BREEDING AND TESTING NEW SOYBEAN VARIETIES

Collaboration between Agroscope IPV, the Russian Far East Plant Protection Institute (DVNIIZR) and the Bioengineering Centre of the Russian Academy of Sciences

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Introduction

Agroscope IPV has developed methods of hybridization that use the available range of genetic variability. Bulk and pedigree methods of advancing the breeding material allow to create adapted new varieties of soybean. Through this project, component experimentation and testing of new soybean varieties from Switzerland and the Russian Federation is carried out, drawing on the Swiss and Russian experience and the genetic resources available in both countries.

The activities under the UNECE Grant have been carried out by Agroscope IPV in cooperation with the Russian Far East Plant Protection Institute (DVNIIZR) and the Bioengineering Centre of the Russian Academy of Sciences.

The objective of this collaboration for 2014 was to set one common trial with 6 Swiss lines from 2009 exchange, 6 Swiss lines from 2014 exchange and 6 Russian lines from 2014. 2014 was also used for seed improvement, first field evaluations and to strengthen the present cooperation.

Genetic material

Germplasm exchange 2009

	Russian genetics			Swiss genetics	
1	Venera	col.10806	1	Paradis	CH20731
2	Glycine soja	col.10807	2	Gallec	CH21507
3	Amurskaja 259	col.10808	3	Toliman	CH21511
4	Xait-Xuan-Do	col.10809	4	Vanessa	CH21679
5	Ai-Xuaei	col.10810	5	Aveline	CH21715
6	Tu-Lu-Gun	col.10811	6	Bagera	CH21855
			7	Protéix	CH21912
			8	Obélia	CH22002
			9	Aisela	CH21886
			10	Swiss line	CH21997
			11	Swiss line	CH21914
			12	Swiss line	CH21908

Results of this first exchange have already been transferred.

Germplasm exchange 2014

	Russian genetics			Swiss genetics	
1	Primorskaya 13	col.10945	1	Amandine	CH22138
2	Primorskaya 81	col.10944	2	Obélix	CH22172
3	Venera	col.10806	3	Amarok	CH22174
4	HODSON	col.10926	4		CH22177
5	Chinese 1	col.10927	5	Tourmaline	CH22161
6	Chinese 2	col.10928	6		CH22232

Remarks : Swiss named varieties are protected and are freely available for crosses, but are not allowed to be transmitted, nor multiplied, commercialized or reselected. Swiss breeding lines are not allowed to be used as parents for hybridization, nor to be transmitted to third parties without prior written permission of the owner. The breeding lines or named varieties proposed by the Russian Far East Institute are checked by the donor for their availability for hybridization and the status (free/not free), as well as the owner is systematically indicated close to the name. All of the breeding lines or varieties exchanged remain property of the donator or of the indicated owner.

Germplasm exchange 2014 from Russian Genebank

Some interesting lines coming from Vavilov Institute obtained through Dmitry Dorokhov have been observed in Changins in 2014. The first one on the list in the table below is a *Glycine soja* type.

Unfortunately, accessions numbers 2 and 5-7 didn't germinate. Only one plant of numbers 2 and 3 was able to go to maturity. *Glycine soja* number 1 (see picture below) set a lot of dark little brown pods and allows us to harvest a lot of seeds.

	Vavilov Institute		Remarks
1	N-KP-1-01-03	10933	*G. soja*
2	AMURSKAJA JELTAJA	10934	1 plant
3	USURIISKAJA 483	10935	1 plant
4	SZIN-E-DOU	10936	0 plant
5	DA-LI-HUAN-JN	10937	0 plant
6	ER-HUAN-JN	10938	0 plant
7	DU-HAI-MI-SZA-UZ	10939	0 plant

Fields observations – quality analysis

Hereunder a list of different analysis and scoring usually used for soybean trials. It is of course not possible to realise all of them during one observation season. This table below have been established in 2014 as part of the protocol for comparative trials in Switzerland and in the Russian Far East.

N°	Notations	Scale	Meaning	Remarks / when
1	Plant emergence	1-9	1 = good / 5 = admissible / 9 = bad	Stage VC
2	Ability to germinate in cold soils	1-9	1 = good / 5 = admissible / 9 = bad	if soil and cold conditions
3	Plants density	1-9	1 = good / 5 = admissible / 9 = bad	Stage V1-V2
4	Blooming	days		Days beetween planting and R1
5	Cold tolerance during blooming	1-9	1 = good / 5 = admissible / 9 = bad	Stage R8-9 if a cold stress has been observed
6	Early lodging	1-9	1 = good / 5 = admissible / 9 = bad	Stage R3-R4
7	*Pseudomonas syringae*	1-9	1 = good / 5 = admissible / 9 = bad	When symptoms occur
8	Shattering	1-9	1 = good / 5 = admissible / 9 = bad	When symptoms occur
9	*Peronospora manshurica*	1-9	1 = good / 5 = admissible / 9 = bad	When symptoms occur
10	Other diseases	1-9	1 = good / 5 = admissible / 9 = bad	When symptoms occur (*Septoria, Cercospora*…)
11	Maturity lodging	1-9	1 = good / 5 = admissible / 9 = bad	Stage R9
12	Maturity	days		Days beetween planting and Stage R9
13	Heat units	℃*day	threshold 6℃	Beetween planting a nd Stage R9
14	General appearance	1-9	1 = good / 5 = admissible / 9 = bad	Stage R9
15	Plant height	[cm]		Stage R9, entire plant height
16	TKW (thousand kernels weight)	[gr/1000]		p.e Marvin or Contador
17	Yield	[kg/are]		On the row in 2014, more accurate in 2015
18	Harvest humidity	[%]		On whole grain (p.e DikeyJohn, Graingage HarvestMaster)
19	Specific weight	[kg/100liters]		On whole grain (p.e DikeyJohn, HarvestMaster)
20	Grain appearance	1-5	1 = good / 3 = bad	Bleached kernels, green seeds….
21	Proteins	[%MS]		NIRS / per raw
22	Oil	[%MS]		NIRS / per raw
23	Plant characteristics		Flowers, leaves, hairs	P=purple / W=white / T=tan / G=grey / Ov=ovate / Ln=lanceolate
24	Grain characteristics		Grain and hilum	Y=yellow / Gr=grey / Bl=black / Br=brown

Technical data

For this first year of collaboration and due to the small amount of seeds, Russian lines were sown in 3 lines of 1.5 meters long. Usual rhizobacterias strain G4 mixed with clay in a microgranulator and a standard objective in our climatic area of 55 plants per square meter were used. The trial was implanted in Prangins near Nyon (46°24'4.49"N / 6°15'32.48"E).

Preemergence weed control was achieved with Frontier X2 (65 % Dimethenamid-P (720 g/l)) and Bolero (40 g/l Imazamox). As post-emergence weed control, Basagran (87% Bentazone) and Bolero were used mixed (stage V2). 2014 was a cold and wet year, no irrigation was needed.

Results data

Scoring data

Scales and units are detailed in the previous table on page 3 (protocol).

Names	Plant emergence	Plants density	Early lodging	Maturity lodging	Maturity	Heat units (threshold 6℃)	General appearance	Virus
Scales / units	1-9	1-9	1-9	1-9	days	℃*day	1-9	1-9
Primorskaya 81	1	1	3	9	170	1815.7	9	5
Primorskaya 13	1	1	1	2	154	1678.2	4	9
Venera	1	1	6	9	175	1834.6	9	3
HODSON	1	1	5	7	126	1404.4	6	3
CHINESE 1	1	1	5	7	128	1428.4	7	3
CHINESE 2	1	1	2	4	155	1687.9	8	4
Gallec (check)	1	1	2	5	124	1378	4	1

Seed quality analysis and scoring

Scales, letters for plant and grains characteristics and units are also detailed in the table below.

Names	TKW (thousand kernels weight)	Grain appearance	Proteins	Oil	Plant and grain characteristics	Remarks
Scales / units	[gr/1000]	1-3	[%DM]	[%DM]		
Primorskaya 81	221.6	2	44.4	17.0	YLBr - WGOv	Mildew +++,
Primorskaya 13	246.7	2	43.2	16.8	YLBr - W/PGLn	Flowers segregation
Venera	237.5	3	45.4	15.9	YLBr/Ybr - PTOv	Some BrBr
HODSON	236.0	2	43.3	17.5	PTOv - YBr	
CHINESE 1	239.0	2	42.8	17.7	PTOv- YBr	
CHINESE 2	282.4	1	43.0	17.0	YY - PGLn/Ov	Leaves segregation, mixes with W/tan
Gallec (check)	221.5	1	42.8	18.3	YY	

Results and discussions

General scoring data

First of all, seed quality was correct. For all the Russians lines, plant emergence and density were good.

In July, a first work of scoring was done for the early lodging parameter. Venera, Hodson and Chinese 1 were quite bad with a level of 5 or more. Early lodging can severely affect yield and seed quality due to poor photosynthesis, unfavourable micro climate in the crop and higher disease pressure.

Maturity lodging is an agronomic important criteria. Plants should have the capacity to lift up as the leaves are dropping off. Primoskaya 13 and Chinese 2 were good enough for this parameter. On the other hand, P81, Hodson and Chinese 1 were poor in comparison with the check Gallec.

Some viruses have been observed. Symptoms are those of the soybean mosaic virus (SMV) but the causal virus has not been confirmed by analysis. The origin of the infection was seedborne, as the symptoms appeared quite early in the season, at the earliest vegetative stages of developpment. No lines seemed to be completely virus free. Primorskaya 81 is severely affected. In contrast, the check Gallec was all right.

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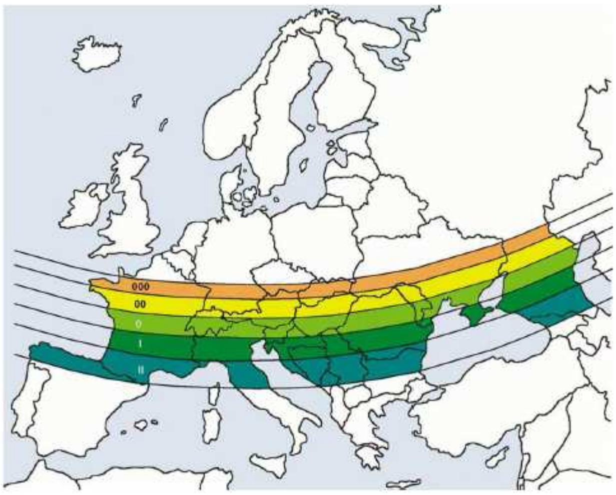
Earliness / Maturity groups

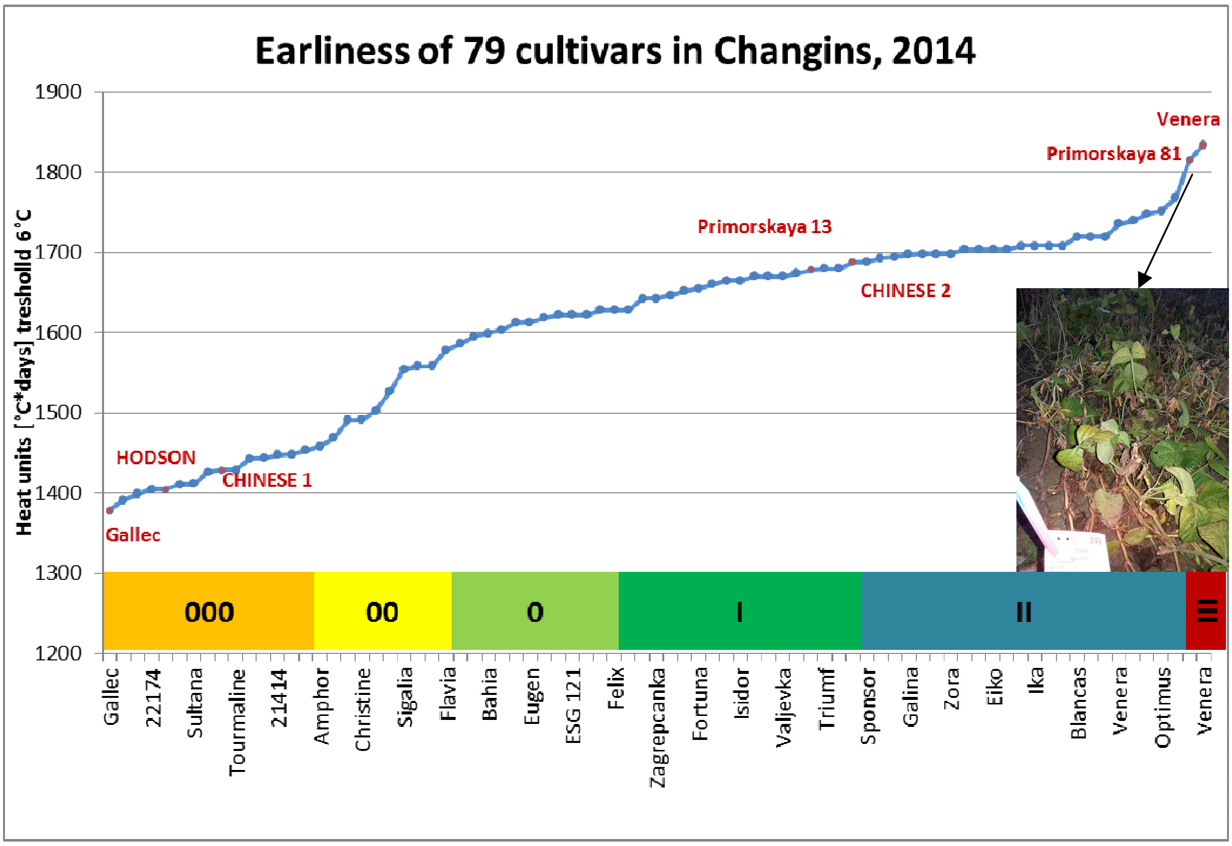


From its origins, soybean requires high amount of cumulated temperature. Earliness is strongly influenced by many genes. Out of the thirteen known maturity groups, only the two first ones (MG 000 and MG 00) are able regularly ripen under the Swiss climate. Breeders retain the varieties having the best balance concerning vegetation period and yield, and calculate for each genotype the productivity per day of vegetation or per heat unit in the specific growing region.

Maturity groups 000 and 00 are the most suitable for Switzerland, as they only need 1400-1550 degree days (with a threshold of 6°C) to mature. MG I and II are adapted to South France or Italy, MG II in Southern Europe, but water availability could be then a problem.

The presented simplified maps for Europe for soy maturity groups is not accurate but give an idea of the needs concerning the cumulated temperature and latitude.

The graph below indicates the heat units required by 79 cultivars originating from different European countries and belonging to another international trial (data to be published), as well as the tested Russian genotypes. The different maturity groups shown on the graph are derived from information provided by the breeders of these varieties. Colours used for the graph and the maps above are identical for each maturity group. The picture below shows P81 in late October near the harvest with still a lot of green leaves and green stems.



We found only 2 Russian lines to be adapted to our latitude : Hodson and Chinese 2. Other provided genotypes are too late and probably belong to MG I-III. Gallec, our check variety is a widely-adopted cultivar in Switzerland, having an important commercial success since early 2000. It is well suitable for the Swiss specific climatic conditions.

Grain quality data and plants/grains characteristics

Yield hasn't been recorded due to the small plots dispositive.

Primorskaya 81 and Venera obtained the most important protein levels, respectively 44.4% and 45.4%.With their light brown hilum characteristics they could be well suitable for human food market and have to be tested for this purpose.

Seeds of Venera are unfortunately segregating with brow hilum seeds and some completely brown seeds. Important contamination with *Peronospora* and other grain diseases have been observed on Primorskaya 81, and can be due to the too late maturing of MG II-III in Changins, under cool and wet fall climate. Leaves shape segregations have also been observed in Chinese 2 and some admixture of plants with tan pubescence and white flowers. Flower segregations on P13 have also been reported.

P13 and Chinese 2 seeds had a high TKW, which is also a positive trait for varieties used for food. Bleached kernels have been observed on all the cultivars at the exception of Chinese 2 and Gallec. Bleaching is genetically controlled, but can also be induced by some stress as viruses, other diseases, drought or cold stress. Anthocyanins are water-soluble and have a negative impact on the colour of soyfoods.

Conclusions and further prospects

The different cultivars tested present an interesting genetic variability. Concerning maturity, only two of them were adapted to the Swiss cool climate, with low cumulated temperatures. The contamination of part of the accessions with viruses did not allow us to fulfil all of the observations we planned to do.

Unfortunately, the germination of the lines from the Genbank of the Vavilov Institute was very poor and the concerned material could not be observed.

We propose to continue the observation in 2015, including the 2 earliest lines of the set. We propose a two-location trial for yield assessment and its different components. Different quality analysis could then be conducted on the harvested seed. Viruses could be a problem, even if these 2 earliest lines seemed to be less concerned. A new source of clean seed, if existing, should be used.

We also promote a broader exchange of early modern material, with the aim of realizing a common program of hybridizations between Swiss and Russian lines. Sanitary quality should be checked before.

Acknowledgment

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