

Interim report carrot trial Lebende Samen e.V. and Lehmann Natur GmbH



Lebende Samen -
Living Seeds e.V.

lehmann *natur*
organic products

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Introduction

This report of the Association Lebende Samen e.V. details preliminary results from the carrot trial as performed by Living Seeds – Sementes Vivas SA in a partnership with Lebende Samen e.V. and Lehmann Natur GmbH. The project has as intent to identify open pollinated carrot varieties suitable for organic production and select potential populations and improve existent cultivars to provide potential alternatives for hybrid varieties. Two trial were sown in Sevilla with a farm partner of Lehmann natur to get a first impression of the carrot varieties available on the market and a few exotic varieties to test their adaptability to Mediterranean organic conditions.

After this trial a further developed spring trial has been sown in Idanha-a-Nova, Portugal and an extensive summer sowing as well as an autumn sowing are planned to continue the project. Details of these trials will be presented after the preliminary results of the trials conducted at the site in Sevilha.

Due to the coronavirus it was not possible to harvest and evaluate the second sowing in Sevilha. Also, the more extensive taste testing and selections for seed production were not possible due to the difficulties presented in cross border travel. However, from the first sowing it was possible to get an idea of the trialed varieties and possible improvements for the future trials. In the next pages of the report we present the methods used and the results of the first trial followed by a small

conclusion after which we detail the currently active trial and planned trials for summer and autumn 2020.

Methods

The carrot trial was sown at Contagri SI in Sevilla, farm partner of Lehmann Natur GmbH. The first trial was sown on the 24th of September 2019. Followed by a second trial on the 13th of November 2019. The sowing dates are located near the beginning and the end of the carrot growing season for the location. For the trials 16 European varieties and 4 tropical varieties were sown. The trial was set up in a randomized block design with 3 replications, meaning that each variety was sown 3 times on randomized places within the trial field. Due to a lack of seed the 4 tropical varieties were sown a single time and only in the first trial.

For all varieties the following characteristics were recorded:

Characteristics	Type	Time
Seedling vigour	Scale	First visit after sowing
Germination	Scale	First visit after sowing
Plant vigour	Scale	Growing season
Foliage orientation	Classification (1 prostrate – 3 erect)	Growing season
Foliage length	Measured in cm	Harvest
Root length	Measured in cm	Harvest
Root width	Measured in cm	Harvest
Crown width	Measured in cm	Harvest
Colour intensity of root	Classification (1 weak – 3 strong)	Harvest
Colour of root	Classification	Harvest
Colour of interior of root	Classification	Harvest
Root Shape	Classification (1 cylindrical – 4 complete conical)	Harvest
Taste	Informal taste panel	After Harvest

During the growing period no abnormal climate anomalies occurred. The location in Sevilla are characterized by a sandy loamy site for the first trial and a mainly sandy site for the second trial. The region is characterized by mild winter temperatures and relatively high levels of precipitation during the winter period. Supplemental sprinkler irrigation was present to guarantee germination and continuous growth.

In the following chapter the results from the first trial are presented. Some data has been collected for the second trial, however, it will only be able to be compared in a meaningful way when the summer sowing in Idanha-a-Nova has been harvested and registered.

Results

Table 2 shows the varieties that were trialed with the root colour (interior and exterior) indicated as recorded in the trials:

Table 2 variety names and root colours (interior and exterior)

Variety name	Exterior colour	Interior Colour
SA18vg	Orange	Orange
Alvorada *	Orange	Orange
Berlikum selection	Orange	Orange
Brasilia*	Orange	Orange
Brasilia 2*	Orange	Orange
Brasilia 3*	Orange	Orange
Bunching carrot Amsterdam Type	Orange	Orange
Dolciva	Orange	Orange
Flakkee Early	Orange	Orange
Gniff	Purple	Purple and white
Jaune du Doubs	Yellow	Yellow
Kuttiger	White	White
Miranda	Orange	Orange
Nantaise early	Orange	Orange
Oxhella	Orange	Orange
purple carrot	Purple	White
Robila	Orange	Orange
Rodelika	Orange	Orange
Solvita	Orange	Orange
Violet Carrot	Purple	Purple and orange

1- * Indicates tropical varieties which were only sown once

As can be seen in table 2 the predominant colour of the trialed varieties was orange, this is mainly linked with the orange varieties being more common for sale and production. However, for the second trial in Idanha-a-Nova it was possible to identify various additional differently coloured carrots which will be presented after the conclusions on the first trial.

In table 3 the recorded values and standard deviations are shown per variety, based over the three different replications within the first trial. The standard deviation refers to the difference in the recorded values between the different replications in the first trial. The lower the standard deviation the more uniform the variety was scored for the trait.

For root colour, foliage orientation and root shape it was possible to establish that all varieties are extremely uniform, explaining the absent standard deviations.

Table 3 Descriptive statistics showing the mean and standard deviation for all characteristics noted. The number of valid repetitions counted is represented by the N =

Variety		Seedling vigour	Germination	Vigour	Foliage length (cm)	Root length (cm)	Root width (cm)	root colour intensity (1-weak,2-medium,3-strong)	Foliage orientation (1-prostrate,2-semi-erect,3-erect)	Rootshape (1-cylindrical,2-slightly conical,3-conical, 4-complete conical)
Purple carrot	Mean	2,33	1,33	4,33	64,20	14,97	2,63	2,00	1,00	2,00
	N = 3									
	Std. Deviation	0,58	0,58	0,58	3,99	2,29	0,45	0,00	0,00	0,00
Violet Carrot	Mean	1,67	1,33	1,33	35,03	15,00	3,40	3,00	2,00	3,00
	N = 3									
	Std. Deviation	1,15	0,58	0,58	2,59	6,08	0,79	0,00	0,00	0,00
Nantaise early	Mean	2,00	2,00	1,67	30,57	16,13	3,33	3,00	3,00	1,00
	N = 3									
	Std. Deviation	0,00	0,00	0,58	1,34	2,61	0,42	0,00	0,00	0,00
Bunching carrot Amsterdam	Mean	1,33	1,67	1,00	23,83	15,00	3,37	3,00	2,00	1,00
	N = 3									
	Std. Deviation	0,58	0,58	0,00	0,78	1,64	0,23	0,00	0,00	0,00
SA18vg	Mean	3,67	2,67	3,00	39,60	17,27	3,97	2,00	2,00	1,00
	N = 3									
	Std. Deviation	1,53	0,58	0,00	0,10	1,50	0,32	0,00	0,00	0,00
Jaune du doubs	Mean	1,33	2,00	3,67	47,37	17,60	3,83	3,00	3,00	3,00
	N = 3									
	Std. Deviation	0,58	0,00	0,58	3,37	1,91	0,06	0,00	0,00	0,00
Kuttiger	Mean	2,33	2,33	3,33	42,90	15,53	4,10	1,00	3,00	4,00
	N = 3									
	Std. Deviation	0,58	0,58	0,58	5,54	1,75	0,36	0,00	0,00	0,00
Gniff	Mean	2,00	1,67	2,33	36,93	13,77	3,67	3,00	2,00	3,00
	N = 3									
	Std. Deviation	1,00	0,58	0,58	3,86	1,72	0,67	0,00	0,00	0,00
Flakkee Early	Mean	2,67	2,33	3,00	45,07	18,27	3,90	2,00	3,00	2,67
	N = 3									
	Std. Deviation	0,58	0,58	0,00	3,70	1,14	0,00	0,00	0,00	0,58
Berlikum Selection	Mean	1,50	2,00	2,50	36,75	16,60	3,10	2,00	3,00	1,00
	N = 2									
	Std. Deviation	0,71	0,00	0,71	5,02	0,85	0,28	0,00	0,00	0,00
Dolciva	Mean	3,33	3,00	3,00	39,03	17,87	3,30	2,00	3,00	1,00
	N = 3									
	Std. Deviation	0,58	0,00	0,00	3,93	0,70	0,46	0,00	0,00	0,00
Oxhella	Mean	2,67	3,00	3,00	41,73	14,00	5,63	2,00	3,00	4,00
	N = 3									
	Std. Deviation	1,15	0,00	0,00	1,72	0,72	0,29	0,00	0,00	0,00
Miranda	Mean	3,67	3,00	3,00	36,53	16,20	3,27	3,00	3,00	1,00
	N = 3									
	Std. Deviation	0,58	0,00	0,00	2,46	2,23	0,25	0,00	0,00	0,00
Robila	Mean	1,33	2,67	2,33	34,33	14,87	2,80	2,00	3,00	1,00
	N = 3									
	Std. Deviation	0,58	0,58	0,58	3,01	0,15	0,10	0,00	0,00	0,00
Rodelika	Mean	2,67	2,67	3,00	38,47	16,70	3,47	2,00	3,00	2,00
	N = 3									
	Std. Deviation	1,15	0,58	0,00	2,32	0,56	0,45	0,00	0,00	0,00
Solvita	Mean	3,00	3,00	3,25	41,33	16,25	3,33	2,00	2,00	2,00
	N = 4									
	Std. Deviation	1,63	0,00	0,50	4,26	1,40	0,17	0,00	0,00	0,00
Total	Mean	2,31	2,29	2,92	41,88	16,35	3,62	2,29	2,42	2,02
	N = 52									
	Std. Deviation	1,11	0,67	1,06	11,62	2,50	0,73	0,57	0,72	1,06

Interesting to note is the fact that seedling vigour, germination and vigour seem to have quite low standard deviations suggesting a high uniformity of the variety or seedlot. For the data we have applied some basic statistic test to find out where were the significant differences as presented in table 4.

Table 4 Results from the Two-way ANOVA test, significant results are marked in bold

	Variety		Repetition		Interaction	
	P-value	F-value	P-value	F-value	P-value	F-value
Seedling vigour	0,366	1,540	0,160	3,006	0,842	0,553
Germination	0,034	7,214	0,226	2,206	0,364	1,552
Plant vigour	0,018	10,305	0,437	1,026	0,770	0,665
Foliage length	0,005	21,042	0,697	0,395	0,731	0,725
Root length	0,099	3,872	0,623	0,535	0,179	2,633
Root width	0,003	26,803	0,034	8,837	0,113	3,548
Crown width	0,000	137,444	0,028	10,037	0,006	18,695

The results, as shown in table 4, showed that germination, plant vigour, foliage length and root width were all significantly based on the variety. Root length did not occur in this list, which can be due to the fact that there was a single harvest date, meaning that if some varieties would have stayed longer in the soil they might have developed into longer roots. Furthermore, there are some results which raise questions such as the interaction between variety and repetition for crown width. At the moment of writing we have no explanations for the observed question, these questions will need to be further investigated in combination with the future trials.

Finally, in a small taste testing panel consisting of several member of the Sementes Vivas staff and Lehmann natur the varieties “Violet carrot”, “Oxhella”, “Dolciva” and “Rodelika” were identified as having the best flavour and structure qualities. The tropical carrot varieties were all identified to have a very particular flavour profile about which existed disagreement whether it was negative or positive, however, the census was that these varieties would not be suitable for retail use in Europe as they were.



Figure 1 taste test of trialed carrot varieties

Discussion

In the first trial several interesting varieties were identified which will be trialed also in Idanha-a-Nova for the future trial. Kuttiger, Jaune du Doubs, Oxhella Robila showed extremely high productivities based on observational comparison compared to the other varieties. Besides adaptation this could be linked to germination and seed lot quality, as well as the trial sowing. However, it is interesting nonetheless and are therefore varieties which will also be sown in future comparisons. Besides these, Dolciva, Rodelika, Berlikum, Flakkee, Nantaise early, Solvita, Bunching carrot and SA18vg performed quite well and will therefore be included in the next trials to see how they adapt to a completely different soil and climate conditions.

Violet carrot showed extremely desirable characteristic on the basis of visual aspect and flavour, however, it did not manage to perform like the other varieties in terms of productivity and vigour. Nonetheless, due to its exceptional qualities we will continue to trial it for one more cycle.

The carrot varieties Gniff and Purple carrot did not perform well at all and did not show acceptable root quality to continue for future trials and will therefore be eliminated. Additionally, the tropical varieties were not appreciated for their taste, nor growth style and will also be eliminated for future trials. However, some seeds will be set aside as the disease resistance can be important in breeding new varieties in the future.

Overall, the whole set represented main season varieties with a slight difference in root types. Oxhella and Kuttiger, two of the best performing varieties, were highly conical and unusual root shapes. Oxhella combined it with performing as one of the best varieties in the taste test. Kuttiger on the other hand presented some fibrousness and a taste not appreciated by all.

Short cycle carrots are still lacking and should be added in future trials.

The trial allowed us to get a better insight of the open pollinated varieties available and managed to help us already eliminate 6 varieties for future testing. Moreover, with the current trial sown in Idanha-a-Nova it will be possible to see how the varieties perform in different climates and different soils. Based on the experiences from these trials we would like to improve a few processes, change and add some new varieties as will be described in the next chapter.



Figure 2 From left to right: Oxhella, Kuttiger and Rodelika

Next Steps

Currently a trial with the following varieties has been sown in Idanha-a-Nova on the first of April with two replications.

Variety	Type
Nantaise 2 FYNN	Short cycle orange
KS-MOG-TH-GEG (AS)	Normal cycle yellow
Fine	Short cycle orange
Nantaise 2 MILAN	Short cycle orange
Rolanka	Normal cycle orange
Pau Roxo	Normal cycle purple
Selection Berlicum	Normal cycle orange
SA18VG nantaise 120 days	Normal cycle orange
Violet Carrot	Normal cycle purple
Amsterdam Bunching	Normal cycle orange
SAT27 Nantaise 100 days	Normal cycle orange
Solvita	Normal cycle orange
Robila	Normal cycle orange
Miranda	Normal cycle orange
Flakkeese	Normal cycle orange
Kuttiger	Normal cycle white
Dolciva	Normal cycle orange
Rodelika	Normal cycle orange
Oxhella	Normal cycle orange
Jaune Du Doubs	Normal cycle yellow
Nantes 2	Short cycle orange

The major change with the previous trial is the addition of one additional yellow and one additional purple coloured carrot, and several short cycle orange carrots.

Besides this, for summer around August is planned an additional trial, with extra new varieties besides those planted in the previous trials. At the moment we have been able to identify and acquire two red/ orange varieties, one white variety, and two hybrid comparison varieties to better contextualize the information. Based on the results of this trial we hope to have sufficient information to start selecting potential candidates for selection and improvement.

For autumn we propose to plant a follow-up trial either in Portugal or Spain to multiply and trial selected varieties on an additional location. We have identified several possibilities for these trials in the Atlantic coast influenced parts of Portugal (from North to South) and are currently identifying several options for Spain. Plants produced on these locations can be harvested in early spring 2021 for multiplication and trialing the same year.