Obtaining Brassica varieties adapted to the organic production system – Liveseed project 2020 update

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Resume

From year to year, society is increasingly focusing on more sustainable agricultural practices.
The Portuguese Genebank (Banco Português de Germoplasma Vegetal, BPGV) has been working together with "Sementes Vivas" in the Liveseed project since 2018, with the aim of obtaining brassica varieties and seeds adapted to organic farming. Currently, there are 8 selection lines of 3 species (*Brassica rapa* (3), *Brassica napus* (1) and *Brassica oleracea* (4)) in the field. This year, and following the work of previous years, stability - uniformity of physiological and phenotypic characteristics and reproductive synchrony between and within generations - were analyzed and verified.

Introduction

The current global demographic and environmental situation that we are facing (sharp population growth combined with climate change) means that we must rethink many of the habits with which we live now. To this extent, internationally, there is the value of various ongoing projects in order to change the unsustainable course the world is following. Among these, the Liveseed Project stands out for its focus on the implementation of more sustainable agricultural practices, namely through the action of organic agriculture (an area of enormous interest and investment worldwide (Willer and Lernoud, 2019)). INIAV (National Institute of Agrarian and Veterinary Research), specifically the Portuguese Genebank (BPGV), integrates this project together with the Sementes Vivas since 2018, with the aim of obtaining varieties and seeds of brassicas adapted to this mode of production.

Cabbages, turnips and broccoli are some of the brassicas produced and consumed in Portugal and are very present in our gastronomy. According to the Portuguese Statistics Institute, more than 50 thousand tons of brassicas are produced annually and exported, with a result superior to 20 million euros, such as turnip (*Brassica rapa*), rutabaga (*Brassica napus*), and cabbage (*Brassica oleracea*) (INE, 2018).

Following the previous work of selection and cultivation of 9 landraces from three brassica species and, considering the general objective of the partnership, this year the focus was on ensuring the uniformity and continuity of the generations of brassicas worked until now.

2020

In the field, of the original 9 landraces, only 6 (Table 1) F1 selection lines are found from the original landraces. 3 F1 of *Brassica rapa* (I1,I2,I3), 1 of *Brassica napus* (I6), and 2 of *Brassica oleracea* (I8,I9). Of these, there are 4 isolations (field divisions of the selection lines) of 16m^2 in 2020 for I1,I2, I3 and I6; 3 for I9; and 1 for I8.

Table 1. Current status of field trials. Of the 3 species (*Brassica rapa, Brassica napus* and *Brassica oleracea*) there are 6 F1 selection lines in different generational stages and with different analyses in progress.

Species	Selection lines	Generational state	Vegetative cycle	Ongoing trials
Brassica rapa "Turnip"	I1	F2	Annual	A
	I2	F2	Annual	A
	I3	F1	Biannual	A
Brassica napus "Rutabaga"	I6	F2	Annual	A
Brassica oleracea "Cabbage"	I8	F1	Biannual	B
	I9	F1	Biannual	B

A – Reproductive analysis; B – Morphological and reproductive analysis.

The current generations, as well as the previous ones, are arranged in different cages (Figure 1), with about 190 plants for I1, I2, I3 and I6, and 160 for I8 and I9, in total.

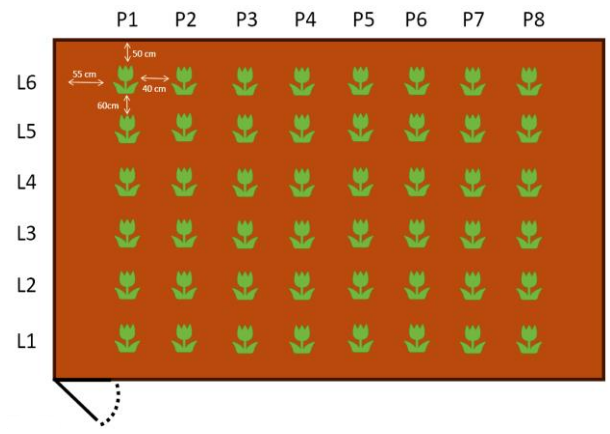

Figure 1. Experimental design of the field trial, the plants being represented in green. The 2 axes used in the study are represented by L and P (Line and Plant, respectively. In a total area of 16 m^2 .

In order to produce seeds with the desired characteristics (uniformity, distinctiveness and stability), reproductive cycles will be carried out up to the fourth generation in order to safeguard the quality of organic seeds (Bueren *et al.*, 2002). This year's plan is governed by:

Follow-up of classic improvement through mass selection

↓

Generational homogeneity check

↓

Phenotypic (according to UPOV and IBPGR guidelines) and reproductive cycle analysis

↓

Elimination of off-types, and selection of plants to reproduce

Trials conducted:

- **Morphological Homogeneity**
  - I8 and I9 - According to the guidelines, the plants selected were analyzed qualitatively (example in Figure 2) and quantitatively (example in Table 2) in order to establish uniform plant lines in each cage;
  - I1,I2 and I3 – Since there seemed to be less morphological dissent, only a simple comparison test of the phenotype with the previous generation was performed, and uniformity was ensured.
- **Reproductive synchrony**– Through the evaluation of the reproductive state (example in Figure 3) of each plant, for all isolations, it was possible to establish a pattern and eliminate the divergences.

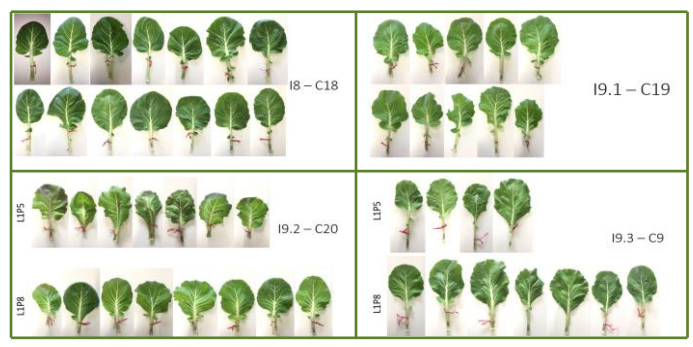

Figure 2. Foliar comparison of plants selected for morphological analysis in I8 and I9 - *B. oleracea* – for the diferente cages (C18, C19, C20 and C9).

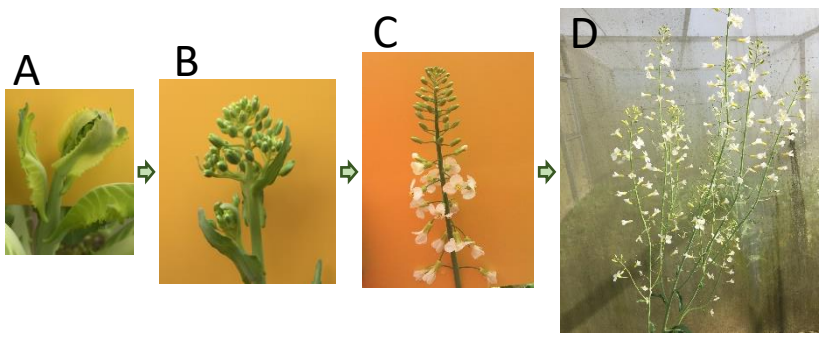

Figure 3. Examples of the different reproductive stages of *B. oleracea* – pre flowering state (A) with first bud formation , inflorescence in bud (B), Terminal inflorescence partially flowering (C), and Terminal inflorescence fully flowering (D) - analyzed every 3 days.

Table 2. Comparison of leaf area, petiole length, number of leaves and plant area between the different morphologically characterized selection lines (I8 (C18) and I9 (C19, C20 and C9); in C20 and C9 there are two different mother lines F1 (L1P5 and L1P8)). Each value represents an average of at least 4 values ± SD. For each parameter, means with different letters are statistically different.

Selection lines	I8		I9			
	C18	C19	C20		C9	
			L1P5	L1P8	L1P5	L1P8
Leaf area (cm²)	270,3 AC (±69,08)	301,2 A (±75,16)	199,2 CD (±35,59)	232,3 ACD (±53,74)	162,0 C (±74,27)	170,2 BD (±39,47)
Petiole length (cm)	11,6 A (±2,45)	11,0 A (±2,24)	4,7 B (±1,87)	6,8 BC (±1,48)	10,5 AC (±2,15)	9,1 AC (±1,45)
Number of leaves	12,1 AB (±1,06)	13,6 A (±1,43)	12,9 AB (±1,25)	11,6 B (±0,99)	12,0 AB (±1,22)	13,5 AB (±1,32)
Plant area (m²)	0,37 A (±0,135)	0,37 A (±0,107)	0,17 B (±0,028)	0,29 AB (±0,067)	0,27 AB (±0,118)	0,29 AB (±0,060)

Conclusions and Future Prospects

Since the selected plants, present reproductive and morphological uniformity, the evaluation will continue until the seeds are formed and, later they will be harvested. For I1,I2 and I6 the definitive harvest of the seeds will be in the next generation (F3). For I3, I8 and I9, it will be necessary to form two more generations (F2 and F3). In the fourth generation (F3), it will be expected to obtain a seed bulk adapted to the organic farming system and, the produced plants will present uniformity (in characteristics), stability (in productivity) and distinction (from what already exists on the market). To support the distinction there will be molecular marker and bioactive data.

References

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