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Studies on the Distribution of Wild Soybean (*Glycine soja*) in China

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Abstract: Investigations showed that wild soybean grew in a vast area from about 24°N (middle-northern Guangdong Province and Guangxi Zhuang Autonomous Regions) in the south to 53°N (Heilongjiang River valley) in the northern China and that there was no wild soybean to find in three regions Xinjiang, Qinghai and Hainan. The area of 30 to 45°N was a diverse region of the wild soybean in China, where the wild soybean has an extensive distribution, large populations and rich types. The highest point of wild soybean distribution in China was 2670 m, locating at 27°30'N, Ninglang County, Yunnan Province. Two critical meteorological indexes related temperature and humidity was key factors to influence the distribution of wild soybean in China: no wild soybeans were found in the areas having a monthly mean temperature of below 20°C in the warmest months or lasting seven months and over bf more than 20°C monthly mean temperature and having an annual precipitation of less than 300 mm during a year.

Key words: Wild soybean, *Glycine sofa*, wild soybean germplasm resources, wild soybean geographic distribution

Introduction

Wild soybean (*Glycine sofa*) is a herbaceous leguminous plant, relative ancestor of cultivated soybean (*G. max*) and mainly distributed in the temperate-zones of Eastern Asia, the Far East of Russia, the Korean Peninsula and Japan and especially in China, the homeland of cultivated soybean. The wild soybean contains higher protein than the cultivated soybean (Li *et al.*, 1986), with the highest recorded content as high as 55.7% (Li, 1990) and its seed oil is rich in linolenic acid (Xu *et al.*, 1993). Today, wild soybean is being considered as an important genetic resources and has been extensively collected from various areas and utilized in soybean breeding programs in China. So far, about 6500 wild soybean accessions including various evolutionary forms have been preserved in the gene bank, which are about 90% of all germplasm collected in the world, a number is increasing day by day. These precious wild soybean resources have unpredictable potential for exploitation of the high protein and disease-resistant varieties as well some other useful gene sources. Wild soybean has also been responsible for widening the genetic basis of the cultivated soybeans that are being imperiled by the genetic narrowing caused by the repeated use of a few excellent parents.

Wild soybean can reciprocally intercross with cultivated soybean without any reproductive isolation producing fertile progenies and its genes are easily transferred into cultivated soybean. Presently, many bridge lines of cultivars x wild lines were successfully created as new soybean germplasm in China (Li, 1996).

Some researchers reported their studies of wild soybean in morphology and taxonomy (Zhuang *et al.*, 1996), temperature-light ecophene (Xu and Lu, 1988), evolution and origin (Tozuka *et al.*, 1998), chemical compositions (Li *et al.*, 1986), breeding and genetic variation (Fujita *et al.*, 1997). Although many researches were conducted on wild soybean germplasm resources in China, most of them were confined to regionally or locally describe the resources and lacked full view of the situation of the whole wild soybean resources in China. There was an unrevealed question as to what critical factors decisively influence the survival and distribution limits of wild soybean in China.

The objective of this paper is an attempt to find out the ecological distribution and current situation of the wild soybean resources in China and to determine the reasons whether wild soybeans can grow or not in an area. So, this is an attempt to provide more useful information on collecting resources and researching soybean's origin and evolution.

Materials and Methods

The materials used were all taken from the germplasm accessions preserved in the National Gene Bank of Chinese Academy of Agricultural Sciences. These germplasm accessions were collected across the areas delineated by 23°57'-52°55'N and 97°29'-134°E. They were representative of the general situation of Chinese wild soybean resources.

The photoperiod response test: Total 300 accessions were sampled separately from 25, 30, 35, 40, 45, 50°N (30-70 accessions per every other five degrees) and were sown together in the experimental fields of the Institute of Crop Germplasm Resources (ICGR), Chinese Academy of Agricultural Sciences (CAAS; Beijing, 39°48'N) in 1994. The flowering and growing period were observed and recorded. The protein and fat contents were analyzed in the ICGR, the Institute of Oil Crop of the CAAS, Jilin Academy of Agricultural Sciences and Nanjing Agricultural University. The mean protein and fat percentage contents were calculated in every one latitudinal zone from 23 to 53°N for their geographic distribution.

Field survey collection: In the past 20 years several large-scale surveys and collecting activities were carried out and the small-scale surveys had not discontinued. The survey's limits were contoured by 18°N (Hainan Province) to 53°24' N (Heilongjiang Province) and 82°43'E (the Xinjiang Uygur Autonomous Region) to 135°E (Northeast). The surveyed areas represented over 1100 counties (or the same class administrative areas) of the whole country, involving all province-class administrative areas of China (not including Hong Kong and Taiwan). The latitude (°N), longitude (°E) and altitude of each sample (accession) were determined and the microhabitats and flowering time were recorded in detail. Meteorological data was quoted from the meteorological records of the local meteorological observatories.

Results

Geographical distribution of wild soybean in China: The most of the country had wild soybean distribution except three regions, the Xinjiang Uygur Autonomous Region and Qinghai Province and southernmost Hainan Province of the Northwestern (Table 1). The distribution sketch map of the Wild soybean germplasm resources collected in China is shown in Fig. 1. The distribution areas of the wild soybean were mainly limited to the non-arid temperate areas of China, delimited by around 24-53°N and 97-135°E, e.g. from the North of the Tropic of Cancer in Southern China (middle-northern Guangdong and middle Guangxi) to the Heilongjiang River valley of Helongjiang Province in the north and from the southeast of Tibet (near Myanmar) in the west to Wushuli River of Helongjiang Province in the east. The distribution frequency (density) of the populations increased gradually from both north *and* south towards the central parts, especially in the areas of 30 to 45°N where there were bigger populations and richer types. Commonly, the wild soybeans varied between 30-300 cm in height and bore from 30-3000 pods per plant.

The longitudinal distribution of the wild soybean was greatly affected by topographical and geomorphological factors. The Eastern half of China is contiguous to the Pacific Ocean and its Western half has great mountains and elevations (the Inner Mongolian Highland, the Qilian Mountains, the Qinghai-Tibet Plateau). The wild soybean distribution started at the western elevations edges, increased eastward and was most abundant with big populations in the eastern areas, for example, in the Northeast Plain, the Yangtze River and Huaihe River valleys and the middle-lower tributary areas of the Yellow River. in the eastern areas, some individual populations had not been seriously interfered with human beings and domestic animals. No wild soybeans were found in the deep northwestern areas (the Xinjiang Uygur Autonomous Region and Qinghai Province) and southernmost Hainan Province.

The Southernmost edge of wild soybean distribution seemed to be a transit zone of the temperate and tropical plants because wild rice of tropical species could appear there. Low temperature and short frost-free period frequently affected the northernmost edge of the wild soybean distribution. For example, wild soybean often appeared scattered in some years but not so in other years and always, stunted itself under low temperature and arid conditions.

The highest point of the wild soybean distribution in China was 3670 m, locating at 27°30'N, Ninglang County, Yunnan Province. The northern highest point was only 312 m, at 48°30'N, Beian City, Heilongjiang Province. The altitude of wild soybean distribution was also influenced by latitude. Geographically, the highest altitude of wild soybean distribution would present an increase from high to low latitudes as the latitudinal zones decreased by every five degrees of latitude (Table 1). In the high latitudes of over 45°N, the highest point was only about 300 m; in the 40-45°N sub-high latitudes, about 1000 m; in the mid-high 35-40°N zone, 1500 m; in the middle 30-35°N zone, 1700 m; in the mid-low latitudes of about 25-30°N, as high as more than 2000 m.

Growth period: Maturity and flowering period are two important genetic characteristics of ecological differentiation and also most basic characteristics for regional wild soybean germplasm resources. The growth period of Chinese wild soybeans was about 120-200 days in provenance from south to north.

Test observations showed that the accessions from different latitudes planted in Beijing had significant changes in their growth period (Table 2). The period from sowing to seedling emergence (phase I) was related to temperature and soil humidity but not to the latitude of provenance. Accessions from 50°N began flowering at mean 30 days after emergence; accessions from 30°N were not able to produce mature seeds and those from 25°N were not able to flower before the early frost in Beijing. The period from emergence to flowering (phase II) was closely related to the latitude of provenance, with a highly significantly negative correlation. The period from flowering to maturity (phase III) was non significantly related to the latitude of provenance. These results showed that the growth period of wild soybean was mainly related to phaseII. The high latitudes had short frost-free periods and long photoperiods and the wild soybeans were of extremely early maturity type. The maturity period (phase II + III) of wild soybeans tended to become late with the lowering of latitudes. The maturity period of these tested accessions had an average of 76 days for 50°N, 104 days for 45°N, 153 days for 40°N, 164 days for 35°N. The trend of maturity differentiation from north to south could be divided as such: extremely-early mature, early, intermediate, intermediate-late, late, extremely-late.

Flowering photoperiod: The photoperiod varied regularly with the latitude and seasons in various areas. Table 3 shows that there was light duration from 14 h 30 min to 17 h 26min on the day of the Summer Solstice (about Jan 22) in 25-50°N, with a difference of 3 hours between south and north.

The time of the first flowering of wild soybean tended to become early from low to high latitudes. In the high 50°N, wild soybeans begun flowering in early July when the photoperiod was 17 h 5 min, while in the low 25°N wild soybeans began flowering in early September when the photoperiod was 13 h 15 min, with a difference of 3 h 50 min between both high and low latitudes (Table 3). Almost all wild soybeans began flowering at about 20-80 days, when the photoperiod was shortening, after the photoperiod peak (the day of Summer Solstice) passed and the first flowering time at every other five degrees of latitude differed by about 10 to 20 days.

The flowering time test in Beijing showed that the southern accessions of Beijing (about 40°N) began flowering later than in their own provenance, while the northern accessions of Beijing began flowering earlier than in their own provenance (Table 3).

Several morphological types in the collection

Seed size: Seed size is an important character in subgenus sofa. The smallest weight of 100-seeds was 0.5 gram and the biggest was over 5 gram. The variation in the seed size resulted from natural evolution or accidental hybridization between both cultivated and wild soybeans. The wild soybeans in China can be divided into three types according to the weight/100-seeds: wild typal, semi-wild type!I and semi-wild type III . The type I category has been thought to be a typical wild soybean; the typell and type III categories have been deemed to be evolutionary types that had originated from both sources of the autogenesis and the natural crossing between wild and cultivated soybeans. About 77.82% of the collection was for wild typel, 12.28% for semi-wild type 9.9% for semi-wild type III (Table 4).

Seed-coat: The seed-coat colours in the wild soybean collection had as many colours as those seen in the cultivated soybeans. There were four basic colours, which were of 86.66% black, 7.07% brown, 3.0% green and 3.2% yellow. The seeds of most wild soybeans had a layer of bloom over their surfaces. A small number of wild soybeans had no bloom, of which the seed-coats of quite a few accessions were bright.

Flower and hair colours: In the collection, purple flower was the main type, about 9.72% and there were also a 6.28% minority which belonged to white type. The white flower type was found only in China up till now.

The hair colours of the wild soybeans had only two colours, as appeared in cultivated soybeans, brown and grey.

Leaf shape: The wild soybean collection had six kinds of leaf shape, ovoid, elliptic, lanceolate, long-elliptic, long-ovoid and narrow-strip.

Above mentioned characters seemed to display some correlations with protein and oil content (Table 4). These character types as black seeds, bloom geed-coat, brown hair and purple flower all constituted the majority in the collection and showed little seeds, high protein content and low oil content. But those types that belong to grey hair, white flower, yellow or green seeds, non-bloom seed-coat were inclined to be high weight of 100-seeds, low protein and high oil. In leaves, nearly broad-leaves like ovoid, elliptic and long-elliptic leaves tended to be high weight of 100-seeds and high oil.

Commonly, long inflorescence, green cotyledon, white flower and yellow or green seed-coat have been seen in cultivated soybeans, however, they were also found in Chinese wild soybeans. A long-narrow leaf was only visible in the wild soybean.

Protein and fat: The protein content of 5929 accessions showed a 45.42% average value, with significant differences among latitude zones. We found two extreme cases of protein content among the accessions, a protein content as high as 55.7% and a content as low as 29.0%.

There was an obviously negative correlation between seed size and protein content and a positive correlation between seed size and oil (Table 4). Table 4 shows that the protein content of wild typel was higher than that of semi-wild typell, which in turn was higher than that of semi-wild type III. These results suggested the decrease of protein content or the increase of oil content was an evolutionary trait in the subgenus sop. The protein content distribution in latitudes was characterized by double peaks, 46.7-47.4% for 29-32°N (the Yangtze River valleys) and 46.5-47.6% for 42-48°N (the Northeast China), respectively.

Regionally, the highest protein content was situated in Anhui and Jilin Provinces, 47.9% and 47.8%, respectively; the lowest protein content was located in Ningxia Hui Autonomous Region, 38.6%.The fat content of the accessions showed a 10.6% average value, varying from 4.4 to 20.2%. There was a significantly negative correlation between the protein and fat (Table 4).

The effects of temperature on the distribudon of wild soybean: The wild soybean distribution was extended from around 23°N in the south to 53°N in the north of China. Over a period of time, not finding wild soybean beyond the distribution bounds in both south and north was imputed to low temperature for north of nearly 53°N and excessive high temperature for the south of nearly 24°N. But the question was what temperature conditions, in other words, what critical meteorological conditions allowed the growth and distribution of wild soybean? This was an important and unresolved puzzle. Through a long'period survey across most areas of China, it was made clear that an effective temperature level and the number of continuous days in that effective temperature level were decisive factors contributing to the survival and distribution of wild soybean under natural conditions.

Some representative investigation sites in the critical boundary areas of wild soybean distribution were listed in Table 5. No wild soybeans were found in the areas where there was no one month of which monthly mean temperature was 20°C and more in the warmest months and where more than 20°C monthly mean temperature was held for seven months and over during a year. In the areas of 30 to 45°N where 3-4 months was at 20°C or more monthly mean temperature, wild soybean was abundantly distributed with large populations, rich types and diversity. Few wild soybeans were found in very high altitudes because in these areas, monthly mean temperature of the warmest months was below 20°C during a year.

Under natural conditions, all wild soybeans will germinate in spring, begin flowering in summer to early autumn and mature before frost in any area, irrespective of latitude and geomorphological conditions. If wild soybeans flowered and matured too early or too late, they could not effectively survive the winter because of the seed germinating earlier or bearing immature seeds before overwintering.

Effects of precipitation on the distribution of wild soybean: The wild soybean is hygrophilous, luxuriant in a humid environment and a relatively high level of soil moisture, though it has a high adaptability to environments. Its distribution was closely related to precipitation. Northwestern China has great mountains and elevations with less precipitation as well as is susceptible to seasonal storms. While there were appropriate temperature conditions present, serious shortages of water was the main factor hindering from wild soybeans extending further westwardly. In the areas having an annual precipitation of less than 300 mm wild soybeans would not grow. As shown in Table 5, Xilinhaote, Erlianhaote, Dunhuang and Jiuquan regions (counties or cities), had an annual precipitation of less than 300 mm and this resulted in no wild soybeans. .fining County had no one month of 20˚C or more monthly mean temperature and this caused no wild soybean being found, despite it having the required annual precipitation of more than 300 mm.

Table 1: Distribution situation of wild soybean in various regions in China

Regions	Situation of distribution	Highest altitude Cm) of the wild soybean Collected in different regions	Degrees of latitude (N) of the wild soybean collected at the highest altitude
Heilongjiang Province	+	312	48°14'
Jilin Province	+	1017	41°25'
Liaoning Province	+	421	41°23'
Beijing City	+	1000	40°28'
Hebei Province	+	910	39°50'
the Inner Mongolian Antonomous Region	+	1309	39°34'
Shanxi Province	+	1500	39°34'
Tianjin City	+	below 100	
the Ningxia Hui Autonomous Region	+	1400	38°32'
Shandong Province	+	305	36°11'
Ganshu Province	+	1700	34°59'
Henan Province	+	750	33°47'
Shaanxi Province	+	1450	32°50'
Sichuan Province	+	1400	32°21'
Hubei Province	+	1600	31°52'
Jiangehu Province	+	below 100	
Shanghai City	+	below 100	
Anhui Province	+	1250	30°32'
Hunan Province	+	1350	29°28'
Chongqing City	+	1906	29°09'
the Tibet Autonomous Region	+	1870	28°39'
Zhejiang Province	+	350	27°32'
Yunnan Province	+	2670	27°18'
Guizhuo Province	+	1260	27°03'
Fujian Provinace	+	950	26°54'
Jiangxi Province	+	230	26°51'
the Guangxi Zhuang Autonomous Region	+	880	25°00'
Guangdong Province	+	260	24°47'
the Xinjiang Uygur Autonomous Region	-		
Qinghai Province	-		
Hainan Province	-		

Table 2: Growth period of wild soybeans from different latitudinal zones in Beijing (39°48' N; 1994)

Degree of latitude (N)	No. of samples	Mean days from sowing to emergence	Mean days from emergence to Initial flowering	Mean days from emergence to mature
50°	30	10	30	76
46°	50	7	35	104
40°	70	8	88	153
35°	60	8	92	164
30°	60	10	131	Not maturing before frost
25°	30	8	not flowering before frost	

Table 3: Flowering time and photoperiod of wild soybeans of different latitudinal zones

Latitude Degree (N)	Light duration on the summer Solstice (22 Jun)	At provenance		At Beijing	
		Initial flowering time	Photoperiod at initial flowering	Initial flowering time	Photoperiod at initial flowering
25°	14h 30min	first ten days in Sep	13h 15min	second ten daysin Sep	13h 35min
30°	15h 00min	third ten days in Aug	14h 10min	first ten days in Sep	14h 00min
35°	15h 40min	first ten days in Aug	14h 52min	second ten days in Aug	15h 00min
40°	16h 15min	third ten days in Jul	15h 32min	third ten days in Jul	15h 32min
45°	17h 03min	second ten days in Jul	16h 30min	second ten days in Jun	16h 10min
50°	17h 30min	first ten days in Jul	17h 05min	first ten days in Jul	16h 05min

Table 4: A comparison of weight of 100-seeds, mean protein and fat contents among various character types

Character types		No. of accessions	%	100 seed weight	Protein content	Fat content
Seed	wt./100-seeds<2.5 g	4567	77.82		45.66±3.25	9.21±1.69
Size	wt.1100-seeds<2.5-5.0 g	721	12.28		45.03±3.00	12.76±2.18
	wt./100-seeds>5 g	581	9.90		44.10±2.96	14.95±1.92
Hair	grey	347	5.86	4.60±2.15	44.79±2.92	13.26±2.82
	brown	5577	94.14	2.10±1.46	45.39±3.20	10.01±2.44
Flower	white	372	6.28	4.70±1.95	44.40±2.95	13.73±2.43
	purple	5553	93.72	2.08±1.53	45.50±3.24	9.98±2.48
Seed	black	5138	86.66	1.88±1.25	45.52±3.06	9.73±2.21
coat	brown	419	7.07	4.80±2.24	45.10±3.78	12.67±2.85
color	green	178	3.00	5.05±2.23	44.90±3.20	14.14±2.60
	yellow	194	3.27	5.24±1.76	44.20±2.99	14.38±2.20
Seed	bloom	5181	87.47	1.85±1.17	45.55±3.23	9.71±2.23
bloom	no-bloom	576	9.72	4.85±2.19	44.85±3.23	13.40±2.74
	no-bloom with bright	166	2.80	5.49±1.78	44.17±2.67	14.89±1.79
	ovoid	1844	31.12	2.60±2.05	45.88±3.24	10.51±2.85
	elliptic	1696	28.62	2.31±1.63	45.36±3.12	10.46±2.41
Leaf	lanceolate	1098	18.53	1.87±1.33	44.99±3.08	9.78±2.57
Shape	long-elliptic	712	12.05	2.07±1.48	43.83±2.74	10.16±2.48
	long-ovoid	516	8.71	1.87±1.19	47.13±3.35	9.47±2.55
	Narrow-strip	80	1.01	1.50±0.59	45.69±2.48	9.33±1.64

Table 5: Situation of wild soybean distribution in critical boundary areas

	Areas	Degrees of latitude N	Monthly mean temperature in the warmest month in a year (°C)	No. of months of 20°C and over (monthly mean temperature) in a year	Annual precipitation (mm)	Situation of wild soybean distribution
Mohe	Helongjiang	53°29'	18.4	0	401.0	-
Huma	Helongjiang	51°43'	20.2	1	456.6	+
Aershan	Jilin	47°37'	16.5	0	425.1	-
Suoluen	Jilin	46°37'	20.1	1	446.0	+
Xilianhaoe	Inner Mongolian	43°57'	20.8	1	269.3	-
Erlianhaote	Inner Mongolian	43°39'	23.0	3	131.6	-
Jining	Inner Mongolian	40°58'	19.2	0	365.4	-
Huhehaote	Inner Mongolian	40°49'	21.8	3	414.7	+
Dunhuang	Guansu	40°08'	21.4	3	29.2	-Jiuquan
	Guansu	39°46'	24.9	3	82.1	-
Tianshui	Guansu	34°35'	22.5	3	580.1	+
Guyuan	Guansu	36°00'	18.8	0	518.3	-
Pinliang	Guansu	35°05'	21.0	1	574.0	+
Chayu	Tibet	28°39'	18.8	0	764.7	-
Xiachayu	Tibet	28°30'	21.0	1	999.6	+
Pucheng	Fujian	27°53'	27.3	5	1760.5	+
Quanzhou	Guangxi	25°55'	27.6	5	1457.8	+
Liouzhou	Guangxi	24°48'	28.9	7	1455.5	-
Shaoguan	Guangdong	24°40'	29.2	7	1451.6	-
Uanxian	Guan don	24°40'	28.1	6	1512.0	+

Meteorological data are mean values of recent decade! data

Discussion

Importance of wild soybean resources: The genetic narrowing of commercial varieties has become a universal problem or a global scale and the opening-up of the genetic bases of crops has been a pressing question faced by people. The collecting and protection of crop germplasm resources, particularly of wild related plants of crops, has increasingly been taken seriously by people. The rich wild soybean resources in China are a natural gene bank which contains many varied genes or genotypes for soybean breeding and genetic studies. These wild soybean resources have been expected in protein exploitation and in widening the genetic basis of the cultivated soybean. Further evaluation and utilization of these resources will be an important area of future study in China.

Successful breeding practice proved the utilizable potential of wild soybean. Now, about two hundred bridge-germplasm lines with various excellent features have been created through the crossing recombinations between the cultivated and wild soybeans in China and all were added into the gene bank as new germplasm resources. Some of them have also been offered to breeders to be sued as breeding parents or directly used in agricultural production.

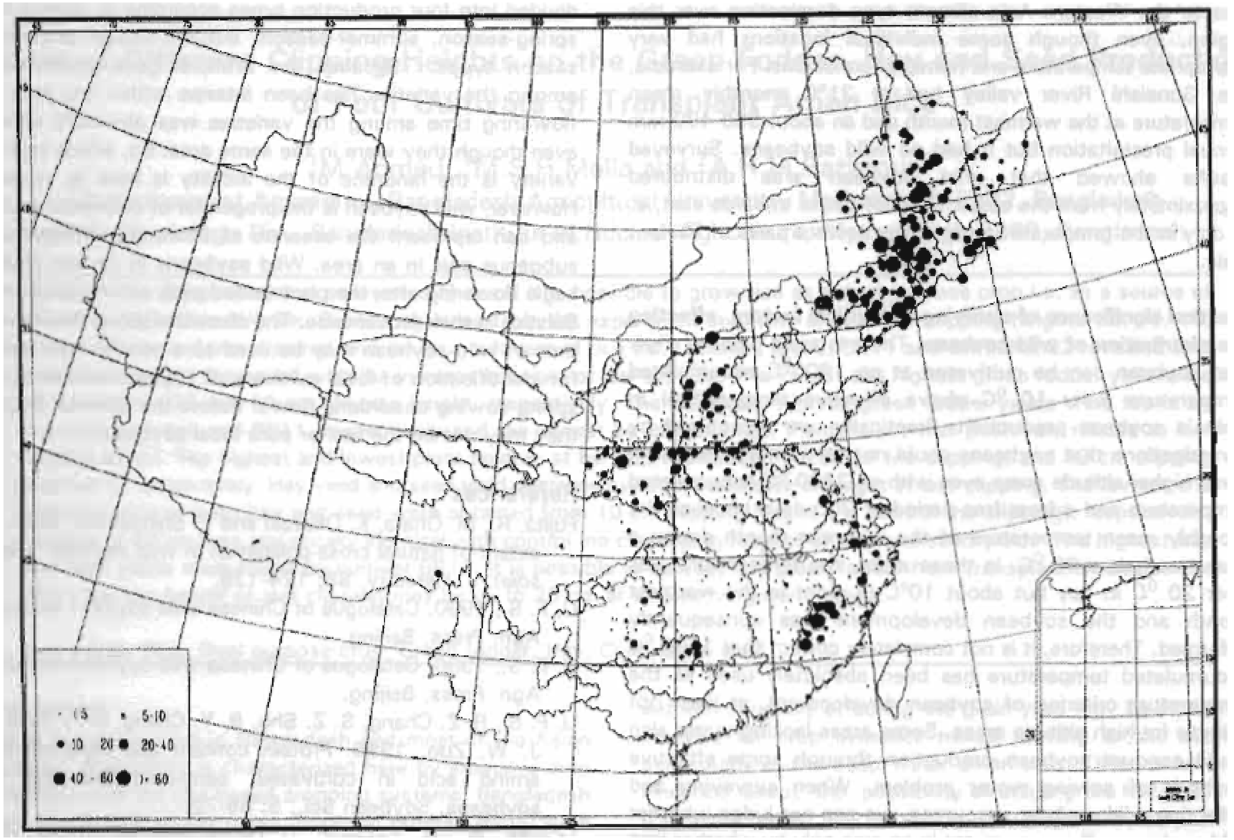

Fig. 1: The distribution sketch map of wild soybean germplasm resources collected in various areas in China. The collection area was from 23° 57' to 52° 20'N and from 97° 29' to 134° E. The distribution limits of wild soybean were delineated by around 24-52° 55'N and 97-135° E. •: Number of accessions collected

In the Chinese wild soybean collection, you can find some rare or extreme characters. The highest protein content, the lowest protein content and the lowest fat content and the highest linolenic acid in subgenus *soja* in China were all found in wild soybeans. Several rare types like long inflorescence, green cotyledon, grey hair, white flower and yellow or green seed-coat commonly seen in cultivated soybeans had been thought to be peculiar to cultivated soybeans before these types were found in Chinese wild soybeans. The discovery of these characters helped the study into the origination of soybean characters. A long-narrow leaf was only associated with the wild soybean and not in cultivated soybeans.

Nearly all wild soybean had a yellow cotyledon in nature. A green cotyledon type, having typical wild traits such as twining stem, black seed with bloom and low weight of 100-seeds, was found in China and only one accession was collected. It was the sole accession of all wild soybean germplasm collected in the world. This discovery was very important and most valuable. Soybeans have two cotyledon colours, yellow and green and green cotyledon has been considered to originate from the mutation of yellow cotyledon in the process of soybean differentiation from wild soybean or after domestication of cultivated soybeans. The discovery of wild soybean with green cotyledon at least offered the second possibility that the green cotyledon had occurred before the origin of cultivated soybeans from wild soybean, in other words, the green cotyledon of cultivated soybeans had come direct from green cotyledon wild soybeans.

We have thought that not only green cotyledon but also nearly most of the morphological characters that appeared in cultivated soybeans were inherited directly from wild soybean because any character in soybeans could be found in wild soybean. Moreover, wild soybean can also supply rare genes for new characters. For example, we had obtained a pentaphyllous line from a cross of both normal cultivated and wild soybean accessions.

Wild soybean distribution only in the eastern parts of Eastern Asia: Wild soybean has been known to grow in China, the Far East of Russia, the Korean Peninsula and Japan. However, China has a vast domain but only its eastern parts had wild soybean. Most areas of western China are plateaus with high altitude, low temperature or less precipitation. So, few wild soybeans were found in the west, for example, in the western Inner Mongolia, northwestern Ganshu Province, Qinghai Province and almost the whole Tibet (in southeast Tibet, only Chayu County near Myanmar had a bit of wild soybean distribution). Hainan Province Lies southernmost of China, belonging to subtropical climate type and it had no wild soybean distribution.

For a long time past whether Xinjiang region that is located in westernmost China, bordering on Western Asia, has wild soybean has been not confirmed. Recent a survey of ours verified that this area had not wild soybeans, which was likely due to the Western Asia climate type dominating over this region, even though some individual locations had very appropriate temperature and humidity conditions. For example, the Gunaishi River valley had a 21°C monthly mean temperature at the warmest month and an about 350-400 mm annual precipitation but it had no wild soybeans. Surveyed results showed that wild soybean was distributed approximately from the eastern hat! of China towards east, e.g., only in the temperate-zones of the eastern parts of Eastern Asia.

Practical significance of clarifying the critical factors affecting the distribution of wild soybean: There is a old point of view that soybean can be cultivated at an 1600°C accumulated temperature lover 10°C above effective temperature) in China's soybean production. Practically, we recognized by investigations that soybeans could not be normally grown in some higher attitude areas even with an 2200°C accumulated temperature and a frost-free period of 200 days because the monthly mean temperature of the warmest month during a year was below 20°C. In those areas, the temperature was over 20°C in day but about 10°C in night in the warmest month and the soybean development was consequently deformed. Therefore, it is not completely correct that 1600°C accumulated temperature has been absolutely used as the temperature criterion of soybean development, at least not suitable for high altitude areas. Some areas lacking water also could conduct soybean production through some effective methods of solving water problem. When surveying and collecting wild soybean resources, we can not judge whether wild soybean will appear or not in an area only by whether that area has the existence of cultivated soybeans or by accumulated temperature.
Some papers characterized the ecological features of the ecotypes of wild soybean in response to temperature and light and did not probe into the affect of main meteorological factors on the wild soybean distribution. Our investigation studies made it clear that mainly two critical meteorological indexes influenced the wild soybean distribution. The study results of ours may have some practical significance to scientists who are leaving for a collecting activity. They can determine their possible collection areas according to the meteorological indexes.

Flowering photoperiod: In China cultivated soybeans were divided into four production types according to sowing time, spring-season, summer-season, autumn-season and winter-season types. Because the artificial gene recombination among the varieties has been intense within any type, the flowering time among the varieties was obviously different even though they were in the same area. So, which type or a variety is the iandrace of the locality is hard to ascertain. However, wild soybean is the progenitor of cultivated soybean and can represent the essence of flowering photoperiod of subgenus *sofa* in an area. Wild soybeans in various areas aN begin flowering after the photoperiod peak around the Summer Solstice in their provenance. The characteristic of the flowering time of wild soybean may be used as a considerable method for identification of local cultivars: if soybean cultivars under spring sowing conditions flower before the Summer Solstice, they may not be the real or pure local soybeans.

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