Current status of the CGN *Linum* collection

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Introduction

The *Linum* collection was established long before the Second World War by the Department of Plant Breeding (IVP) of the Agricultural University of Wageningen. Later it became a working collection of the former Foundation for Plant Breeding (SVP) at Wageningen and was used in flax breeding research programmes from 1948 until 1990. The *Linum* germplasm was used mainly to provide resistance to flax scorch (*Pythium megalacanthum),* fusarium wilt (*Fusarium oxysporum* f.sp. *lini)* and rust *(Melampsora lini).* Material from the collection was also used for the improvement of fibre content.

The collection was adopted by CGN in 1995 following encouragement by a group of four private Dutch breeding companies which wanted to see this valuable collection properly maintained and stored under optimal conditions. In 1996 cooperation began between the breeding companies and CGN.

Composition of the collection

Type of material

The collection includes 974 accessions and is divided in material of fibre flax, linseed, intermediate flax and wild species (Table 1). The collection consists predominantly of cultivated material of the species *Linum usitatissimum* and includes landraces, cultivars and research material (Table 1).

There are several old landraces in the collection, e.g. 'Fries landras' (NLD, 1816), 'Crete' (TUR, 1914), 'Bombay' (IND, 1917) and 'Soddo' (ETH, 1914). The date of origin of several other landraces is not known. Furthermore, several cultivars developed early last century, often from old landraces, are included in the collection, e.g. 'Blenda' (NLD, 1926), 'Frontier' (USA, 1898), 'Pioneer' (GBR, 1921) and 'Ottawa White Flower' (CAN, 1913). Many accessions described as research material are found in the collection. The information on this material is limited: the origin as well as the properties for which the material (particularly research lines) was selected are often not known. All the research material was developed more than 20 years ago.

The collection also includes 15 accessions of 7 different wild species: *L. bienne, L. marginale, L. austriacum* subsp. *euxinum, L. perenne* subsp. *anglicum, L. grandiflorum, L. decumbens* and *L. monriseo* (this species is probably a type of linseed).

Table 1. Population types included in the CGN *Linum* collection

Population type	Fibre flax	Linseed	Intermediate flax	Other	Total
Landraces	27	17			44
Cultivars	165	117	6		288
Research lines	230	240			470
Unknown	80	76	1		157
Wild				15	15
Total	**502**	**450**	**7**	**15**	**974**

Origin of the accessions

Much of the collection is of European origin but accessions from the USA, Canada, Australia, Turkey, Japan and several North African countries are also included in the collection.

Table 2. Origin of *Linum usitatissimum* accessions in the CGN collection

Origin	No. of countries	No. of accessions			
		Fibre flax	Linseed	Intermediate flax	Total
Benelux	2	55	4	1	60
UK/Ireland	2	35		2	37
Central Europe	5	41	15		56
Eastern Europe	4	43	16	1	60
Nordic countries	6	28	6		34
Mediterranean countries	5	11	9		20
Total Europe	24	213	50	4	267
North America	2	89	48	3	140
South America	5	19	76		95
Total Americas	7	108	124	3	235
Asia	7	29	46		75
North Africa	4	8	26		34
Unknown		144	204		348
Grand total	**42**	**502**	**450**	**7**	**959**

Documentation

Passport data

Lately CGN has put a lot of emphasis on the documentation of passport data of the *Linum* collection. Although much time has been spent, it was not possible to document the complete collection and several data are missing, including information on the country of origin, year of development, ancestry of several cultivars, etc.

A list of 22 passport descriptors for *Linum* was developed for the International Flax Data Base (IFDB) of the FAO/ESCORENA Flax and other Bast Plants Network (Rosenberg 1993; Pavelek 1994). The database management system GENIS (Genetic Resources Information System of CGN) (van Hintum 1989) includes multicrop passport descriptors for all crops maintained by CGN. The passport table in GENIS provides fields for 23 descriptors (van Hintum and Hazekamp 1992). Most of these descriptors are also listed in the proposed list of IFDB. There are however some differences in the descriptor states of some passport descriptors of both lists.

The available passport data have been included in GENIS. Data of the CGN *Linum* collection can be found on CGN's Web site: <http://www.plant.wageningen-ur.nl/cgn/>.

Presently passport information of nearly 900 accessions in the collection can be obtained on the Internet. Since early 2001 passport data can be searched on-line and characterization and evaluation data can be downloaded from the Internet.

Characterization and evaluation data: development of a minimal descriptor list

In order to conduct the characterization and evaluation of the collection a minimal descriptor list was developed (van Soest 1996). The descriptors for *Linum* are based on the descriptor list of the IFDB (Rosenberg 1993; Pavelek 1994, 1995). The original IFDB descriptor list comprising 14 morphological and 10 important agromorphological and evaluation characters was sent to all private flax breeders, who were requested to prioritize these descriptors using a 1-3 scale (1 = high priority, 3 = low priority). A similar procedure was followed for the development of a descriptor list for wheat in connection with a regeneration programme of this crop in the Netherlands (Loosdrecht *et al.* 1988). As a result of the

questionnaire 16 descriptors were included on the list and after a final discussion with flax breeders the list was divided into the following two groups:

- 10 mandatory descriptors: these traits should be always recorded during the regeneration;
- 6 optional descriptors: these traits can be recorded when sufficient time is available or in the case of diseases for which the character is ideally scored in the field. Some of these descriptors (quality properties) cannot be screened during the maintenance of the material since special analyses are required (e.g. fibre and oil content).

Details of the procedure of the development of the *Linum* descriptor list are reported by van Soest and Bas (1998).

A set of 8 standard varieties has been selected for the description of the agromorphological characters included in the minimal descriptor list. The standard varieties used are 'Amazone', 'Ariane', 'Hermes', 'Laura', 'Liflora', 'Mikael', 'Opaline' and 'Regina'.

Regeneration and characterization/evaluation

The last regeneration of the *Linum* collection was conducted by the former Foundation for Plant Breeding (SVP) in 1981. The collection was stored in paper bags under medium-term storage conditions (+4°C and 30% relative humidity). Material from the collection was used in breeding research until 1990. Although the viability of the seeds in the collection was still reasonable, seed of many accessions became scarce. In 1995 CGN decided to adopt the collection and in 1996 an agreement was made between CGN and four Dutch private flax breeding companies whereby the breeders agreed to rejuvenate, characterize and partly evaluate the *Linum* collection. Annually, each company receives 50 accessions which are multiplied, characterized and evaluated for some properties following a jointly developed descriptor list (van Soest 1996). This cooperative programme was terminated at the end of 2001: practically all accessions have been rejuvenated. After a viability test the last group of accessions will be stored in the genebank.

Storage

Presently nearly 900 *Linum* accessions are stored in the genebank. Storage is conducted under optimal conditions after drying to a seed moisture content of approximately 5% (van Hintum and van Soest 1997). The seeds are packed in laminated aluminium foil bags and stored at -20°C (long-term storage) and +4°C (medium-term storage).

Utilization

Since 1998 seed samples of 118 accessions and stems of 126 accessions have been distributed to users. Users are supplied with 300 seeds when they request cultivated material, but for wild species, smaller amounts are supplied. Additional passport information of the material is sent with the samples. However, since the inclusion of passport and evaluation data on the Web site of CGN, users have been able to obtain the data from this source themselves. They have to sign the Material Transfer Agreement (MTA) of CGN before they can obtain material. More information on the MTA can be found on the Web site of CGN.

Development of a core collection for fibre flax types

As part of a multidisciplinary fibre research programme, a core collection of fibre flax was created between 1998 and 2001. This took place in four stages:

- **Initial core:** selection of material from the 506 accessions of the CGN *Linum* collection, which is predominantly of the fibre flax type. Selection was based only on passport descriptors such as origin, age of the accession, population type and ancestor. From the

unknown origin group, only accessions with a variety name were selected and research material with codes or acronyms were excluded.

- **Improved core I:** the initial core was further reduced on the basis of a comparison of available characterization data of accessions from the same origin group (or country). These data were obtained from previous field observations in the Netherlands.
- **Improved core II:** the Improved core I (164 accessions) was grown as one replication on sandy soil at Wageningen and described for 10 descriptors and tested for fibre content in the autumn of the same year using the "green decorticating method".
- On the basis of agromorphological data, especially fibre content, data of the 164 accessions were reduced by a further 50 (Table 3). In this process important passport information such as origin, population type and ancestor was always considered.
- **Final core:** a similar procedure to that described under the Improved core II was followed to leave the final core. The 114 accessions of the Improved core II were grown again in the Wageningen fields and described and evaluated for fibre content. On the basis of this information the number was reduced by a further 30, leaving 84 in the final core (Table 3).

Table 3. Development of a core collection for fibre flax types

Group	No. of countries	Accessions in CGN collection	Initial core	Improved core I	Improved core II	Final core
Benelux	2	48	21	17	10	7
UK/Ireland	2	37	16	14	10	7
Central Europe	5	39	19	15	10	7
Mediterranean countries	5	10	6	6	5	4
Nordic countries	6	28	13	11	9	7
Eastern Europe	4	45	17	18	12	9
North America	2	91	37	27	19	14
South America	3	20	10	8	7	5
Asia/Australia	7	29	17	16	10	8
North Africa	4	8	6	7	5	4
Unknown		145	21	14	8	6
Standards		6	6	11	9	6
Total	**42**	**506**	**189**	**164**	**114**	**84**
% of CGN collection		**100**	**37**	**32**	**22**	**17**

The final 84 accessions were sown at two locations in 2001, one on a sandy soil at Wageningen and the other on an alluvial soil near the river Rhine near Wageningen. Data from these trials need further processing: fibre content will be measured in late 2001.

Prospects for the future

In 2002 the entire *Linum* collection will be regenerated and stored under optimal conditions. The developed "core" collection of *Linum* will be used in future research projects. Passport data and, in a later stage, characterization data of the CGN collection will be included in the International Flax Data Base.

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