

SUGAR BEET VARIETY TESTING IN EUROPE

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ABSTRACT

Variety testing in almost all EU-countries is done in two stages. The first part is called a study on the DUS (distinctness, uniformity and stability) of the varieties. For this, field and or greenhouse trials are carried out in which several parameters are measured such as root yield, sugar content and the contents of sodium, potassium and amino nitrogen. In some cases also special parameters are taken into account: colour of hypocotyls, length of leaf petioles, relation between length and width of the leaves, crown heights and others. The latter parameters vary between countries. If these parameters prove to be different from other existing varieties, uniform within the variety and stable during the two years that DUS tests normally last; a breeder's product is regarded as a new variety. At that stage the variety is given a name by the breeder and is entered on the national and or European list of varieties. In most countries a governmental body is responsible for this stage of variety testing. For the nomenclature an agreement is needed from the authorities of the other European countries. In most cases the same genetics get the same name over all countries. The costs of this stage of variety testing in most countries is charged to breeders.

The second stage of variety testing is the study of the cultural value of the varieties. In most cases the period of testing of this stage lasts three years. In some countries both stages are combined into two years of testing of DUS and cultural value and a third year of cultural value testing only. In other countries both stages are done in succession so that a complete cycle lasts five years. For cultural value again root yield, sugar content, and the contents of sodium, potassium and amino nitrogen are measured. In some countries also soil tare, completion of ground cover and susceptibility to diseases are measured separately. If this is claimed, special tests can be made to determine the rate of resistance to pests of diseases or variety tests are carried out in presence of the relevant pest or disease.

The number of trials, number of replications, plot size, drilling, harvesting and sampling method can vary from country to country. Some examples will be presented. In almost all countries the results are expressed relative to the existing varieties. If new varieties prove to be better than these existing varieties they are admitted to a recommended list. The criteria for a decision on being better than the existing varieties can also vary between countries. Also for this some examples will be presented.

In most countries also the second stage of variety testing is a responsibility of a governmental body. Discussions are on going as to whether this stage should be the responsibility of the market parties involved: breeders, sugar industry and

beet growers. In most countries they are paying for the tests on the cultural value of varieties.

Examples of recommended lists for different countries will be shown.

ABRÉGÉ - RECHERCHES VARIÉTALES AVEC BETTERAVES SUCRIÈRES EN EUROPE

Dans la plupart des pays européens, les recherches variétales se déroulent en deux parties. La première partie consiste à étudier la distinctibilité, l'homogénéité et la stabilité (DHS) des variétés. Dans ce but des essais sont mis en place, en plein champ ou en serre, afin de rassembler des données concernant le rendement racine, la teneur en sucre et les taux de sodium, de potassium et d'azote α -aminé. D'autres paramètres spécifiques tels que la couleur des hypocotyles, la longueur des pétioles, la relation entre la longueur et la largeur des feuilles, la hauteur du collet etcetera peuvent également être pris en compte. Ces paramètres peuvent varier d'un pays à l'autre. S'il est établi que ces paramètres diffèrent de ceux des autres variétés existantes, qu'ils sont uniformes au sein de la variété et s'ils sont stables pendant deux ans l'étude sera poursuivie; le produit du sélectionneur est considéré comme étant une variété nouvelle. Le sélectionneur donne un nom à la variété qui est admise sur la liste nationale et/ou européenne. Dans la plupart des pays une organisation gouvernementale est responsable pour cette partie de la recherche variétale. L'approbation des autres gouvernements européens est requise en ce qui concerne la nomenclature.

Dans la plupart des cas une variété reçoit le même nom dans les autres pays. A ce stade de la recherche les coûts sont supportés par les sélectionneurs.

La seconde partie de la recherche concerne l'analyse de la valeur culturelle des variétés. Généralement cette partie couvre trois ans. Dans certains pays la recherche combine les deux parties: deux ans de recherche DHS et analyse de la valeur culturelle, une troisième année consacrée uniquement à l'analyse de la valeur culturelle. Dans d'autres pays les deux parties sont réalisées successivement et le cycle complet couvre cinq ans. Les recherches culturales concernent également le rendement racine, la teneur en sucre et les taux de sodium, de potassium et d'azote α -aminé. Certains pays font aussi entrer en ligne de compte la tare terre, le moment de la fermeture des rangs et la sensibilité aux maladies. Des tests spécifiques peuvent également être effectués pour déterminer la résistance aux maladies et aux ravageurs et des recherches peuvent être effectuées dans des champs infestés.

Le nombre d'essais et de répétitions, la largeur des parcelles, le semis, la récolte et l'échantillonnage varient selon les pays. Quelques exemples sont présentés. Dans la plupart des pays les résultats sont exprimés par rapport aux variétés enregistrées. Si des nouvelles variétés s'avèrent être supérieures à des variétés enregistrées, elle sont admises sur la liste recommandée. Les critères qui doivent établir si une variété est supérieure à une autre peuvent également différer entre les pays. Quelques exemples seront présentés.

Ici également c'est en général une organisation gouvernementale qui est responsable pour cette seconde partie des recherches variétales. A l'heure

actuelle des discussions sont menées dans le but de mettre cette responsabilité entre les mains des parties concernées: les sélectionneurs, l'industrie sucrière et les planteurs. Dans la plupart des pays ce sont eux qui financent cette partie de la recherche.

Quelques exemples des listes recommandées sont présentés.

KURFASSUNG - ZUCKERRÜBENSORTENPRÜFUNG IN EUROPA

In den meisten europäischen Ländern wird die Sortenprüfung in zwei Stufen durchgeführt. Der erste Teil, auch die Registerprüfung genannt, enthält eine Untersuchung der Unterscheidbarkeit, der Homogenität und der Beständigkeit. Dafür werden Feld- und/oder Gewächshausversuche durchgeführt in denen Eigenschaften, wie Rübenertrag, Zuckergehalt und Gehalte an Natrium, Kalium und Amino Stickstoff gemessen. In einige Fällen werden auch Sondermerkmale, wie Farbe des Hypocotyls, Länge des Blattstieles, das Verhältnis zwischen Blattlänge und Blattbreite, Kopfhöhe und so weiter gemessen. Die Merkmalen variieren zwischen Ländern. Wenn diese Merkmalen/ Eigenschaften sich von bisher zugelassene Sorten unterscheiden und in beiden Versuchsjahren homogen und beständig sind, wird das Produkt eines Züchters als eine neue Sorte anerkannt. Der Züchter gibt der Sorte dann einen Namen und sie wird zur national- und/oder europäischen Liste zugelassen. In den meisten Ländern ist eine staatliche Behörde verantwortlich für diese Stufe der Sortenprüfung. Für den Namen ist eine Anerkennung der anderen europäischen Länder notwendig. Überwiegend bekommt die gleiche Genetik in alle Ländern den gleichen Namen. Die Kosten dieser Stufe der Sortenprüfung werden in meisten Länder von der Züchter getragen.

Die zweite Stufe der Sortenprüfung ist die Untersuchung des landeskulturellen Wertes. Meistens dauert diese Stufe drei Jahre. In einige Länder werden die beide Stufen zusammengefügt in zwei Jahren von Registerprüfung und Prüfung des landeskulturellen Wert und einem dritten Jahr nur für den landeskulturellen Wert. In anderen Ländern werden beide Stufen hinter einander durchgeführt so dass ein kompletter Zyklus fünf Jahre dauert. Auch für den landeskulturellen Wert werden Rübenertrag, Zuckergehalt und die Gehalte an Natrium, Kalium und Amino Stickstoff gemessen. In einige Länder werden auch der Erdanhang, der Zeitpunkt des Reihenverschlusses und die Anfälligkeit für Krankheiten bestimmt. Spezialversuche können zur Bestimmung der Resistenz gegen Krankheiten durchgeführt werden oder die Sortenversuche werden auf Feldern in Anwesenheit dieser Krankheiten angelegt.

Die Anzahl der Versuche und der Wiederholungen, die Parzellengröße, die Aussaat, die Methode der Ernte und Probenahme können sich zwischen den Ländern unterscheiden. Einige Beispiele werden vorgestellt. In den meisten Ländern werden die Ergebnisse als Zahlen relativ zu schon zugelassenen Sorten dargestellt. Wenn eine neue Sorte besser ist als die schon zugelassenen Sorten, wird sie zur empfehlenden Liste zugelassen. Die Kriterien zur Entscheidung besser zu sein als zugelassene Sorten variieren ebenfalls zwischen Ländern. Auch hierzu werden einige Beispiele dargestellt.

In den meisten Ländern ist auch die zweite Stufe der Sortenprüfung in der Verantwortlichkeit einer staatlichen Behörde. Es wird diskutiert, diese Stufe in die Verantwortlichkeit der Marktteilnehmer zu übergeben: Züchter, Zuckerindustrie und Rübenanbauer. In den meisten Ländern bezahlen diese auch für die Prüfung des landeskulturellen Wertes der Sorten.

Einige Beispiele von empfehlenden Listen werden gezeigt.

INTRODUCTION

For the presentation of varieties, in most European countries two lists are used. One list is used for registration purposes; the other one for the recommendation of varieties to growers and sugar industry. For the admission to both lists different criteria are used. Trials are carried out to measure the characteristics of the varieties. In this presentation a summary will be presented of a questionnaire which was held in 2000 among European institutions on variety testing and on characteristics and criteria, which are valid for the admission of varieties to both lists.

1.- LIST OF VARIETIES

In the first stage it needs to be studied whether a variety is distinct from other varieties, whether a variety is uniform within the population and over some years and whether it is stable over the years. This study is called **DUS**. The characteristics of the varieties which are taken into account vary from country to country. Some examples which are used are: degree of ploidy, resistances, colour of the hypocotyl, length of petioles, shape and size of the leaves, crown height and yield characteristics: root yield, sugar content and contents of sodium, potassium and amino nitrogen. If these characteristics differ enough from already listed varieties, a breeders product is regarded as a new variety. In that case the variety is listed on the **national list** and as a consequence of that also on the **EU-list**. At that moment the variety is also given a name, to be approved by the member countries. The seed for DUS is provided by the breeders.

Additional studies will follow the DUS studies to obtain data on the performance of the varieties concerning yield and quality. These studies are carried out to obtain information on the **cultural value** of the varieties. If a variety proves to be an improvement or to be at least equal to already listed varieties, it is admitted to the **recommended list**. This list is valid only for one country or even for a part of a country. The rate of improvement, in comparison with earlier listed varieties can vary between countries.

2.- SEED TREATMENTS AND SAMPLING

In all EU countries the seed treatment applied in the trials is the same as the most important treatment sold to the growers.

As long as no commercial seed is available seeds for the trials are sent in by the breeders. As soon as a variety is commercialised, seed is sampled from

commercial lots in most cases at sugar industry, prior to seed distribution. The seed is sampled by the institutes, responsible for the trials, by sugar industry or by certified organisations.

3.- STUDIES FOR LISTS

Studies on germination, germs and cotyledons for DUS mostly are made in greenhouses. The other characteristics are studied in field trials. In some countries (Table 3), field trials are drilled at narrow distances and the crop is thinned out to obtain a regular stand. In other countries the trials are drilled to a stand of 80,000 to 100,000 plants per hectare. For some countries, table 1 shows information on the field trials for DUS.

From table 1 it can be seen that in most countries the DUS study takes two years. After DUS the varieties which can be recognized as new, are continued in the trials for cultural value for another two years. In some countries field trials are used for both DUS and cultural value from the first year onwards. In those cases, the total cycle of studies for both lists lasts mostly three years. In some countries DUS of specific resistances like cercospora and nematode is tested on separate trials, while in other cases it is done on trials without any disease or on trials with only rhizomania. The latter is the case if cercospora and nematode are combined with rhizomania resistance. Table 2 shows information on trials on cultural value.

Table 1. Number of trials drilled and harvested (if different between brackets) and duration of testing for DUS testing in some EU countries ¹⁾ (status 2000).

	B	D	DK	F	GR	NL	TR	S	UK
<i>number of trials:</i>									
varieties without resistance:									
year 1	6	14	3	7	6	3	5	5	6 (4)
year 2	6	16	3	7	6	3	5	5	6 (4)
later years	6						5	5	6 (4)
with rhizomania resistance	4	14		7		3	5		3
with cercospora resistance	3	4					4		
with nematode resistance		4		6 (5)					
<i>duration (years)</i>	3	2	2	2	2	2	1-2	2-3	2

¹⁾ For the different countries in this and the following tables the abbreviations mean: B = Belgium, CH = Switzerland, CZ = Czech Republic, D = Germany, DK = Denmark, ES = Spain, F = France, FIN = Finland, GR = Greece, I = Italy, IRL = Republic of Ireland, NL = Netherlands, TR = Turkey, S = Sweden and UK = United Kingdom (England).

Table 2. Number of trials drilled and harvested (if different between brackets) duration of testing for cultural value in some EU countries (status 2000).

	B	CH	CZ	D	DK	ES	F	FIN	GR	I	IRL	NL	TR	S	UK
number of trials: without															
resistance:															
year 1	4	8	12-14	25	7	8-10	8-13	6	7	2-3	4	4	5	5	9 (6)
year 2	6	8	12-14	25	7	8-10	8-13	6	7	2-3	6	4	5	5	17 (14)
later years	6	8	12-14	25	7	8-10	8-13	3			6	4	5	5	17 (14)
with rhizomania	4	7	3-5	14			8		4	7		7	5		
with cercospora			3-5	4			5		3	9		2	4		
with nematodes	3											2		4-6	
with rhizoctonia				1		3	7			14	1	1			3
for bolting															
duration (years)	3	3	3	2-5	3	2		2-3	3	2	4	3	1	3	3

In table 2, duration of testing is inclusive DUS for B, IRL and NL. It is apparent that there is a big difference in the number of trials between the different countries. This is mainly due to the differences in growing conditions between regions within the countries.

Table 3. Some aspects of the trial techniques used in some EU countries (status 2000).

part 1	B	CH	D	DK	F (DUS)	F (cult.)	GR	I	IRL	NL	S	TR	UK
nr of replications	5(4)	4	4	6	4-5	4	6	6	6	4	4-6	4-6	4-6
plot length (m)	6-7	10	8	10	6-10	8	8	7	6	13.5	10-12	10	9
plot width (m)	2.7	1.5	1.35	3	1.35	1.35-1.5	2	1.35	1.68	3	2.46	1.2-1.35	1.5
final distance in row	18.5-20	25	18-20	18-20	18-20	18	20		22	18.5	18.2	22-25	>15
singling	no	yes	yes	no	yes	no	yes		no	no	no	yes	no
rows drilled	6	3	3	4	3	3	4	3	3	6	4	3	3
rows harvested	4 ¹⁾	3	3	2	3	3	2	3	3	6	2	3	3
weight total (sub/plot) ²⁾	yes	yes	yes	yes	yes	yes	yes		yes	yes	yes	yes	yes
quality total (sub/plot)	yes	yes	yes	yes	yes	yes	yes		yes	no	yes	yes	yes
nr (sub)samples	n.r. ³⁾	3		2	2	2	2		n.r.	3	1	n.r.	n.r.
weight samples (kg)	n.r.	± 30		± 100		80-100	± 30		n.r.	± 25	n.r.	n.r.	n.r.
top correction	if req.	yes	no	yes	yes	yes	yes		yes	yes	yes	yes	yes

¹⁾ In Belgium the system has been changed since 2000. Now only the centre four rows of a six row plot are harvested.
²⁾ In the case not all rows are harvested the answer is yes if the harvested part is weighed completely.
³⁾ n.r. = not relevant.

4.- TRIAL TECHNIQUES

In table 3 some aspects of the trial technique is presented.

From table 3 it can be concluded that most countries use a three row trial system. Denmark and Sweden are using a four row system from which the centre two rows are harvested. Belgium changed in 2001 from a fully six row system to six row system with harvesting the centre four rows. Only the Netherlands is using a six row system for weighing and subsampling for quality assessment. The main reason to harvested centre rows of plots only or to use a six row system is to minimize the influence of neighbouring plots [Büchse, 2002].

5.- ADMITTANCE CRITERIA FOR LISTING

There are great differences in criteria between countries. Full details for admittance criteria for the national and for the recommended list is given by Wevers (2002). Also the criteria for continuation of varieties to the next year of testing is listed there. In most countries varieties will proceed to the next year and final admittance to the recommended list if the results are competitive with the varieties already listed. The exact criteria will differ from country to country, but generally it means competitive in sugar yield or a calculated growers income, sometimes with special attention to sugar content.

Removal from the recommended list will occur if the breeder withdraws the variety, if the variety is not sold any more, or if the variety is outclassed by new varieties.

6.- RECOMMENDED LIST

In appendix I an example is given of the recommended list of 2003 with varieties without resistances and in appendix II with varieties with resistances from the Netherlands. The relative figures in these appendices are calculated based on the A and N varieties from the list of the previous year. The character N in front of the variety names means that the variety is new on the list. Mainly based on growers income afterwards every year a decision is taken on the category in which this variety will be placed: A for a general recommendation or B for a restricted one. The latter can mean restricted in terms of its performance as well as restricted in terms of acreage e.g. in the case of additional resistance. Then the recommendation is restricted to fields where infestation is expected.

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APPENDIX I

in general high figures mean a positive score for the criteria, except for dirt tare, K+Na and	score	relative figures								
	1	crown height 2	dirt tare 3	K+Na 4	α -amino N 5	sugar content 6	extracta- bility 7	root yield 8	sugar yield 9	growers income 10
A - Blenheim	8	104	103	102	101	99	100	103	102	102
A - Santana	8	99	106	99	96	99	100	103	101	101
A - Humber	8	97	100	99	96	100	100	100	100	100
A - Helsinki	7	102	94	102	107	101	100	99	100	100
A - Coloradoro	7,5	92	96	98	94	103	101	94	97	99
B - Assist	7,5	102	100	101	99	99	100	101	100	99
B - Bronco	6	104	100	99	107	99	100	100	99	99
B - Winsor	7,5	89	99	96	91	105	101	90	95	98
N - Rosetta	5	86	97	91	98	101	101	102	103	105
N - Philippa	4,5	84	105	92	98	99	100	106	105	105
N - Cinderella	5,5	88	114	94	96	98	100	105	103	102
N - Narvik	7,5	95	98	97	88	102	101	97	99	101
varieties with rhizomania resistance (average of all varieties tested)										
average	5,5	89	92	92	93	102	101	101	103	105

APPENDIX II

in general high figures mean a positive score for the criteria, except for dirt tare, K+Na and α -amino N	score		relative figures							
	earliness of canopy closing	crown height	dirt	K+Na	α -amino N	sugar content	extracta	root yield	sugar yield	growers income
			tare					-bility		
1	2	3	4	5	6	7	8	9	10	
A - Aligator	7	102	98	94	100	100	100	103	104	104
A - Dorena	7,5	89	112	105	106	98	99	106	104	102
A - Pasadena	7,5	106	90	97	99	98	100	105	103	102
A - Scorpion	7,5	93	102	96	101	100	100	100	100	100
A - Santesse	7,5	107	88	102	108	100	100	101	100	100
A - Rosaly	7,5	119	91	104	102	96	99	106	102	100
B - Trinidad	7	96	106	98	103	102	100	97	99	99
B - Lolita	8	109	109	93	84	101	101	97	98	99
B - Lenora	7	94	115	95	93	97	100	103	101	99
B - Cyntia	8	89	98	104	102	105	100	91	95	97
B - Toledo	7,5	95	93	112	103	104	100	91	95	96
N - Rosabelle	7	103	92	95	95	99	100	106	105	105
N - Charne	7	102	90	93	101	100	100	103	103	104
N - Pursan	7	109	90	100	92	99	100	106	104	104
N - Tornado	7	103	99	98	100	100	100	104	104	104
N - Miranda	5,5	91	108	99	117	101	100	102	103	103
varieties with resistance to rhizomania and rhizoctonia (tested in presence of rhizomania only)										
B - Nagano	6,5	152	59	101	89	98	100	95	93	93
B - Laetitia	8,5	108	109	115	98	97	99	96	93	90
N - Magnolia	8	111	107	115	98	97	99	99	97	94
N - Heracles	7,5	103	91	108	108	105	100	87	91	93
varieties with resistance to rhizomania and beet cyst nematodes (tested in presence of rhizomania only)										
B - Paulina	5	92	99	131	140	97	97	97	94	89
N - Agnella	5	88	106	125	121	97	98	96	93	89
varieties with resistance to rhizomania and cercospora (tested in presence of rhizomania only)										
B - Crestor	8,5	112	90	98	97	100	100	95	95	96