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THE GENETIC RESOURCES OF HIPPOPHAE GENUS AND ITS UTILIZATION

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ABSTRACT

The Genetic Resources of Hippophae are very rich. Hippophae includes 15 species and subspecies that are widely distributed in Europe and Asia. Only 4 subspecies are being used in practical research and development. This paper summarized the existing utilization of genetic resources of Hippophae and its potential uses in the future. In the Central Asia local people used Seabuckthorn berries for treatment of hypertension, digestive system and skin diseases. The oil extracted from berries is used for treatment of gastritis, stomach ulcers, erosion of uterus and inflammation of genital organs. In addition, people used infusion of dried berries for skin diseases. The exact number of species in the genus Hippophae is still unclear however, there are considered to be seven species Hippophae rhamnoides L. has 9 subspecies.

Keywords: Seabuckthorn, Elaeagnus rhamnoides, Medicine, Oleaster.

INTRODUCTION

Seabuckthorn is very rich in its biodiversity. According to the latest study, there are 15 species and subspecies in Hippophae , but only 4 subspecies are being used. For example, Russian scientists have used one subspecies (Hippophae rhamnoides subsp. mongolica) for more than 70 years and many good varieties have been bred out but their localization in adapting on other weather conditions limited those varieties to be popularized in the other parts of the world. China has used another subspecies (H. rhamnoides subsp. sinensis) which has been widely used for ecological restoration and producing a series of products (Rajchal, 2009). In Europe, Hippophae rhamnoides subsp. rhamnoides is used in many countries like Germany, Italy, Switzerland, Sweden, Finland etc. Several improved varieties bred from this subspecies have been cultivated in these counties. In the Central Asia and South Asia, a widely distributed subspecies is Hippophae rhamnoides subsp. turkestanica. Due to its rich wild resources this subspecies is being used for producing a lot of products in India, Pakistan, Turkmenistan, Kirghizstan etc. Since H. rhamnoides subsp. sinensis and Hippophae rhamnoides subsp. turkestanica both are rich in wild resources, so they are directly being used for various purpose. But these two subspecies have a lot of disadvantages like small berries, many thorns, lower content of oil and lower yield per unit area (Li and Wardle, 1999).

However, there are other 11 species and subspecies in Hippophae which have many good characteristics such as less thorns, high contents of vitamins, oil and resistance to drought, cold and saline and alkali, but most of these species and subspecies have not been used in growing and breeding. Very few studies have been done on these species and subspecies. Since many countries are awareness of seabuckthorn is a very important plant in economy and ecology, it is believed that more attention and more studies will be given to those genetic resources of Hippophae , including that have been used and that have not been touched but very promised.

A Review of Genetic Resources of Hippophae

A Simple History of Seabuckthorn Taxonomy

Seabuckthorn is a general term given to the shrub-tree Hippophae rhamnoides Linn. which was named by Swedish taxonomist Linnaeus in 1753. After that several other species were found and named by many taxonomists. In 1971, finnish taxonomist Arne Rousi divided this species into 9 subspecies that is growing from Norway in Scandinavia to the Northwest of China. For the other species and subspecies Arne Rousi recognized three species: Hippophae rhamnoides L, Hippophae salicifolia D.Don, and Hippophae tibetana. In 1978, Chinese taxonomists, Liu Shengwu and He Tinnong, reported a new species, H. neurocarpa from the Qinghai Plateau, China. In 1995, another Chinese taxonomist, Lian Yongshan found 1 new species and 2 subspecies: H.goniacarpa, H. goniacarpa subsp. litangensis and H. nrurocarpa subsp. stellatopilosa. In 2000, Lian Yongshan summarized previous studies of seabuckthorn taxonomy and raised his new taxonomic system of Hippophae. According to Lian, there are 15 taxons in Hippophae (Rajchal, 2009).

1. H. rhamnoides. subsp. rhamnoides 2.H. rham. subsp. sinensis 3.H. rham. subsp. yunnanensis 4. H. rham. subsp. mongolica 5.H. rham. subsp. turkestanica 6. H. rham. subsp. fluviatilis 7. H. rham. subsp. carpatica 8. H. rham. subsp. caucasica 9.H. goniocarpa 10. H. goniocarpa subsp.

litangensis 11. H. neurocarpa 12. H. neurocarpa subsp. stellatopilosa 13. H. Tibetana 14. H. gyantsensis 15. H. salicifolia The Distribution and Status of Utilization of Hippophae

The following table shows the distribution and the status of utilization of Hippophae:

Taxons	The Areas of Distribution	The Status of Utilization
1. H. rhamnoides. subsp. rhamnoides	Scandinavian countries, Baltic Sea countries, Germany, Belgium, Netherlands, Ireland, Poland, U.K. France, Russia	Many varieties are cultivated in some European countries and Canada.
2. H. rham. subsp. sinensis	The North, Northwest, Southwest of China	Wild resources are used for ecological restoration and berries are processed for products. Some new varieties are in tests.
3. H. rham. subsp. yunnanensis	Sichuan, Yunnan, Tibet of China	Wild resources are used for ecological restoration only.
4. H. rham. subsp. mongolica	Siberia of Russia, Mongolia, Xinjiang of China	More than 60 varieties are cultivated in Russia, Mongolia, many East European counties. Many West European counties, Canada and China introduced the varieties for test
5. H. rham. subsp. turkestanica	India, Pakistan, Afkhanistan,Turkmenistan, Kirghizstan, Uzbekistan, Kazakhstan, Iran, Turkey, Xinjiang , Tibet of China	Wild resources are used for ecological restoration and berries are processed for various products
6. H. rham. subsp. fluviatilis	Around Alps Mountains: Germany, France, Switzerland, Austria, Czech, Slovakia, Italy,	Most of wild resources are protected as forest species. Some berries are collected for processing products
7. H. rham. subsp.	The Capathinan Mountains,	Most of wild resources are

carpatica	Transsylvanian Alps,the valley and the mouths of the Donube and its tributary.	protected as forest species. Some varieties are cultivated for processing products
8. H. rham. subsp. caucasica	The Caucasus Mountains, Georgia, Azerbaijan, Armenia, Ukraine, Romania, Turkey, Bulgaria, Iran, Russia.	Most of wild resources are protected as forest species. Some selected varieties are cultivated for test.
9. H. goniocarpa	Sichuan, Qinghai of China	Most of wild resources are protected as forest species. Very few studies have been don on it.
10. H. goniocarpa subsp. litangensis	Sichuan, Qinghai of China	Most of wild resources are protected as forest species. Very few studies have been don on it.
11. H. neurocarpa	Sichuan, Qinghai,Gansu of China	Most of wild resources are protected as forest species. Very few studies have been don on it.
12. H. neurocarpa subsp. stellatopilosa	Sichuan, Qinghai, Tibet of China	Most of wild resources are protected as forest species. Very few studies have been don on it.
13. H. tibetana	Sichuan, Qinghai, Gansu, Tibet of China, Nepal, India	Most of wild resources are protected as grassland species. Very few studies have been don on it.
14. H. gyantsensis	Tibet of China	Most of wild resources are protected as forest species. Some berries are collected for producing Tibetan medicine.
15. H. salicifolia	The southern slope of Himalayan Mt. Tibet of China, Bhutan, Nepal, India	Most of wild resources are protected as forest species. Some berries are collected for producing products.

Table 1. The Distribution and the Status of Utilization of Hippophae:

Practical Utilization of Genetic Resources of Hippophae

Some Utilization of Genetic Resources of Hippophae In China Since 1980s some research programs on introduction, selection and breeding have bee conducted in China.Introduction of Russian varieties from former USSR.

In 1980-2000 more than 30 Russian varieties were introduced to China for tests. From those around 10 varieties were considered to be suitable for China's natural environment. Seabuckthorn provenance tests:

From 1985 about 19 Chinese seabuckthorn provenances were collected from 10 provinces of China were tested on 10 sites in the Northern China. The tests shown that the provenances from Qinghai, Gansu and Ningxia have small berries, late mature period but more content of vitamin C. Those provenances from Shanxi, Inner Mongolia and Hebei have bigger berries and earlier mature period but the vitamin C contents are less than that from Qinghai, Gansu and Ningxia.

Breeding for Purpose of Leaves Utilization.

Seabuckthorn leaves are rich in protein, fats and flavonoids that are used for fodder and medicine. In 2001-2004 a program on breeding types of leaves utilization was carried out. Some good varieties with high yield forage and less thorns have been selected out.

Hybridization for Improving Chinese Seabuckthorn.

H. rhamnoides. subsp. sinensis is a dominated species of Hippopgae in China. It accounts for 95% of total seabuckthorn resources of China. But it has some disadvantages like small berries, many thorns, lower yield etc. a program on improving Chinese seabuckthorn by making hybridization was carried from 1990s. Some progress on the program is promising. For example, a hybridization between a Russian variety (♀) and a Chinese variety (♂) has produced some promising hybrids.

The Bio-economic Characteristics and Berries' Characteristics in Hybrids, Russian and Chinese Varieties of Seabuckthorn are shown in following tables:

Varieties	Age of Tree（year）	Height of Tree （m）	Diameter of Canopy (m)	Diameter of Trunk (cm)	Length of Growth (cm）	Thorns (pcs/10cm)	Yield Per a Tree （kg/tree）
Chinese SBT	4	1.95	1.55x1.60	5,05	18.5	3.2	1.99
Hybrid-1	4	2.07	1.60x1.53	4.95	27.0	0.8	4.04
Hybrid-2	4	2.20	1.20x1.25	5.10	29.0	0.9	4.53
Hybrid-3	4	2.10	1.20x1.35	5.65	28.0	0.9	4.50
Hybrid-4	4	2.40	1.50x1.60	6.03	26.5	1.0	5.02
Russian ‘Chuisk’	4	2.27	1.61x1.65	6.38	28,5	0.4	5.06

From these 2 tables it can be seen that the Chinese seabuckthorn variety can be improved through hybridization in increasing the size of berries, the oil content, reducing thorns and so as to increasing the yield per a plant.

Table 2. Comparison of Bio-economic Characteristics in Hybrids, Russian and Chinese Varieties of Seabuckthorn (Fuxin, Liaoning, China)

Varieties	Color of Berries	Juice Content (%)	Weight of 100 Berries (g)	Soluble Solid Substances (%)	Organic Acids (%)	Vc Content (mg/100 g)	Oil Content of Pulp （%）	Oil Content of Seeds （%）	Harvest Date
Chinese SBT	Orange-yellow	80.3	19.4	13.0	2.85	526.0	1.59	8.12	Sept.11, 2002
Hybrid-1	Orange-yellow	80.3	21.8	9.0	2.07	78.0	5.04	8.48	Sept.1, 2002
Hybrid-2	yellow	81.0	27.3	9.0	2.09	69.0	4.13	8.31	Sept.1, 2002
Hybrid-3	Orange-red	75.0	22.3	10.0	1.66	127.0	4.50	10.21	Sept.1, 2002
Hybrid-4	Yellow	84.0	48.5	7.0	1.54	175.0	5.21	8.67	Sept.8, 2002
Russian ‘Chuisk’	Orange-yellow	90.0	59.7	5.0	1.01	37.0	6.72	11.20	Aug.19, 2002

Table 3. Comparison of Berries’ Characteristics in Hybrids, Russian and Chinese Varieties of Seabuckthorn (Fuxin, Liaoning, China)

Some Utilization of Genetic Resources of Hippophae In Europe and other countries Progress of Utilization of Genetic Resources of Hippophae In Russia

Seabuckthorn selection and breeding in Russia started from 1933,

during the last 70 years more than 60 new varieties were bred out from H. rhamnoides subsp. mongolica and H. rhamnoides subsp. rhamnoides through distant hybridization, radiation and chemomorphosis. The Russian varieties have many good characteristics such as large berries, high content of oil, high yield per plant and less thorns. Perhaps the highest yield per plant in the world was created by Russian varieties. Several famous varieties like "Orange", "Chuisk", "Superior", "Sun", and "Alay" have been successfully cultivated in the Northeast China. Progress of Utilization of Genetic Resources of Hippophae In Germany Seabuckthorn selection and breeding in Germany started from 1962s, till now about 27 varieties and breeding clones are collected in several German research institutes. Those collections include 9 collections from indigenous wild populations, 3 from crossing populations, 9 from open pollinated populations, 6 from crossing with H. rhamnoides subsp. mongolica clones (from Altai Mt. in Russia). Among those collections "Askola", "Dorana", "Frugana", "Hergo", "Leikora", and a pollination variety "Pollmix" have been cultivated in Germany and introduced to some other counties. Progress of Utilization of Genetic Resources of Hippophae In Other Countries Based on using H. rhamnoides subsp. rhamnoides, Finland, Sweden, Estonia, Latvia, Lithuania, Poland, Belarus and the west part of Russia have their own breeding programs although they introduced many Russian varieties for tests.

France, Italy, Switzerland, Southern Germany are using H. rhamnoides subsp. fluviatilis from Alps Mt. to breed their varieties. In the same time they are also testing some Russian and German varieties. Ukraine, Romania and Bulgaria selected some varieties from H.rhamnoides subsp.aucasica for tests.

Canada has selected a good variety " Indian Summer" from introduced H. rhamnoides subsp. rhamnoides. This variety has been cultivated in Canada and many exotic species and varieties are in tests.

Bolivia has planted the seedlings of H. rhamnoides subsp. sinensis in area of 75 hectare. These seedlings are reported growing well there. Chile introduced 3 German and 6 Russian varieties for test in 1994. The results of testing hown that the German varieties performed better than that of Russia. The suitable area for German varieties is on S 53°in Chile. Pakistan, India, Nepal mainly use their local species H. rhamnoides subsp turkestanica, H. salicifolia and H. tibetana to collect berries for producing products.

Prospect of Utilization of Genetic Resources of Hippophae. Potential value of wild species of Hippophae. As mentioned above, Hippophae is rich in diversity but only 4 subspecies are used in certain scale. The other 11 species and subspecies are very potential for selection and breeding. For example, H. salicifolia has the highest content of vitamin C (1400-1700 mg/100 g) and its plant has very few thorns; H.Tibetana. has large berries (40-50g/100 berries) and the highest seed oil content (18-19 %); H.neurocarpa and H. neurocarpa subsp. stellatopilosa are real oil seabuckthorn with 12-18% of pulp oil and 10-14 % of seed oil; H. rham. subsp. caucasica has also large berries with long peduncles.

Generalize all practical utilization of genetic resources of Hippophae, it can be seen that no one variety could be suitable for various environment in all counties that grow seabuckthorn. Each region or country should have their own varieties that adapt their weather and environment. Fortunately, the biodiversity of Hippophae provides a possibility to breed many kinds of varieties that could adapt many different countries all over the world.

Prospect of Utilization of Genetic Resources of Hippophae

It seems that the most valuable species at moment are H. rhamnoides subsp. mongolica and H. rhamnoides subsp. rhamnoides, H. rhamnoides subsp. sinensis, H. rhamnoides subsp. turkestanica. Based on those 4 subspecies, many good varieties have been bred out and they have been successfully cultivated in many countries. But these varieties are far not favorite due to their some disadvantages. Through various breeding methods these varieties could be improved further by using other species and subspecies of Hippophae. It is estimated that more than 20 countries have their own breeding programs on seabuckthorn.

Each country has its localization of genetic resources so it is needed to make an international cooperation on exchange of genetic resources of Hippophae. It is believed that the favourite varieties will be produced through wide international cooperation.

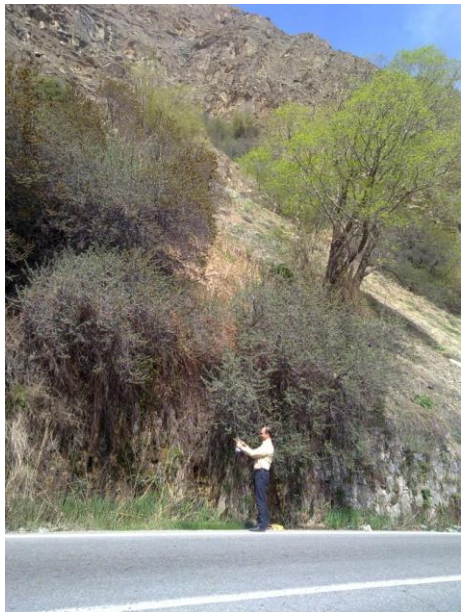

Fig1. Seabuckthorn in Iran, Alborz.

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