The updated Progress of Seabuckthorn Breeding in China

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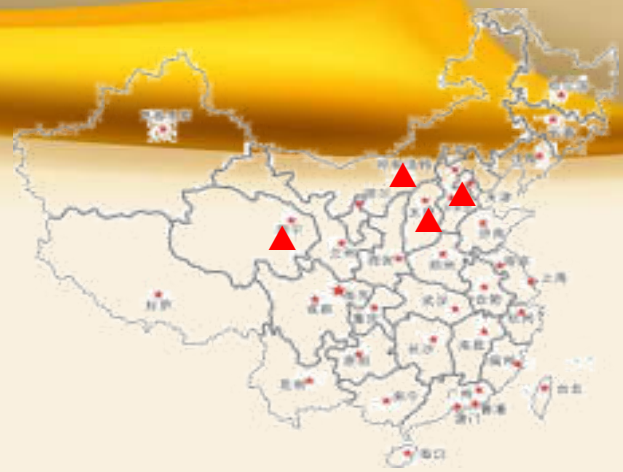
The seabuckthorn breeding achievements and activities in different stages in China

the first stage, 1985-2000: ***Provenances study and individuals selection and introduction***

the second stage, 2000-2012: ***Crossing breeding***

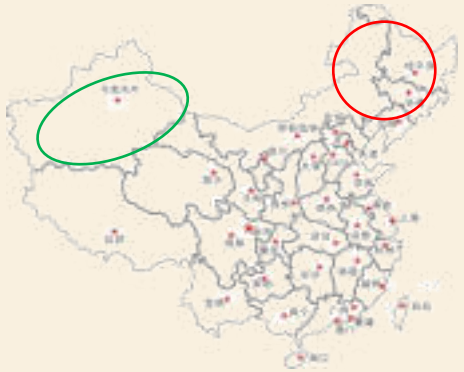
the third stage, 2012-2021(now): ***New introduction, crossing and Regional test***

1. the first stage, 1985-2000



1.1 Provenances study and individuals selection of *sinensis* in China

Begun in 1985, the Chinese Academy of Forestry organized to set up the cooperation study group on seabuckthorn resource (subspecies *sinensis*) and provenances nationally in China. The results showed that the main character varied closely related to the geographical latitude, longitude and altitude with the trend pattern from southwest to northeast. The fruit size is from small to large, the fruit yield from unstable to stable, the fruit flavor from sour to sweet, the Vc content from high to low, the ripening time is from later to early. The study showed the better provenance of *sinensis* in China are mainly from the north area of China, such as Kelan and Youyu in Shanxi province, Yu county and Zhuolu in Hebei province, Liangcheng and Chifeng in Inner Mongolia, etc. 8 provenancs and 8 female individuals and 2 male fine single plants were selected from different *sinensis* populations.



1.2 Superior varieties introduction and selection

From 1990-2000, over 10 individuals were selected from the introduced seed population, like ‘Liaofu No. 1 and No.2’, ‘Chuanxiu’, Lognjiang No1, No2, No3’, ‘Shenqiuhogn’ and so on.

2. the second stage, 2000-2012
Crossing breeding for special goals in China

different hybridy population

Why crossing?

- no farm（good）land for seabuckthorn cultivation
- introduced varieties are limited only in northeast area with more precipitation;
- heterosis is evident between *monogolica* and *sinensis*

From 2000, the China National Seabuckthorn Center has been organizing the study on the crossing breeding, and selected the excellent individuals from the hybrid populations which the females are good varieties introduced from Russia and Mongolia, the males are selected from the natural population of *sinensis*. In ten years (from 2000-2009), 12 leaf-use-types individuals and 10 eco-economy-types individuals were selected from different hybrid populations, which have a good performance both on fruit features and quality and adaptability to the testing eco-conditions.

2.1 Breeding for leaf-use-type's selection and utilization

Seabuckthorn leaves have three main usages: first, it is the raw materials for tea; second, flavonoids and other components can be extracted from it; third, it is good animal husbandry feed for livestocks.

in 2003 12 fine individuals were selected for **leaf-use-type, but** at present, only one individual passed the regional test, from north-east to far west of China and it performances well both on leaves production and on adaptation.

Zaxiongyou No. 1

Analysis of seabuckthorn species/subsp/selected individuals from different places （dried leaves）

	Species/subsp/selected individuals	Provenance		Flavonoids	Polyphenol	Polysaccharide	Alkaloids
Species and subsp.				%	%	%	%
1	subsp. *sinensis*	Qingyang，Gansu		5.86	6.22	13.83	0.85
2	subsp. *yunnanensis*	Linzhi, Tibet		10.77	6.88	21.24	0.63
3	subsp. *mongolica*	Qinghe, Xinjiang		5.64	6.84	17.56	1.22
4	subsp. *turkestanica*	Aketao, Xinjiang		5.10	2.765	9.615	1.00
5	subsp. *turkestanica*	Zhada, Tibet		5.92	4.485	15.12	0.68
6	*H. gyantsensis*	Cuona, Longzi, Qushui, Mozhugongka, Tibet		5.84	5.44	23.72	0.79
7	*H. salicifolia*	Cuona, Tibet		4.58	4.34	9.06	0.67
8	*H neurocarpa*	Menyuan, Qinghai		4.71	3.67	11.03	1.02
9	*H tibetana*	Plan, Mozhugongka, Tibet		6.0	2.61	15.47	0.14
10	Zaxiongyou NO. 1	Emin, Xinjiang		11.89 (Axel Waehling)			
	Varieties (individuals)		Fresh leaves production(kg/plant)	mg/100g			
11	Male population of subsp. *sinensis*	Ordos, Inner Mongolia	3.1	999			
12	Manhanshan pollinizer (Male parent））	Liangcheng, Inner Mongolia	4.6	1110			
13	Fengning pollinizer（ Male parent）	Ordos, Inner Mongolia	0.9				
14	Zaxiongyou NO. 1	Ordos, Inner Mongolia	11.5	1583			
15	Shenqiuhong	Emin, Xinjiang		8.32(Axel Waehling)			

2.2 Breeding for eco-economy-type’s utilization

From 2000 to 2009, China National Seabuckthorn Center had selected more than 10 individuals from hybridization population. Up to now, 5 varieties have passed regional tests with good performance in every tested places.

Fuza No.1
selected in Fuxin, Liaoning

Fuza No.3
selected in Fuxin, Liaoning

Fuza No.4
selected in Fuxin, Liaoning

the fruit size difference between *sinensis* and hybrid seabuckthorn

Zaciyou No.1
selected in Erdos, Inner Monogolia

Zaciyou No.10
selected in Erdos, Inner Monogolia

Zaciyou No.12
selected in Erdos, Inner Monogolia

Zaciyou No.54
selected in Erdos, Inner Monogolia

Fruit analysis for individuals in selected places

selected individuals / items	Zaciyou No.1	Zaciyou No.10	Zaciyou No.12	Zaciyou No.54	Fuza No.1	Fuza No.3	Fuza No.4	Note
Weight /100berreis (g)	41.2	35.8	30.6	30	40.37	34.13	37.66	
Yield/plant (kg)	4.4	5.2	5.0	15.2	5.87	4.594	5.9	
Vc (mg/100g)	117.0	313.0	277.5	81	80.4		81.0	In juice
β-carotene (mg/100g)	1.89	6.05	3.0	13.5	4.8	0.71	0.77	Fresh fruit
Total Flavonoids (mg/100g)				47.33	55.27	27.14	20.89	Fresh fruit
Total sugar (g/100g)	10.35	11.01	11.4	**15.0**	8.3	9.0	7.2	Fresh fruit
Organic acids (g/100g)	1.98	1.99	2.0	1.39	2.49	2.09	1.82	Fresh fruit
Fruit oil (%)	3.9	2.9	4.2		3.88	2.63	2.47	Fresh fruit
Seed oil (%)	9.1	9.4	5.7	8.71	9.4	10.62	10.09	
places	Erdos, Inner Mongolia				Liaoning province			

3. the third stage, 2012-2021
Breeding activities and achievements in recent years

3.1 The new varieties (selected materials) introduced from Russia (2012-2020)

At the end of 2013, 22 kinds of new selected fine material were introduced from Lisavenko Research Institute of Horticulture, Russia. In the spring of 2014, they were cultivated respectively to the places from northeast to far west

* - new test point from 2021

● - old test point from 2013

			
201304(dried content): weight of 100 berries 57~70g, whole fruit oil 23.5%， fruit meat oil 23.5%， seed oil 21.0%	flavonoids 129.40mg/100g， β -Carotene 40.32mg/100g ， VE 387.80mg/100g, 464.86mg/100g	201307(dried content): weight of 100 beans 53~80g, whole fruit oil 15 %， fruit meat oil 16.3%， seed oil 10.9%	flavonoids 134.42mg/100g， β -Carotene 34.7mg/100g， VE 291.61mg/100g, 730.05 mg/100g
			
201308		201309	

201310

201312

201313

201315

201319

201320

	Types	M/F	Serial number of introduced clones	Values
1	large fruit (11)	F	201302,-03,04,05,07,08,09,11,14,16,19	50-90g/100 berries
2	high production (12)	F	201301,-02,-04,-05,-07,-08,09,-12,-15,-16,-20,-22	3.75-9t/ha(250kg-600kg/Mu)
3	high oil (6)	F	201302,-13,-14,-15,-21,-22	Dried fruit oil 22-31%Seed oil 17-31%
4	high flavonoid (5)	F	201301,-08,-16,-17,-19	235-319mg/100g
5	high carotene (10)	F	201303,-04,-05,-10,-12,-14,-18,-20,-21,-22	28-65mg/100g
6	high quebrachitol (8)	F	201301,-07,09,-15,-18,-19,-20,-21	400-700mg/100g
7	dwarf form (6)	F	201305,09,-17,-18,-22	110-200cm
8	red fruit (6)	F	201304,-07,-12,-14,-16,-20,-22	
9	tea type (1)	M	201306	

The common features introduced seabuckthorn varieties are better adaptability, vigorous growth and high yield both fruits and leaves special in Heilongjiang and Xinjiang regions. Compared with the early introduced varieties and *sinensis*, the new introduced varieties and materials showed a significant economic values.

3.2 Regional test results for superior hybrid varieties (2012-2020)

5 hybrid varieties selected by our center (2000-2009) were tested at the same time with the cultivation of introduced varieties (materials), and be evaluated last year

Zaciyou No. 1
(to be named with Mengzhonghuang)

weight of 100 berries: 40.1±9.2g;

yield: 804±693kg/Mu

oil of dried fruit meat : 26.97±3.95%

seed oil: 10.16±2.26%

the flavonoids: 173.78±34.38mg/100g

the β -carotene: 24.29±3.55mg/100g,

Ve : 464.18±73.64mg/100g.

＊ Dried fruit as analysis matrix

Zaciyou No. 10
(to be named with Mengzhonghong)

＊ Dried fruit as analysis matrix

weight of 100 berries: 35.3±12.9g

yield: 524±422kg/Mu

oil of dried fruit meat : 16.01±5.87%

seed oil: 14.44±9.54%

the flavonoids: 167.01±37.22mg/100g

the β -carotene: 56.58±10.15mg/100g

Ve :403.95±44.14mg/100g

Zaciyou No. 12 (to be named with Dalate)

weight of 100 berries: 31.8±8.6g;

yield: 572±194kg/Mu

oil of dried fruit meat : 20.01±7.18%

seed oil: 14.69±10.88%

the flavonoids: 245.68±122.93mg/100g

the β -carotene: 37.28±25.97mg/100g,

Ve :500.38±166.66mg/100g.

*** Dried fruit as analysis matrix**

Zaciyou No. 54
(to be named with Ezhognxian)

weight of 100 berries: 31.3±4.5g;

yield: 386±289kg/Mu

oil of dried fruit meat : 14.97±5.14%

seed oil: 18.11±14.68%

the flavonoids: 235.955±37.34mg/100g

the β -carotene: 31.06±15.17mg/100g,

Ve :517.7±326.47mg/100g.

3.3 Study on new superior individuals selection in natureal seabuckthorn populations and new cross breeding with different parents (2019-Now)

● **The first**, new superior individuals selection in populations of Chinese *sinensis* (Shanxi, Guansu, Qinhai, Liaoning, Inner mongolia and so on), *monogolica* (Xinjiang), and *turkestanica* (Xinjiang and Tibet) which in the natural seabuckthorn forest

▲ Selected individuals with larger fruit size, high yield, red colour, less thorn, vigorous growth.

▲ At least 10 excellent single plants can be selected every year

Qinhai Province

Guansu Province

Shanxi Province

Natural forestry of *subsp. sinensis*

Liaoning Province

Natural seabuckthorn forestry of *subsp. turkestanica* in Zhada, Tibet

Hard wood cutting for selected individuals in next spring

- **The second**, new cross breeding has begun for 2 years, taken different varieties including the introduced Russian seabuckthorn as the female parent, and Chinese *sinensis* as the male parent, some hybrid seeds and seedlings has been gotten already.

Crossing

Hybrid seed

Hybrid seedlings

Thanks !

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