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A BETTER BALANCE IN QUANTITY AND QUALITY: OPPORTUNITIES FOR VEGETABLE VARIETIES BRED FOR QUALITY AND TASTE

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Abstract: Various trends shape organic agriculture. One trend is that organic consumers value product quality more and more. Another trend is that conventional breeding increasingly focuses on the use of molecular tools, F1 hybrid breeding and patents. For organic traders and farmers this means an alternative approach in breeding becomes more urgent: a breeding approach that meets economic, societal and nutritional values in a balanced way. One option is to develop varieties that have a good balance in storability, taste and nutritional value. To better understand whether hand how such balance is possible, field trials were conducted for two years with three vegetable crops (pumpkin, red cabbage and carrots) with five varieties per crop, on two bio-dynamic farms with different soils (clay and sand), using two harvest moments. Measured traits were yield, storability, taste (at three moments after harvest), and nutrient quality (dry matter percentage, Brix and content of eight minerals). A general conclusion is that it should be possible to breed for crop varieties with a good balance in yield (fresh), dry matter yield, taste, nutritional quality and storability. All these aspects should be taken into account at the start of the breeding process. The research showed clearly that in the context of bio-dynamic farming, open pollinated varieties can have similar yield and storability as F1-hybrids, although they are often lower in uniformity. How the balance in yield, taste, quality and storability should look like exactly for each of the crops should not only be discussed with farmers, but with the whole value chain including traders, processors and consumers.

Introduction: Various trends in conventional and organic agriculture and society at large are intertwined. Together these trends shape the further development of organic agriculture. One trend is that consumers, in particular organic consumers, value product quality more and more. Another trend is that conventional breeding increasingly focuses on the use of F1 hybrid breeding, molecular tools and patents. For organic traders and farmers this means an alternative approach in breeding becomes more urgent: a breeding approach that meets economic, societal and nutritional values in a balanced way and addressing the four IFOAM principles of care, health, fairness and ecology. The breeding of open pollinated (OP) varieties has the potential to meet these values, important for organic consumers. However, the choice of good OP varieties in terms of yield, storability and uniformity is often limited as the focus in plant breeding has been more and more on F1 hybrids since the 1980s. A general advantage of F1 hybrids is higher uniformity. In organic agriculture, good taste and good nutritional values are also considered important traits.

So far, mainstream breeding has focused on yield and storability. However, field trials on carrot and pumpkin suggested there can be a negative relation between storability on the one hand and taste and quality on the other hand (Nuijten and Lammerts van Bueren 2016). It implied that varieties with good taste and quality are more difficult to store than the commonly used varieties by farmers. An important question is what can be done to improve the storability of vegetables with good taste and quality. One option may be to look for varieties that have a good balance in storability, taste and nutritional value. The results of a research conducted with three crops on two biodynamic farms for two years are interpreted from the perspective of the concept of growth and differentiation by Bloksma et al. (2007). They suggested that yield and quality are influenced by two processes in plants, e.g. growth (resulting in quantity) and differentiation (resulting in quality).

Material and methods: Field trials were conducted for two years with three vegetable crops (pumpkin, red cabbage and carrots) on two bio-dynamic farms with different soils (clay and sand) in the Netherlands, in respectively Swifterbant and Oostelbeers. For each of the crops five varieties were compared: three open pollinated varieties and two F1-hybrids. On each of the farms the trials were set up with three replications and completely randomised designs. On both farms, two harvest dates were applied for all three crops. Dates for sowing, planting and harvesting were chosen as similar as possible on both farms. Apart from general observations on crop growth, crop traits that were measured were yield (fresh and dry matter yield), storability, taste (after harvest, mid storage and after storage), and nutrient quality (dry matter percentage, Brix and content of eight minerals). Tasting tests with all materials were conducted at the beginning, half-way and towards the end of the storage period at the farm in Swifterbant. Storage of all harvests of all crops was done at the farm in Swifterbant. Laboratory analysis was conducted at the Louis Bolk Institute. ANOVA and correlations were used to analyse the results.

Results: Results showed that the interactions for yield, storability, taste and quality are complex and crop specific. One general conclusion is that whereas yield differed a lot between varieties when calculated in fresh matter, yield was much more similar when calculated in dry matter (Table 1). Another general conclusion is that soil quality can have a big effect on storability and taste (Table 1). In this research the storability tended to be better for all three vegetable crops on the farm with clay soil than on the farm with sandy soil. Differences in taste were observed between the two farms (Table 1). Pumpkin grown on the farm with sandy soil had clearly better taste than pumpkin grown on the farm with clay soil. The taste of red cabbage grown on the farm with sandy soil tended to be better. However, the differences in taste for carrot were not that clear between the two farms. A confounding factor could also be that the carrot yield on the farm with clay soil was relatively low, due to the dry weather of the two seasons under which the trials ran. For each of the crops, varieties showed different patterns of change in taste during storage and no general patterns were observed that could be applicable to all varieties of a crop (Table 2). Some pumpkin varieties grown on clay soil showed a clear decrease in taste during storage, whereas this was not the case for other varieties. For carrot and red cabbage varieties, the dynamics in taste development during storage were more complex.
Correlations suggested negative relationships between yield fresh matter) and quality (in particular dry matter content), but no clear negative relationships with taste (Table 3). Correlations suggest a positive relationship between dry matter content and taste for carrot and pumpkin, but a negative relationship in the case of red cabbage. Time of harvesting seems to have a large effect on the outcomes of the correlations of taste with many other parameters, for all three crops. No clear relationships could be observed between storability with quality, taste, and yield.

Discussion: When starting the research, the effect of harvest moment was an important element of discussion among farmers, particularly for pumpkin. The results suggest different patterns in the effect of harvest moment on storability, taste and quality between the crops and also between varieties of the same crop. Not only the three crops have different growth patterns, but also the tested varieties of the crops seem to have different growth patterns, which was clearest for red cabbage, but less clear for pumpkin.
The processes of growth and differentiation (including ripening) in plants are linked to physiological processes in plants (Bloksma et al. 2007). This concept departs from the perspective that plants first have a process of growth, after which gradually the process of differentiation may become more important which can be observed in plant phenology. The earlier the process of differentiation starts, the earlier a plant will ripen, and it can be assumed that yield will be lower but quality should be higher. From this follows the idea that earlier harvested plants will be less mature, and could be stored better, like in the case of apple is commonly applied. This trend was observed for pumpkin, although there were also clear variety, season and soil effects. In addition, other factors may play a role as well. Some varieties develop more taste or quantity than other varieties, which seem unrelated to the processes of growth and differentiation. In the case of carrot, it seems the growth processes were much influenced by weather conditions. In both years rainfall during the summer was limited and in both years the carrots seemed to catch up in their growth process at the start of the autumn in different ways. The growth processes of the red cabbage varieties were very different per

variety. Some varieties started head formation early, while other varieties were very slow in head formation. Early head formation could be related to an early process of differentiation. The early varieties had the lowest storability, but also had lowest percentages of dry matter content, being an indicator for lower quality. Hence, considering the collected data, the concept of growth and differentiation may be a useful starting point to understand the process of quality development for particular varieties and that different varieties have different processes of growth and differentiation. A general conclusion is that it should be possible to breed for crop varieties with a good balance in yield (fresh), dry matter yield, taste, nutritional quality and storability. All these aspects should be taken into account at the start of the breeding process. The research showed clearly that in the context of bio-dynamic farming, OP varieties can have as high yields and storability as F1-hybrids, although often lower in uniformity. Presentations of the first results to farmers and consumers at several occasions in 2018 underline the importance of finding a better balance in quality and yield, e.g. with more weight given to taste and quality, in addition to storability and yield. How the balance in yield, taste, quality and storability should look like exactly for each of the crops is to be discussed not only with farmers, but with the whole value chain including traders, processors and consumers.

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Keywords: balance, nutritional quality, organic plant breeding, storability, taste, yield

Table 1a: Average values for yield, storability, taste and quality for five carrot varieties, measured at two locations and with two harvesting moments in 2017 and 2018.

Catogory	Avg. N	Yield fresh (tons/ha)	Yield dry matter (tons/ha)	Storability (in percentage loss)	General taste appreciation 3rd taste test (1-9)+	EC (mS/cm)	Brix (in %)	Dry matter content (in %)
Soil								
Clay-17	10	36,0	4,6	23,1	5,9	6,1	9,4	12,9
Clay -18	10	56,0	7,2	13,4	6,4	5,9	10,3	13,2
Sand-17	10	57,0	6,7	19,4	6,0	3,9	8,6	12,0
Sand-18	10	65,6	8,0	36,2	5,8	4,5	9,9	12,3
Year								
2017	20	46,5	5,7	21,3	5,9	5,0	9,0	12,4
2018	20	60,8	7,6	24,8	6,1	5,2	10,1	12,8
Harvest moment								
2017-1	10	38,6	4,8	28,5	5,7	5,1	9,0	12,6
2017-2	10	60,1	7,2	17,3	6,2	5,0	9,3	12,1
2018-1	10	55,9	7,4	29,1	5,9	5,3	10,6	13,5
2018-2	10	65,7	7,7	20,5	6,3	5,1	9,6	12,0
Variety, harvest 1 only								
Crofton F1	4	38,2	5,7	18,0	5,9	5,1	10,0	13,1
Nerac F1	4	51,4	6,6	25,4	5,5	5,2	8,6	11,4
Robila	4	42,5	6,2	20,8	6,2	5,4	10,1	13,2
Rodelika	4	42,4	6,8	27,3	6,7	5,0	10,4	13,9
Solvita	4	61,7	7,8	23,7	5,8	4,9	8,8	11,4
Variety, harvest 2 only								
Crofton F1	4	49,3	6,1	12,7	6,1	5,0	9,5	12,4
Nerac F1	4	64,6	7,1	23,7	5,8	5,1	8,5	11,1
Robila	4	52,6	6,7	13,6	6,0	5,3	9,9	12,8
Rodelika	4	56,0	7,5	21,4	7,1	4,7	10,1	13,4
Solvita	4	77,8	8,4	14,9	6,0	4,9	8,6	10,9

+ 1 = very low; 9 = very high

Table 1b: Average values for yield, storability, taste and quality for five carrot pumpkin, measured at two locations and with two harvesting moments in 2017 and 2018.

Catogory	Avg. N	Yield fresh (tons/ha)	Yield dry matter (tons/ha)	Storability (in percentage loss)	General taste appreciation 3rd taste test (1-9)	EC (mS/cm)	Brix (in %)	Dry matter content (in %)
Soil								
Clay-17	10	20,6	3,5	37,0	4,3	7,5	9,9	17,3
Clay-18	10	28,3	3,7	36,7	4,1	10,4	8,9	13,0
Sand-17	9	25,2	4,8	74,2	7,0	5,1	9,8	18,5
Sand-18	9	26,7	3,7	76,7	6,2	7,7	10,1	14,0
Year								
2017	19	22,6	4,1	61,3	5,5	6,5	9,8	17,8
2018	19	27,5	3,7	56,7	5,1	9,1	9,5	13,5
Harvest moment								
2017-1	9	20,6	3,8	42,2	5,5	6,5	9,7	18,6
2017-2	9	27,3	4,1	62,6	5,2	7,5	9,7	15,0
2018-1	10	25,3	3,4	52,9	5,3	9,7	9,7	13,7
2018-2	10	29,7	3,9	60,6	5,0	8,5	9,3	13,3
Variety, harvest 1 only								
Bright Summer F1	3	27,2	3,6	11,7	3,9	8,1	8,3	13,5
Fictor	4	18,7	3,0	34,8	5,5	8,8	10,2	16,8
Orange Summer F1	4	25,0	4,0	55,1	5,5	7,5	9,9	16,1
Red Kuri	4	22,1	3,7	66,8	5,9	8,4	9,5	16,8
Uchiki Kuri	4	23,3	3,8	47,2	5,6	8,3	10,0	16,7
Variety, harvest 2 only								
Bright Summer F1	3	34,6	4,4	56,5	4,1	7,0	8,5	12,8
Fictor	4	20,1	3,3	44,8	5,5	7,9	10,2	15,7
Orange Summer F1	4	28,5	4,3	71,0	5,8	7,1	9,7	14,7
Red Kuri	4	29,0	4,4	83,4	5,7	7,6	9,7	15,1
Uchiki Kuri	4	24,6	4,0	58,9	4,8	7,9	10,2	16,2

+ 1 = very low; 9 = very high

Table 1c: Average values for yield, storability, taste and quality for five red cabbage varieties, measured at two locations and with two harvesting moments in 2017 and 2018.

Catogory	Avg. N	Yield fresh (tons/ha)	Yield dry matter (tons/ha)	Storability (in percentage loss)	General taste appreciation 3rd taste test (1-9)	EC (mS/cm)	Brix (in %)	Dry matter content (in %)
Soil								
Clay-17	10	42,9	3,7	44,2	5,9	5,0	6,9	8,5
Clay -18	10			68,2	5,5	6,2	7,9	10,2
Sand-17	10			74,8	6,2	4,5	6,7	8,6
Sand-18	10	34,2	3,6	86,7	5,8	5,9	8,3	10,5
Year								
2017	20	42,9*	3,7*	59,5	6,0	4,7	6,8	8,6
2018	20	34,2*	3,6*	77,5	5,7	6,0	8,1	10,3
Harvest moment								
2017-1	10	34,3*	2,8*	65,0	6,1	4,8	6,8	8,4
2017-2	10	41,8*	4,0*	64,4	5,9	5,4	7,6	9,6
2018-1	10	36,4*	3,7*	80,1	5,6	6,0	7,9	10,3
2018-2	10	32,1*	3,4*	74,9	5,7	6,1	8,3	10,4
Variety, harvest 1 only								
Granat	4	45,4*	3,9*	85,9	6,1	5,4	7,1	8,9
Marner Lagerrot	4	22,6*	2,1*	75,5	5,4	5,4	7,3	9,2
Rodynda	4	45,8*	4,3*	83,3	6,2	5,5	7,5	9,4
Roxy F1	4	32,7*	3,1*	53,1	5,6	5,3	7,5	9,5
Travero F1	4	30,3*	2,9*	64,9	5,5	5,4	7,4	9,5
Variety, harvest 2 only								
Granat	4	43,4*	3,9*	75,8	5,7	5,4	7,3	9,1
Marner Lagerrot	4	32,0*	3,0*	69,6	5,9	5,3	7,5	9,6
Rodynda	4	51,2*	4,8*	75,1	5,8	5,4	7,5	9,4
Roxy F1	4	41,6*	3,9*	45,9	5,7	5,3	7,7	9,6
Travero F1	4	40,9*	4,1*	55,6	6,2	5,4	7,8	10,1

* measured in 2017 only on clay, and in 2018 only on sand

+ 1 = very low; 9 = very high

Table 2: Average values for taste general appreciation (1 = very low; 9 = very high) at three taste evaluations for three crops, five varieties and two locations in 2017 and 2018.

Year	Soil type	Carrot	Oct.	Dec.	Mar.	Avg.	Pumpkin	Oct.	Dec.	Jan.	Avg.	Red Cabbage	Oct.	Dec.	Feb.	Avg.
2017	Clay	Crofton F1	6,3	5,8	5,6	5,9	Bright Summer F1	6,2	5,0	4,7	5,3	Granat	5,7	5,7	4,8	5,4
2017	Sand	Crofton F1	5,9	6,1	6,3	6,1	Bright Summer F1	NA	NA	NA	NA	Granat	5,8	5,6	6,4	5,9
2018	Clay	Crofton F1	6,7	5,9	6,3	6,3	Bright Summer F1	4,5	4,0	2,2	3,6	Granat	5,8	5,4	5,0	5,4
2018	Sand	Crofton F1	6,9	6,4	5,6	6,3	Bright Summer F1	6,0	4,7	4,3	5,0	Granat	6,9	6,5	6,4	6,6
2017	Clay	Nerac F1	5,9	5,5	5,5	5,6	Fictor	4,2	6,1	4,7	5,0	Marner Lagerrot	5,9	4,9	5,5	5,3
2017	Sand	Nerac F1	4,8	6,3	5,9	5,7	Fictor	7,6	8,2	6,6	7,5	Marner Lagerrot	6,1	6,1	6,4	6,2
2018	Clay	Nerac F1	5,9	4,3	6,0	5,4	Fictor	4,2	5,2	4,1	4,5	Marner Lagerrot	6,0	5,7	5,6	5,7
2018	Sand	Nerac F1	6,3	4,3	6,0	5,6	Fictor	6,8	6,5	7,0	6,8	Marner Lagerrot	5,5	5,9	5,9	5,8
2017	Clay	Robila	5,9	5,5	5,6	5,7	Orange Summer F1	5,4	5,9	5,8	5,7	Rodynda	5,9	5,5	5,5	5,7
2017	Sand	Robila	5,4	6,6	6,5	6,2	Orange Summer F1	6,6	6,1	7,0	6,6	Rodynda	6,3	6,6	6,3	6,4
2018	Clay	Robila	6,9	5,4	6,8	6,4	Orange Summer F1	6,4	7,3	4,7	6,1	Rodynda	6,9	5,5	6,2	6,2
2018	Sand	Robila	6,2	5,7	5,1	5,7	Orange Summer F1	7,7	6,3	6,0	6,7	Rodynda	*	5,9	6,2	6,1
2017	Clay	Rodelika	6,4	7,8	6,1	6,8	Red Kuri	6,2	5,7	4,3	5,4	Roxy F1	4,6	4,5	5,1	5,0
2017	Sand	Rodelika	6	6,6	6,6	6,4	Red Kuri	6,0	6,9	7,8	6,9	Roxy F1	6,2	6,6	6,8	6,5
2018	Clay	Rodelika	7,6	7,9	7,9	7,8	Red Kuri	3,7	4,7	3,9	4,1	Roxy F1	5,6	4,9	5,0	5,2
2018	Sand	Rodelika	6,0	6,1	7,2	6,4	Red Kuri	6,4	4,8	7,2	6,1	Roxy F1	6,3	5,3	5,5	5,7
2017	Clay	Solvita	6,5	6,2	6,4	6,4	Uchiki Kuri	5,3	5,4	2,4	4,4	Travero F1	5,3	5,9	5,9	5,9
2017	Sand	Solvita	5,6	5,6	5,5	5,6	Uchiki Kuri	6,7	6,2	7,1	6,6	Travero F1	5,3	5,4	6,1	5,6
2018	Clay	Solvita	5,8	5,3	5,6	5,6	Uchiki Kuri	3,0	5,5	3,8	4,1	Travero F1	5,5	5,3	6,0	5,6
2018	Sand	Solvita	6,3	6,1	6,8	6,4	Uchiki Kuri	6,8	6,3	6,1	6,4	Travero F1	5,4	5,2	6,4	5,6

Average least significant difference for carrot: 1,052; pumpkin: 1,189; red cabbage: 1,172

Table 3a: correlations between yield at harvest with various traits for the crops carrot, pumpkin and red cabbage, based on two locations and two harvest moments in 2017 and 2018.

Trait	all data	Location clay	Location sand	Year 2017	Year 2018	Harvest moment 1	Harvest moment 2
Carrot							
N	40	20	20	20	20	20	20
Brix (%)	-0,3	-0,2	-0,2	-0,7	-0,6	-0,1	-0,4
EC (mS/cm)	-0,5	0,1	-0,4	-0,7	-0,4	-0,4	-0,6
pH	-0,3	-0,6	-0,2	-0,1	0,3	-0,6	-0,4
Dry matter content (%)	-0,6	-0,4	-0,7	-0,8	-0,8	-0,3	-0,8
Yield dry matter, at harvest (tons/ha)	0,9	0,9	0,9	1,0	0,8	0,9	0,9
Storability (percentage rot)	0,0	-0,6	0,0	-0,5	0,2	0,2	0,2
Taste, general appreciation (1-9)	0,0	0,0	0,1	0,1	-0,3	-0,3	0,0
Pumpkin							
N	38	20	18	18	20	19	19
Brix (%)	-0,6	-0,8	-0,6	-0,5	-0,6	-0,5	-0,8
EC (mS/cm)	-0,1	0,2	-0,2	-0,7	-0,3	0,2	-0,2
pH	-0,3	-0,2	-0,4	0,1	-0,4	0,1	-0,2
Dry matter content (%)	-0,6	-0,7	-0,5	-0,4	-0,5	-0,6	-0,6
Yield dry matter, at harvest (tons/ha)	0,6	0,7	0,6	0,9	0,9	0,5	0,7
Storability (percentage rot)	-0,1	-0,4	0,1	-0,2	0,0	-0,3	0,1
Taste, general appreciation(1-9)	-0,1	-0,2	-0,4	0,5	-0,4	-0,1	0,0
Red Cabbage							
N	20	10	10	10	10	10	10
Brix (%)	-0,4	-0,5	-0,3	see clay	see sand	0,0	-0,9
EC (mS/cm)	-0,4	-0,4	0,3			0,1	-0,7
pH	0,3	-0,5	0,5			0,0	0,9
Dry matter content (%)	-0,4	0,0	-0,4			-0,1	-0,8
Yield dry matter, at harvest (tons/ha)	0,9	1,0	1,0			0,9	0,9
Storability (percentage rot)	-0,3	0,0	0,3			0,3	-0,7
Taste, general appreciation(1-9)	0,2	-0,1	0,4			0,6	-0,5

Table 3b: correlations between taste with various traits for the crops carrot, pumpkin and red cabbage, based on two locations and two harvest moments in 2017 and 2018.

Trait	all data	Location clay	Location sand	Year 2017	Year 2018	Harvest moment 1	Harvest moment 2
Carrot							
N	40	20	20	20	20	20	20
Brix (%)	0,5	0,7	0,1	0,2	0,7	0,7	0,4
EC (mS/cm)	0,1	-0,3	-0,2	-0,1	0,2	0,4	-0,1
pH	0,0	-0,3	0,4	0,2	0,4	-0,1	0,0
Dry matter content (%)	0,5	0,7	0,1	0,2	0,6	0,8	0,4
Yield fresh, at harvest (tons/ha)	0,0	0,0	0,1	0,1	-0,3	-0,3	0,0
Yield dry matter, at harvest (tons/ha)	0,2	0,4	0,2	0,2	0,1	0,0	0,2
Storability (percentage rot)	-0,1	-0,1	-0,1	-0,2	-0,1	-0,2	0,1
Pumpkin							
N	38	20	18	18	20	19	19
Brix (%)	0,4	0,1	0,2	-0,2	0,8	0,8	0,6
EC (mS/cm)	-0,5	0,0	-0,2	-0,8	-0,4	-0,7	-0,7
pH	0,2	0,3	0,4	0,3	0,0	0,5	0,0
Dry matter content (%)	0,4	0,2	0,6	0,3	0,7	0,6	0,5
Yield fresh, at harvest (tons/ha)	-0,1	-0,2	-0,4	0,5	-0,4	-0,6	-0,1
Yield dry matter, at harvest (tons/ha)	0,3	0,0	0,1	0,6	-0,1	-0,2	0,4
Storability (percentage rot)	0,6	0,1	-0,2	0,6	0,5	0,7	0,6
Red Cabbage							
N	40	20	20	20	20	20	20
Brix (%)	-0,2	-0,3	-0,1	0,3	0,3	-0,4	-0,1
EC (mS/cm)	-0,3	-0,3	-0,3	-0,2	0,1	-0,3	-0,4
pH	0,3	0,4	0,3	0,0	0,2	0,4	0,3
Dry matter content (%)	-0,3	-0,4	-0,2	0,0	0,2	-0,5	0,0
Yield fresh, at harvest (tons/ha)	-	-	-	-	-	-	-
Yield dry matter, at harvest (tons/ha)	-	-	-	-	-	-	-
Storability (percentage rot)	0,1	0,1	0,0	0,3	0,3	-0,1	0,3

Table 3c: correlations between storability (measured as percentage rot) with various traits for the crops carrot, pumpkin and red cabbage, based on two locations and two harvest moments in 2017 and 2018.

Trait	all data	Location clay	Location sand	Year 2017	Year 2018	Harvest moment 1	Harvest moment 2
Carrot							
N	40	20	20	20	20	20	20
Brix (%)	0,1	0,1	0,3	0,0	0,0	-0,1	0,1
EC (mS/cm)	-0,2	0,3	0,4	0,3	-0,7	-0,3	-0,2
pH	-0,2	0,3	-0,5	-0,2	-0,1	0,0	-0,2
Dry matter content (%)	0,0	0,2	0,1	0,1	-0,1	-0,2	-0,1
Yield fresh, at harvest (tons/ha)	0,0	-0,6	0,0	-0,5	0,2	0,2	0,2
Yield dry matter, at harvest (tons/ha)	0,0	-0,5	0,1	-0,6	0,3	0,2	0,1
Taste, general appreciation (1-9)	-0,1	-0,1	-0,1	-0,2	-0,1	-0,2	0,1
Pumpkin							
N	38	20	18	18	20	19	19
Brix (%)	0,3	0,2	0,0	0,0	0,6	0,4	0,2
EC (mS/cm)	-0,5	0,0	-0,1	-0,7	-0,7	-0,4	-0,6
pH	-0,1	-0,2	0,0	0,1	-0,2	0,1	0,3
Dry matter content (%)	0,0	0,1	-0,3	0,1	0,2	0,0	0,2
Yield fresh, at harvest (tons/ha)	0,3	0,1	0,5	0,7	0,0	0,2	0,3
Yield dry matter, at harvest (tons/ha)	0,5	0,4	0,4	0,9	0,1	0,3	0,6
Taste, general appreciation(1-9)	0,6	0,1	-0,2	0,6	0,5	0,7	0,6
Red Cabbage							
N	40	20	20	20	20	20	20
Brix (%)	0,3	0,3	0,3	-0,5	-0,2	0,2	0,4
EC (mS/cm)	0,3	0,6	0,6	-0,6	0,0	0,3	0,3
pH	-0,3	-0,5	-0,5	0,3	0,2	-0,3	-0,4
Dry matter content (%)	0,3	0,3	0,3	-0,3	-0,3	0,3	0,3
Yield fresh, at harvest (tons/ha)	-	-	-	-	-	-	-
Yield dry matter, at harvest (tons/ha)	-	-	-	-	-	-	-
Taste, general appreciation(1-9)	0,1	0,1	0,0	0,3	0,3	-0,1	0,3