural production and market relation. Introducing a variety with abundant yield, quality and high productivity into production is significant to increasing yield and its quality. Therefore, our research aim is to grow, introduce, propagate, create varieties of fruit and berry, which are adapted in the region, with high productivity, high quality of biochemistry and technology, resistant to disease, pest and drought.

RESEARCH MATERIAL AND METHOD

Research was conducted according to the methodology "Obtaining selection basic material", "Variety study and selection of strawberry", "Establishing of gene-foundation of fruit and berry", "Stress tolerance of fruit and berry cultivars", which were approved by the meeting of scientific committee of the IPAS, and conducted at the experimental field of the sector for fruit, berry and ornamental plants of the IPAS.

STUDY RESULT

Result of seabuckthorn's variety study and selection research

A valuable source of seabuckthorn's breeding is basic material, which was propagated by seed and vegetative organ, and selected materials by their valuable property from abroad. Therefore, we used seabuckthorn's foreign varieties and natural selected forms in the comparative research.

Annual mean growth of the one-year branch of the seabuckthorn varieties and forms were varying depending on the varieties peculiarity and age. For instance, growth power was vigorous for the varieties Elizabeta, Inya varieties and it was medium for the varieties Altaiskii, Ayganga, Obilnaya, Oranjevaya, respectively. But growth power was vigorous for the natural forms SB-9(II)-15-18, SB-15(I)-1-18, SB-15(II)-8-18, SB-20-18-18, SB-21-29-18 and it was medium for other remaining numbers, respectively (Figure 1).

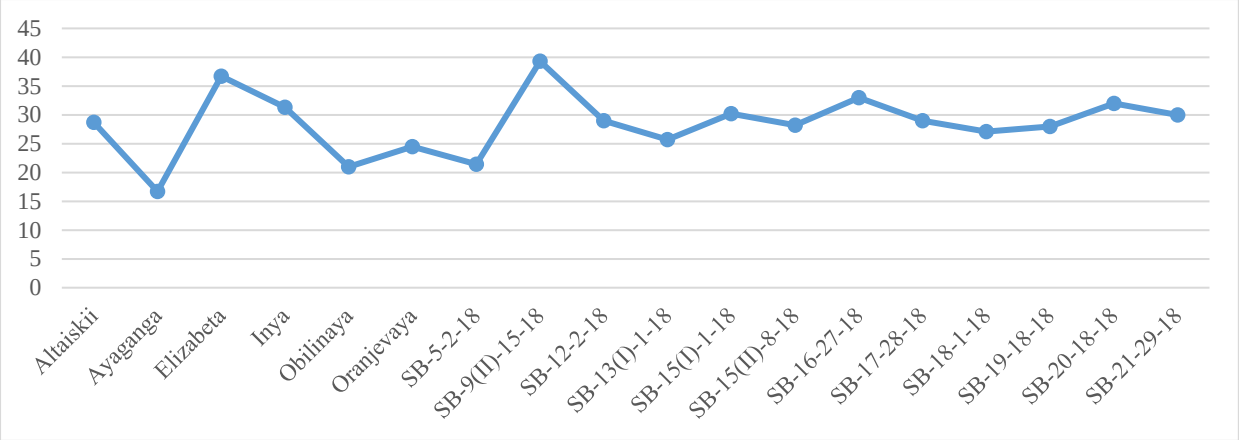

Figure 1. Annual growth of the seabuckthorn varieties and forms

According to our research weight of 100 berries of seabuckthorn varieties was 40.7-73.0 gr, it was fluctuating between 14.4 and 43.1 gr for natural numbers. Berry index shows that berries of seabuckthorn varieties are much bigger than those of the natural numbers (Table 1).

Table 1. Characters of yield structure for seabuckthorn's variety and numbers

№	Variety, number	Weight of 100 berries, gr	Weight of one berry, gr	Berry's		
				length, sm	width, sm	Index
1	Altaiskii	51.4	0.79	1.22	0.89	1.36
2	Ayaganga	73.0	0.84	1.45	0.95	1.52
3	Elizabeta	53.9	0.65	1.45	0.84	1.72
4	Inya	40.7	0.43	1.11	0.71	1.56
5	Obilinaya	71.4	0.79	1.41	0.89	1.58
6	Oranjevaya	54.2	0.58	1.27	0.81	1.56
7	SB-5-2-18	32.1	0.32	0.92	0.70	1.31
8	SB-9(II)-15-18	37.9	0.38	0.89	0.76	1.17
9	SB-9(II)-24-18	31.2	0.33	0.90	0.76	1.17
10	SB-12-2-18	32.3	0.32	0.85	0.71	1.19
11	SB-12-5-18	28.3	0.28	0.82	0.64	1.26
12	SB-13(I)-1-18	19.2	0.20	0.70	0.64	1.09
13	SB-13(II)-3-18	21.6	0.22	0.72	0.62	1.15
14	SB-13(II)-27-18	25.8	0.26	0.71	0.70	1.00
15	SB-15(I)-1-18	33.6	0.35	0.90	0.73	1.23
16	SB-15(I)-5-18	22.1	0.23	0.83	0.64	1.29

17	SB-15(II)-34-18	32.5	0.34	0.79	0.75	1.05
18	SB-15(II)-8-18	33.3	0.34	0.87	0.68	1.27
19	SB-16-27-18	43.1	0.47	0.95	0.77	1.22
20	SB-17-28-18	22.5	0.23	0.81	0.62	1.30
21	SB-18-1-18	38.6	0.44	0.99	0.79	1.24
22	SB-19-18-18	29.8	0.31	0.82	0.72	1.13
23	SB-19-28-18	35.1	0.36	0.90	0.73	1.23
24	SB-19-36-18	31.4	0.30	0.76	0.73	1.04
25	SB-20-18-18	25.0	0.24	0.71	0.70	1.02
26	SB-21-10-18	14.4	0.17	0.68	0.57	1.20
27	SB-21-22-18	30.8	0.30	0.77	0.73	1.04
28	SB-21-25-18	28.4	0.28	0.81	0.69	1.16
29	SB-21-29-18	36.4	0.42	0.93	0.79	1.17
30	SB-21-93-18	28.6	0.29	0.87	0.67	1.29

Size of seabuckthorn berry depends greatly on the year's weather condition. Size of natural seabuckthorn is belonging to small classification but berry of the SB-21-29-18, SB-19-36-18, SB-19-28-18, SB-18-1-18, SB-16-27-18, SB-9(II)-15-18 numbers are slightly bigger than remaining other forms (Figure 2).

According to the research of Ts.Alimdariya and O.Juuperelmaa (2013), yellow color 58%, orange 38%, red 7% in all seabuckthorn population within the Mongolian areal but color was varying for each population. For instance: Color of seabuckthorn, which were grown in majority area of Uvs aimag, was red and they had higher oil content (3.1-4.0%).

SB-15-1-18 SB-16-27-18 SB-18-1-18 SB-19-28-18 SB-21-10-18

Figure 2. External symptom of some natural seabuckthorn numbers'

According to our research, color of natural seabuckthorn was yellow, yellowish, orange, bright orange, reddish orange and red. Berry color of most of forms were yellowish orange and bright orange, respectively.

Seabuckthorn berry has less sugar and high organic acid, thus it is sour when it is completely ripening. Correlation of of sugar and acid if main character of determining taste of berry.

According to the taste determination result, taste was sweet for Altaiskii and SB-5-2-18; sweetish sour Ayganga and SB-16-27-18; sourish sweet for Obilnaya; other varieties and numbers had sour taste (Table 2).

Table 2. Berries' biochemistry and technological properties of seabuckthorn's varieties and numbers

№	Variety and number	Rate					
		Vitamin C, mg/%	Organic acid, %	General sugar, %	Dry matter, %	oil content, %	taste
1	Altaiskii	147.8	0.67	7.0	17.6	3.9	sweet
2	Ayaganga	70.4	1.02	5.5	15.2	3.5	sweet sour
3	Elizabeta	105.6	1.59	2.7	14.2	4.4	sour
4	Inya	126.4	1.45	5.2	15.2	3.7	sour
5	Obilnaya	135.9	1.27	4.9	13.8	3.4	sweet sour
6	Oranjevaya	81.3	1.86	2.3	14.2	3.8	sour
7	SB-5-2-18	257.0	1.12	6.8	17.3	3.8	sweet
8	SB-9(II)-15-18	165.4	2.10	4.4	15.8	-	sour
9	SB-9(II)-24-18	52.8	1.65	3.5	15.8	-	sour
10	SB-12-2-18	195.4	2.57	3.2	15.7	3.8	sour
11	SB-12-5-18	220.0	2.20	3.1	14.8	3.1	sour
12	SB-13(I)-1-18	193.6	2.05	2.3	16.3	-	sour
13	SB-13(II)-3-18	147.8	2.34	3.6	15.5	3.0	sour
14	SB-13(II)-27-18	146.1	1.78	5.0	17.7	4.1	sour
15	SB-15(I)-1-18	200.6	2.03	4.7	14.1	2.7	sour
16	SB-15(I)-5-18	204.2	2.20	4.6	17.7	3.1	sour
17	SB-15(II)-34-18	137.3	2.87	3.5	15.3	3.0	sour
18	SB-15(II)-8-18	146.1	2.46	3.6	16.1	2.2	sour
19	SB-16-27-18	96.8	1.51	6.1	14.8	3.8	sweet sour
20	SB-17-28-18	202.4	2.30	4.6	16.4	3.0	sour
21	SB-18-1-18	105.6	1.79	2.7	11.6	-	sour
22	SB-19-18-18	174.2	2.88	4.1	16.1	3.9	sour
23	SB-19-28-18	163.7	2.75	3.3	16.3	3.3	sour

24	SB-19-36-18	191.8	2.83	3.0	15.3	3.2	sour
25	SB-20-18-18	117.9	1.34	3.7	15.8	-	sour
26	SB-21-10-18	207.7	1.83	3.2	19.2	4.4	sour
27	SB-21-22-18	73.9	1.94	5.5	19.2	3.5	sour
28	SB-21-25-18	186.5	2.26	5.0	19.2	3.1	sour
29	SB-21-29-18	140.8	2.12	4.5	15.3	3.3	sour
30	SB-21-88-18	198.9	2.24	3.5	17.1	5.6	sour
31	SB-21-93-18	220.0	1.90	4.6	16.3	3.6	sour

According to our research result, vitamin C content was 52.8-257.0 mg/%, pulp oil content was pluctuating between 2.2 and 5.6%. Natural numbers of seabuckthorn SB-15-2-18, SB-12-5-18, SB-15-1-18, SB-15-5-18, SB-17-28-18, SB-21-10-18, SB-21-93-18 had the highest content of vitamin C (more than 200 mg/%); pulp oil content was higher in numbers SB-21-88-18, SB-21-10-18, SB-13(II)-27-18 and Elizabeta variety (more than 4%). Sugar content was the highest (6.8-7.0%) in Altaiskii variety and SB-5-2-18 number; they had more sugar than the other variants.

Result of seabuckthorn's hybridzation

Seabuckthorn hybridization was done on the selected sunny day, separation of female flower was done before mail flowers'flowering or in the third decade of April; fertilization was done in the first decade of May, when all female flowers were massively flowering, flowering branch was cut of Alei (father) variety and located in the separator. Separators were removed after complete flowering of all female plants in the middle decade of May, when flowering was completed and all flowers had berries.

Weather condition (air temperature, precipitation and wind) was significantly affecting on the success of seabuckthorn's hybridization. Weather condition of hybridization years' was: day's mean air temperature of May, 2019 was close to many years' mean temperature, precipitation was 2.8 mm, this was 9 times less than many years' mean precipitation, weather was very dry and droughty. Sum of the effective temperature in May, 2021 was 163.9 or less than many years' mean, precipitation was higher by 6 mm, the coefficient of moisture and temperature was 1.98, thus the weather was moist. This indicates that there was a positive effect on the success of seabuckthorn's hybridization in 2021.

Table 3. Success of fertilization for seabuckthorn's hybridization

№	Pair		Number of fertilized flowers (bud), piece	Number of berries, piece	Success of fertilization, %
	Mother	Father			
2019					
1	Ayaganga	Alei	515	131	25.4
2	Bayangol	Alei	75	5	6.6
3	Elizabeta	Alei	190	27	14.2
4	Obilnaya	Alei	125	18	14.5

5	Oranjevaya	Alei	75	12	16.0
6	Solnechnaya	Alei	174	20	11.5
7	Chuiskaya	Alei	165	40	24.2
8	Prevoshodnaya	Alei	275	50	18.1
2020					
9	Elizabeta	Alei	120	108	11.2
10	Jivko	Alei	110	96	10.9
11	Lyubimaya	Alei	100	82	10.2
12	Minusa	Alei	110	93	10.5
13	Solnechnaya	Alei	110	94	10.6
14	Chuiskaya	Alei	125	112	11.2
2021					
15	Ayaganga	Form 21	798	2478	38.8
16	Obilnaya	Form 21	193	555	35.9
17	Oranjevaya	Form 21	180	625	43.4

Fertilization success was on average 16.3% in 2019, fertilization of the pair Ayganga x Alie, Chuiskaya x Alei were the highest (24-25%), respectively. Fertilization success of seabuckthorn pair was 10-11% in 2020. But we obtained 3658 pieces of hybrid seeds and fertilization success was fluctuating between 35.9 and 43.4% and this was the highest (Table 3).

Study result of biological peculiarity and economical properties for other fruit and berry crops

Winter and frost resistance is the most important criteria for our country's extreme weather condition. Frost resistance of perennial plant is the biological important property and this is narrowly connected to the heredity and environmental condition. This depends on the weather condition and winter frost hardiness reduces due to incomplete wooding, budding during spring.

General status of the bush depends on complex characters such as sun bite, hazard of disease and pest and agro-technology. According to the evaluation for general status of the bush, apple varieties had 2-3 score or affected by frost and degraded; varieties of plum, hybrid, Sackhatoon berry, blue honeysuckle, peach had 5 score or growth and development was normal, thy had high winter resistance.

Table 4. Evaluation of winter resistance and general status of the new varieties of the fruit and berry

№	Variety name	Evaluation, score	
		Winter resistance	General state of bush
apple, pear			
1	Altaiskoy purpurovaya	3	3
2	Bayna	5	2
3	Gorno-Altaiskoe	3	3
4	Zavetnoe	3	3
5	Ranetika purpurovaya	3	3

6	Grusha dichok /pear/	0	5
Plum, hybrid			
7	Altaiskaya yubileinaya	0	5
8	Chomalskaya sinya	0	5
9	СВГ-11-19	0	5
Sackhatoon berry			
10	Martin	0	5
11	Thiessen	0	5
12	Smoky	0	5
13	Honey wood	0	5
Blue honeysuckle			
14	Berel	0	5
15	Golubnoy vereteno	0	5
16	Ognennii opal	0	5
Black currant			
17	Altaiskaya pozdnaya	3	3
18	Drujnaya	0	5
19	Zaraia dabot	0	5
20	Ojerel	0	5
21	Sokrovishe	0	5
22	Ruslan	0	5
23	Elbeg	0	5
24	Yadrennoe	0	5
25	Andreichenko	3	5
26	Shedraya	0	5

According to the evaluation of winter resistance, Drujnaya, Zariya dabote, Sokrovishe, Yadrenaya, Elbeg, Shedraya varieties had 0 score they didn't have any freezing symptoms, so they were winter and frost resistant. But 50% of buds was frozen for Andreichenko variety, woody issue became brownish, sun bite was medium. Up to 50% of fruiting branch was frozen for Andreichenko variety, evaluation of winter resistance had 5 score, this shows that this variety is irrestainable to winter and frost (Table 4).

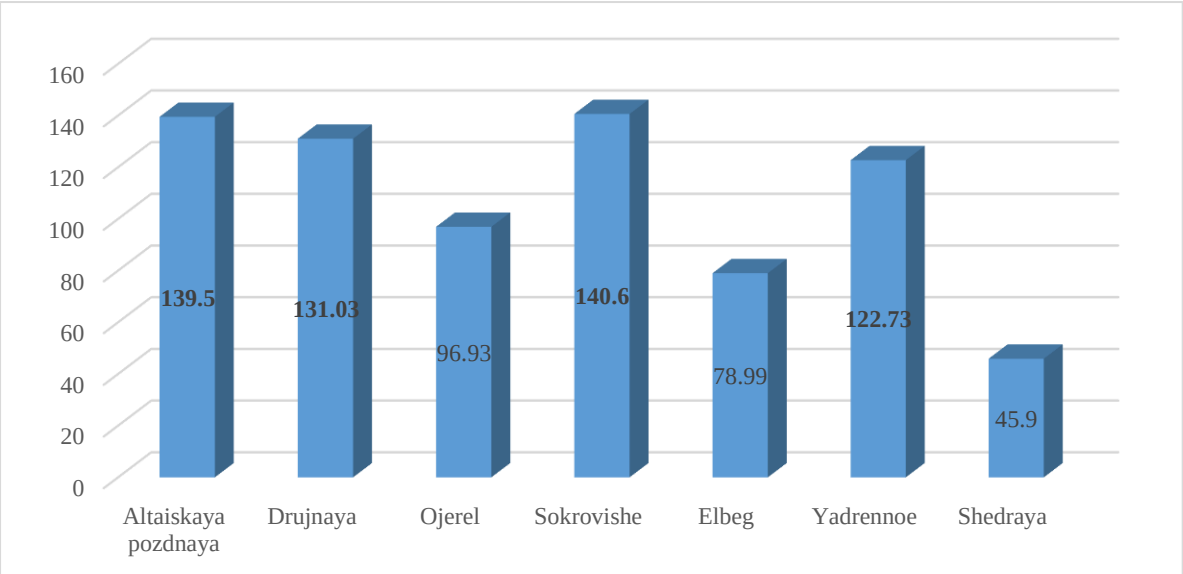

Figure 3. 100 berries' weight of new varieties of black currant, gr

Berry of Altaiskaya pozdnaya. Ojerel, Sokrovishe, Yadrennoe varieties of black currant were big, bright black color, and thick skin, this shows those varieties have higher ability to tolerate storing and transportation and attracting consumers' attention.

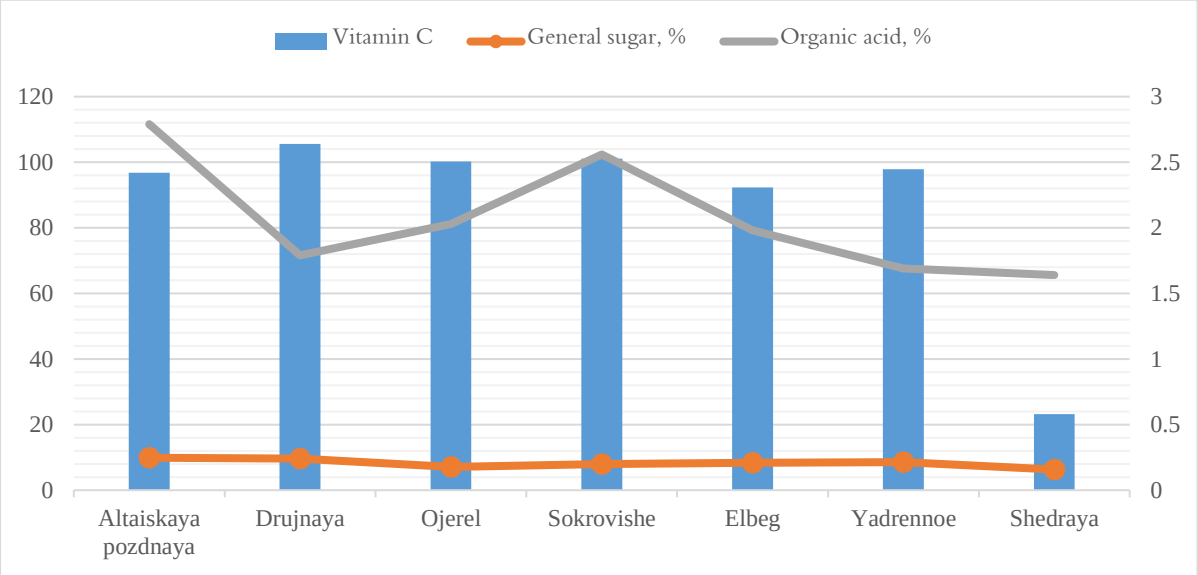

Figure 4. Vitamin content of new varieties of black currant

Vitamin C content was 96.8-105.6%, organic acid was 1.6-2.7%, general sugar was 7-9% in new varieties of black currant berries. Vitamin C content was higher in Ojerel, Drujnaya, Sokrovishe varieties (101.2%–105.6%) than other varieties. Sugar content was the highest in Altaiskaya pozdnaya, Drujnaya varieties (9.6-9.9%). Organic acid content was fluctuating between 1.69-2.56% in berry of black currant varieties (Figure 5).

Compare to other crops of fruit and berry, strawberry growing is relative easy, it is possible to grow everywhere in the yard, on the balcony and window and obtain high yield. If we grow strawberry by a seed, it is possible to harvest yield in the next year, if we grow strawberry by a seedling it is possible to harvest yield in that year. One fruit weight of remotant variety of strawberry was 9.8-12.3 gr, yield of one bush was 156.2-280.1gr; one fruit weight of normal fruiting variety was 10.2-22.48 gr, yield of one bush was 83.2-185.8 gr, respectively (Table 5).

Table 5. Yield of strawberry varieties, kg/m^2

№	Variety name	Average weight of one fruit, г	Yield of one bush, г	Yeild, kg/m^2
Remotant				
1	Albion	12.3	241.9	1.40
2	Sulhyan	10.0	280.1	1.71
3	Soulhyan	11.1	156.2	0.93
4	Flamenko	9.8	252.7	1.56
Normal fruiting				
5	Maxim	22.4	102.2	0.60
6	Bors	12.5	185.8	0.75
7	Ostara	19.8	141.5	0.85

8	Anna	11.0	133.1	0.80
9	Alenushka	10.5	91.5	0.55
10	Alexsandrina	10.2	83.2	0.50

CONCLUSION

1. Vitamin C content was 52.8-257.0 mg/%, pulp oil content was fluctuating between 2.2 and 5.6% in berry of seabuckthorn's variety and numbers. Natural numbers of seabuckthorn SB-15-2-18, SB-12-5-18, SB-15-1-18, SB-15-5-18, SB-17-28-18, SB-21-10-18, SB-21-93-18 had the highest content of vitamin C (more than 200 mg/%); pulp oil content was higher in numbers SB-21-88-18, SB-21-10-18, SB-13(II)-27-18 and Elizabeta variety (more than 4%); sugar content was the highest (6.8-7.0%) in Altaiskii variety and SB-5-2-18 number; they had more rate than the other variants.
2. Fertilization success of hybridization for seabuckthorn was fluctuating between 10.7 and 39.3% depending on weather condition of study years. Hybridization was done in 14 pairs and result was obtained.
3. According to the evaluation of frost tolerance for new varieties of berry crops, Sokrovishe , Yadrenaya, Drujnaya, Elbeg, Shedraya varieties of black currant Martin, Thiessen, Smoky, Honey wood varieties of Sackhatoon berry had 0 score and had resistance.
4. One fruit weight of remotant variety of strawberry was 9.8-12.3 gr, yield of one bush was 156.2-280.1gr; one fruit weight of normal fruiting variety was 10.2-22.48 gr, yield of one bush was 83.2-185.8 gr.

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19.SEA BUCKTHORN INDUSTRY UPGRADING THROUGH ENTREPRENEURSHIP AND INNOVATION

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ABSTRACT

The paradigm shift in cluster development is occurring rapidly. Over the past 40 years, governments, companies, universities, and academic institutions have collectively made significant contributions to enhancing the competitiveness of various sectors. In the context of cooperation, developing export-oriented manufacturing zones has provided a pivotal experience for national economic integration. This has resulted in increased contributions from such sectors to GDP, rising export growth rates, expanding global market shares, and greater attraction of foreign investment. Simultaneously, in the last 20 years, the creation of national values has increasingly focused on innovation and the development of unique products. Consequently, entrepreneurs' capabilities have grown, leading to a heightened demand for new financing structures, innovative forms, and novel experiments.

The cluster development paradigm, as a methodology, is based on the belief that economic integration should be directed not from the top down but from the bottom up. It posits that private sector initiatives, cooperation between related sectors, and the creation of multifaceted cooperation networks and platforms will accelerate the country's prosperity. Although the level of cluster development and the implementation of technological advancements, scientific research, and innovation vary across sectors, the competitive advantage and competitiveness of resources in each geographical location can stimulate the creation of diverse values.

This research will introduce the experience of cluster initiatives implemented in the Mongolian fruit industry and demonstrate that it has taken over 10 years to import and localize new knowledge, transitioning the sector’s development model from a leader-driven approach to a more integrated framework with company leadership. Serving as a case study for other clusters, it will discuss the involvement of various stakeholders in developing the fruit industry, which is narrowing towards “collaboration. "

Keywords: cluster paradigm shift, sea buck thorn cluster initiative, collaboration system

INTRODUCTION AND MOTIVATION

Since the launch of the Sea Buckthorn Cluster Initiative in Mongolia in 2015, several key issues have necessitated careful consideration in developing clusters or bottom-up sector development.

The primary link between national and local economies has been concentrated in economic zones. Consequently, countries have developed policy models for economic integration within special economic zones, which include science and technology parks, industrial technology parks, industrial districts, export production zones, and special industrial zones, thereby accumulating significant development experience.

The cluster development approach has been formed based on the experiences learned since the 1990s. The main point is that location and cooperation in economic zones are crucial, and the role of various development actors focuses on enhancing the private sector's competitiveness.

The main benefits of empowering entrepreneurs in economic zones are as follows: first, knowledge sharing; second, achieving efficient resource allocation; third, focusing more on research, development, and innovation; fourth, expanding market efficiency; and fifth, improving skills. Developing various forms of cooperation positively affects the successful implementation of cluster policies. However, the development trend of clusters varies depending on the level of development across different clusters. This variation occurs regardless of whether a cluster policy exists or the nature of cooperation among cluster stakeholders. In general, the development trend of successful clusters is influenced by factors such as strong leadership or pioneers, precise locations for cluster concentration, more significant mobilization of skilled labor, support for the private sector with accessible, adequate, and effective infrastructure, and a transparent, understandable, and open policy environment that emphasizes knowledge exchange and cooperation.

Since 2002, the Institute for Competitiveness and Strategy at the Harvard Business School has pioneered the concept and analysis of cluster theory. Universities and research institutes in Europe, Latin America, and the Asia-Pacific region have steadily focused on key research areas. As a result, cluster policies have attracted the attention of many governments. This work will review the best practices of the European Union and demonstrate that the Mongolian sea buckthorn cluster initiative is undergoing a transition period.

ANALYTICAL FRAMEWORK

Building collaboration in a cluster is a multifaceted process that unfolds through various initiatives and ongoing efforts. Additionally, partnerships, networks, and matchmaking activities remain essential until this process becomes permanent. Support, assistance, and follow-ups consistently promote the cluster collaboration process. Hence, the cluster collaboration process will create ecosystems.

Why must the next transition be made in the Mongolian sea buckthorn cluster initiative?

Cluster development approaches vary significantly in terms of the roles and functions of cluster participants, the products they develop within and between clusters, and the level of expertise in the private sector. Cluster development models can take many forms. Expanding into new markets is often seen as a “cluster growth model” that is export-oriented, designed to attract private sector companies to a cluster. In this context, innovation that fosters efficiency is crucial for private sector entities. Companies can implement more comprehensive strategies to test innovations within their organizations, including operational practices, production

technologies, human resource capabilities, product development, and new market research. Moreover, they can build trust within the cluster and foster a collaborative business culture. Some cluster initiatives can be further enhanced by cultivating trust and cooperation, paving the way for the next stage. A "cluster transition model" can be jointly developed in such cases. Here, it is essential to identify a direction for sector transition within and between clusters. Having engaged cluster members is crucial, as is accelerating the transition by aligning member companies with the cluster policy. During this transition, start-ups become vital, with all participants collectively sharing the responsibility for speeding up innovation. Another model is the "creation model," which pivots towards innovation. New sectors may emerge from existing ones, or the focus may narrow to involve only a small number of members. In such instances, substantial funding will be necessary to finance innovation, making access to large amounts of capital a key issue. There is a novel trend in cluster development, with countries with adequate financing beginning to embrace this direction.

The trend of cluster development has always been "collaboration", discussing the goal of creating value together. In the beginning, the tripartite alliance - government, private sector, and academic institutions - had the task of developing "collaboration" in cluster development. The "cluster initiative" and its implementation process have existed for about 20 years. As a result, cluster organizations have become more capable and have contributed valuable to cluster development. It is believed that such a cooperative development approach was implemented in the EU between 1900 and 2010.

A good example of this is the European Union.

Table 1. Integrated information of the European Cluster Framework

	Total	EX27	Non-EU COSME countries	Third countries
Cluster Organizations	1398	1091	84	213
Cluster Members	7283	399	21	8
European Cluster Partnerships	276	203	3	9
Cluster Networks	46	34	0	1
National cluster associations	22	19	2	1
Policy Institutions	19	17	1	1
Resource Providers	136	129	3	1
Training organizations	25	22	3	0

Source: https://www.clustercollaboration.eu/

Until now, the cluster development approach has emphasized "collaboration." This is sometimes called the "Pentagon model." In addition to the three previous participants, the new approach to collaboration that has emerged since 2010 has also included capital or financiers and emerging entrepreneurs.

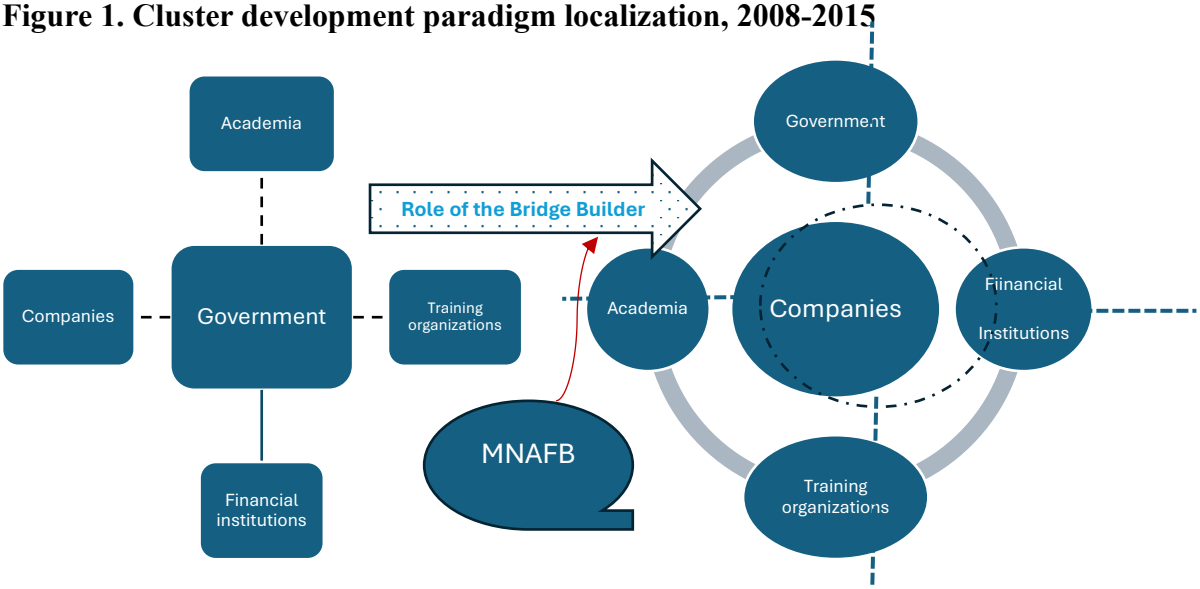
The main challenge for countries is to simultaneously focus on developing collaboration by strengthening collaboration in traditional sectors and attracting new start-ups and financiers to the cluster development approach. Of course, governments are implementing initiatives to support cluster collaboration. Still, cluster collaboration will be successful if they focus on six issues: financial activation, infrastructure development, regulatory support, market access and internationalization, skills development and training, and research and development.

Countries will analyze the interconnectedness of clusters within a single cluster, based on the economic performance of all economic activity sectors. The focus on integrating multiple economic activities into a single whole is a historical fact of the past. Still, now we have reached a stage where we need to coordinate, organize, and integrate multiple activities following their diversity, and measure not only economic performance but also the prosperity of the country. That is why countries have developed cluster classifications based on ISIC data. Although cluster development levels vary, measuring innovation, productivity, and output has become a standard indicator.

FINDINGS AND DISCUSSIONS

The Mongolian Sea Buckthorn Cluster Initiative was launched in 2015. The cluster development approach was based on the interpretation of the Stockholm School of Economics in Sweden. New knowledge was imported from the Harvard Institute for Competitiveness and Strategy at the National University of Mongolia to implement it. Between 2008 and 2015, the initiative focused on developing cooperation among Mongolian sea buckthorn industry stakeholders, holding multiple meetings and discussions, and conducting multi-faceted activities.

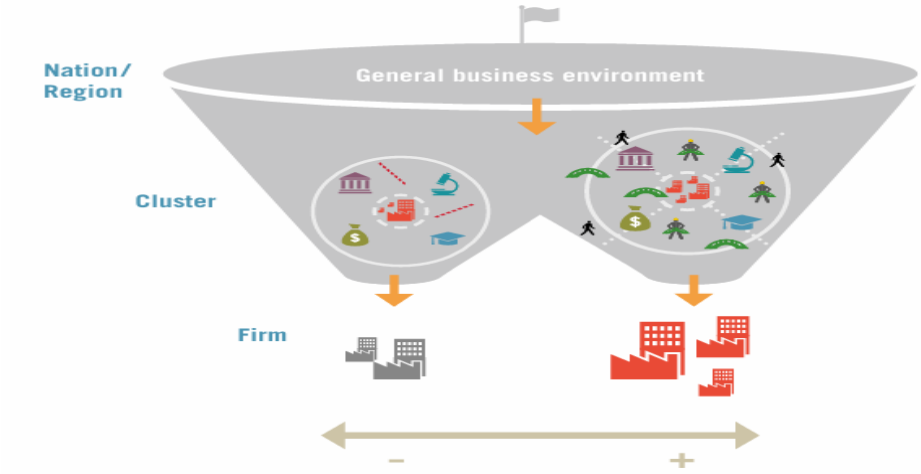
Figure 1. Cluster development paradigm localization, 2008-2015



Source: https://irp-cdn.multiscreensite.com/bcb8bbe3/files/uploaded/doc_3540.pdf

According to this paradigm, the Mongolian National Fruit and Vegetable Association played a key role in cluster cooperation and became a “bridge” for cluster participants. We called this model the “leader-driven sea buckthorn cluster initiative” and began to attract diverse development participants to the sea buckthorn sector. As can be seen from the performance of this model, although the sea buckthorn cluster strategy was formulated, the cluster growth rate was slow because the “financing structure” was not jointly defined. Therefore, starting from 2015, companies were identified as key players in the sea buckthorn cluster. The work of identifying companies as key players in the sea buckthorn cluster and making their competitive strategies, policies, and advantages more visible to the market began.

Figure 2. Paradigm shift in activating cluster development approaches, 2015-



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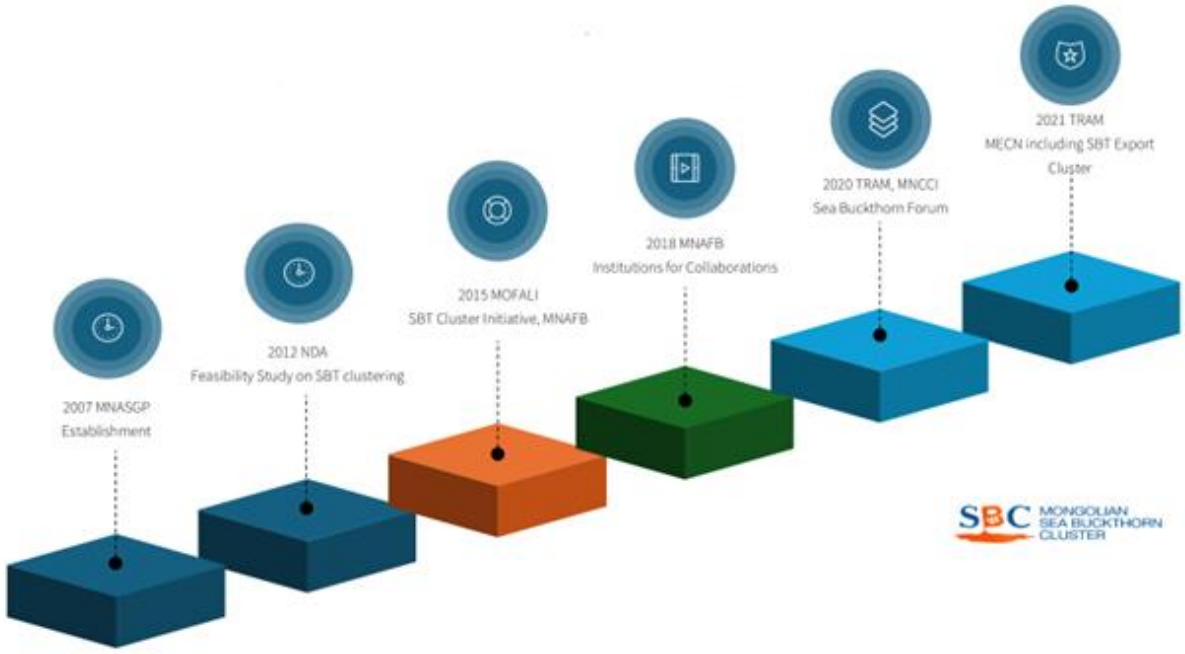
The remoteness of Mongolian fruit growers from processing plants is a significant challenge for strengthening cooperation. One reason why cluster participants are not concentrated in one location in the current situation is the lack of a business culture that defines the location of cluster participants by distance or time. Therefore, a paradigm shift is needed to accelerate the development paradigm of the sea buckthorn cluster. There are several reasons for this. First, pre-harvest logistics are weak, and introducing good agricultural practices into fruit farming is costly and time-consuming; there is no system for introducing, transferring, and localizing innovations in traditional agriculture. Second, since agricultural development policies are often top-down, great efforts are needed to align them with the bottom-up approach. Third, the sea buckthorn cluster lacks the institutional environment to integrate into similar fruit value chains in other countries and attract investment in its multifaceted activities, such as concentration, differentiation, differentiation, and identification. Thus, the government’s activation and initiative are crucial in activating the sea buckthorn cluster initiative. Also, the previous lessons are that, first, all stages of the fruit value chain should be supported and the opportunities for cooperation should be improved at the local, regional, and national levels, and the focus areas and export products should be agreed upon. In the current situation, the product is “sea buckthorn oil”, but the focus areas of the sea buckthorn value chain are unclear.

Between 2012 and 2023, the MJJU contributed to the development of cluster-related policies. Such policies related to sea buckthorn clusters at the local level and the national level have attracted more “collaboration” of development stakeholders in the Mongolian fruit sector.

Figure 3. Activities of Mongolian Sea Buckthorn Cluster Initiative



Source: MNAFB 2024

The Mongolian fruit and vegetable sector's development approach until 2024 focuses on creating an institutional environment for cluster policies, including generating new knowledge, guiding industry participants toward a cluster development approach, and laying the groundwork for sectoral cooperation.

There are still more issues to be resolved in a systematic and step-by-step manner, such as visiting companies, providing technical assistance to reformulate companies' competitive strategies and policies in light of global changes, reassessing the direct, indirect, and indirect impacts of the sector, introducing and stabilizing the transition system from cluster-related policies to cluster policies by learning from international good practices, integrating the support provided by various development actors to businesses, which are the main participants of the cluster, under their functions, reviewing the direction and rules of the “cluster cooperation” in cooperation with other clusters, organizing the “cluster network” into a more unified platform, directing this platform more towards the public, and ensuring that all participants are more focused on new generations of entrepreneurs and innovations. Therefore, the development of a cluster system with different activities in one location, such as having a cluster organization, being a cluster member, training cluster managers and coaches to create resources, policies, collaborations, and networks, developing cluster policy institutions more regionally, diversifying cluster training, and attracting the activities of professional associations serving their members operating at local, regional, and national levels to cluster activities, has moved

to a stage where different activities are developed in one location. The Mongolian Export Cluster Network NGO can be said to have laid the foundation for this.

CONCLUSIONS

The multifaceted participants of the sea buckthorn cluster can unite around the goal of developing entrepreneurs who can join new business trends, such as tech jobs and tech scale-ups.

The time has come to redefine the strategy for converting the triple-bottom-line model to the Pentagon paradigm by 2030.

A more detailed study of cluster policy institutions and resource providers can be conducted.

Cluster data hubs and data centers are crucial for emerging clusters.

To empower cluster organizations, it is necessary to consider training more leaders, managers, and coaches.

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