Report

Reuse substrate in strawberry after steaming

Plastic greenhouse, spring 2025

PROEFCENTRUM HOOGSTRATEN

SOIL STEAM
Clean soil. No chemicals.

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1 INTRODUCTION AND CHALLENGE

Modern and intensive strawberry cultivation is very common in Belgium. Different cultivation systems are being planted throughout the year to realize year-round fresh strawberry production. From lit glasshouses in winter to aerated tabletops in summer, all systems have their specific cultivation periods to achieve sequential harvest periods on the farms. The majority of strawberries are grown in substrate based systems. The main ingredient of the substrate is peat, although mixtures with coir and perlite are very common. Peat is still available in different countries around the world, but due to its bad influence on our climate, several governments are prohibiting the harvest of peat or are planning a definitive stop in use in the coming years. Massive numbers of CO_2 are released when peat fields are burned dry to allow digging in the fields. Without transport 247 kg CO_2 is released per cubic metre of peat. On top of this the worldwide demand for peat is increasing and it is expected to be doubled by 2050.

Strawberry is one of the more important cultivations depending on peat in Belgium. Around 275 growers use peat today in their substrate, they realize a yearly use of around 140.000 m³ of peat per year. Alternatives and reuse of substrate are being investigated. In 2023 and 2024 Proefcentrum Hoogstraten ran a trial with the reuse of 4 different substrate mixtures. With 2 cultivations per year the substrates were used 4 times. Next to fresh substrate in each cultivation (method 1), substrate was reused after removing the leaves and shredding the substrate (method 2), shredding the substrate together with the foliage (method 3) and cutting out the old plant and replanting the created plant hole (method 4). Shredding makes the substrate finer and during the second and third use of the substrate, the crop growth is hampered and production is lost. Only with retaining the structure of the substrate in method 4 we realize similar results as the fresh substrate.

For practical reasons it is not an option for growers to execute method 4 constantly. Growers would prefer to shred and store the substrate for the next use on their company. It also allows to mix substrate with fresh components. Also, cutting out the plants in method 4 is very time consuming and therefore expensive, not really an option in a cultivation were labour costs are already around € 1,1 per harvested kilogram of fruits.

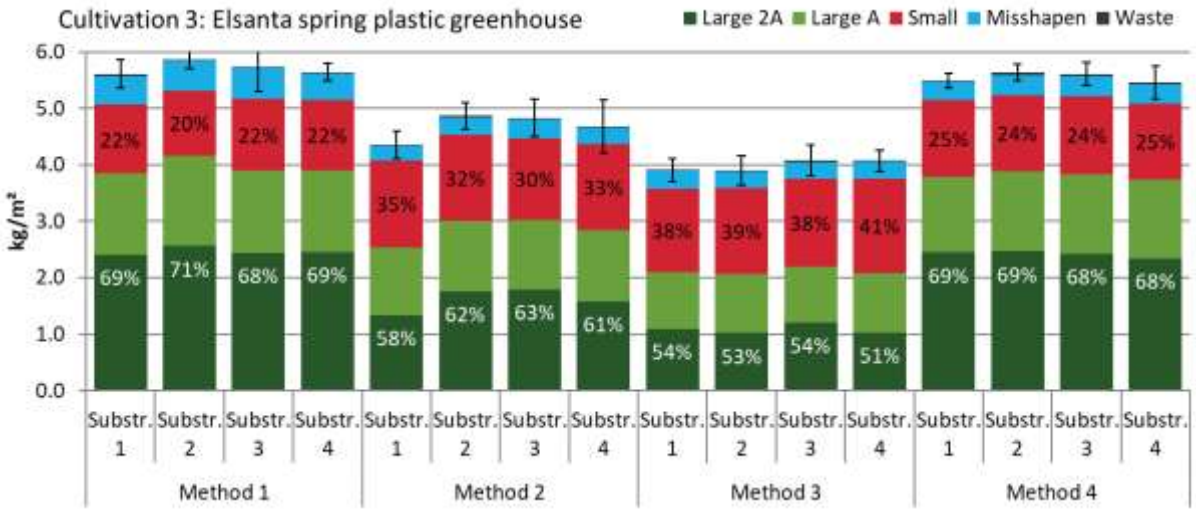

Figure 1-1 Yielding results after a cultivation in 3 times used substrate, trial with cultivar Elsanta in spring 2024.

After meeting up with Oddbjorn Bergen from the Norwegian company SoilSteam in February 2024 a collaboration arised. Used strawberry substrate after shredding has the right texture and feel to steam it according to SoilSteam. So a plan was merged to test the SoilSteam steaming technology in a for Belgium common way of growing strawberries. The goal is to reuse substrate after shredding and find out if steaming can give a surplus to the previous obtained results at Proefcentrum Hoogstraten.

2 TRIAL SET-UP

2.1 Background of substrate

Two substrates of the previous reuse trial in Hoogstraten did not contain perlite and were mixed through shredding without the foliage in December 2024 by the company Heecon. Substrate was taking form the methods based on shredding (with and without foliage). We are talking about substrates that are already used 4 times in strawberry cultivation. The two mixtures were a 100% peat mixture and a 75% peat and 25% woodfibre mixture. Around 2 m³ of shredded substrate was available for the trial to perform a fifth cultivation. Additionally, fresh 75% peat and 25% woodfibre mixture was also used in autumn cultivations at PCH in 2024, also from this substrate 2 m³ were shredded to be reused for the first time in the SoilSteam set-up.

2.2 Steaming of substrate

From each pile 1 m³ of substrate was steamed with the SoilSaver P8 installation at Coöperatie Hoogstraten in Belgium. SoilSteam arranged transport to Belgium, PCH arranged a crane for unloading the truck and the technical teams of SoilSteam and Coöperatie Hoogstraten installed the machine. On February 5th 2025 the two substrates were steamed at plus 90°C and brought back to PCH to dry out and cool down.

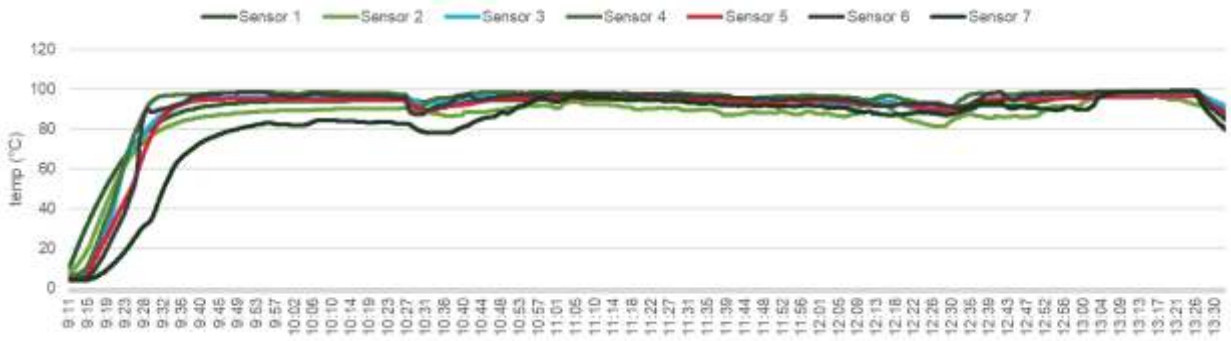

Figure 2-1 Temperature measured in the steaming compartment of the SoilSaver P8 during the operation on 5 February.

2.3 Set-up of cultivation trial

On 12 March 2025 Sonsation trayplants were planted in 17 different objects. The trial was planted as a spring cultivation in a non-heated plastic greenhouse of the type Van Den Heuvel. The first object is the control with fresh substrate of a 75% peat and 25% woodfibre mixture. In the next 4 objects the 25% woodfibre mixture that already was used once is mixed with fresh substrate at 20%, 40%, 60% and 100% reuse. The reused substrate is not steamed, only shredded. Objects 6 to 9 are similar to the previous 4 objects, only in this case all reused substrate is steamed by SoilSteam. The last 8 objects are a repetition of objects 2 to 9 with the difference that the substrate has been used already 4 times before and has been shredded 4 times already. Each object was planted in 4 repeating plots of 60 plants at a density of 10 plants/m².



Every reuse percentage was connected to a different fertigation unit. We used 4 units to conduct this trial in case a certain percentage of reuse is in need of a different fertigation strategy. The fresh substrate and 20% reuse objects were combined to a unit, the other reuse percentages used a seperate fertigation unit. Drain EC and substrate moisture levels were regularly measured and if necessary the frequency of irrigation or EC levels of the feeding water were altered. We can already say that the frequency was never changed during the spring cultivation and minimum EC changes were needed to get a drain EC of 1,5 mS/cm during the cultivation in all different objects. In total close to 350 l/m² was dripped during the cultivation that ended on 17 June.

Tabel 2-1 Objects and description

	Object	Description
1	Fresh	75% peat - 25% woodfibre mixture
2	20% 1x used not steamed	Peat-woodfibre mixture: 20% reuse without steaming and 80% fresh
3	40% 1x used not steamed	Peat-woodfibre mixture: 40% reuse without steaming and 60% fresh
4	60% 1x used not steamed	Peat-woodfibre mixture: 60% reuse without steaming and 40% fresh
5	100% 1x used not steamed	Peat-woodfibre mixture: 100% reuse without steaming
6	20% 1x used steamed	Peat-woodfibre mixture: 20% reuse with steaming and 80% fresh
7	40% 1x used steamed	Peat-woodfibre mixture: 40% reuse with steaming and 60% fresh
8	60% 1x used steamed	Peat-woodfibre mixture: 60% reuse with steaming and 40% fresh
9	100% 1x used steamed	Peat-woodfibre mixture: 100% reuse with steaming
10	20% 4x used not steamed	Trial mixture: 20% reuse without steaming and 80% fresh
11	40% 4x used not steamed	Trial mixture: 40% reuse without steaming and 60% fresh
12	60% 4x used not steamed	Trial mixture: 60% reuse without steaming and 40% fresh
13	100% 4x used not steamed	Trial mixture: 100% reuse without steaming
14	20% 4x used steamed	Trial mixture: 20% reuse with steaming and 80% fresh
15	40% 4x used steamed	Trial mixture: 40% reuse with steaming and 60% fresh
16	60% 4x used steamed	Trial mixture: 60% reuse with steaming and 40% fresh
17	100% 4x used steamed	Trial mixture: 100% reuse with steaming

3 RESULTS

3.1 Crop and flower truss length

Both in crop and flower truss length we see a big benefit from steaming. Reuse even at 20% results in a compact crop, 10 cm smaller than the control. Steaming restores the growth and results in a vigourous crop with long flower trusses.

Table 3-1 Crop length and flower truss length in cm

Object	Crop length (14/Apr)	Crop length (3/Jun)	Flower truss length (12/Jun) Longest
Statistics	*F(16,51)=7,912 p=6,040e-9*	*X(16)=58,647 p=8,833e-7*	*F(16,51)=39,324 p=4,601e-23*
Fresh	27,3 def	49,1 df	32,3 b
20% 1x used not steamed	25,7 abcde	39,6 c	26,4 a
40% 1x used not steamed	25,8 abcde	39,6 c	25,8 a
60% 1x used not steamed	25,7 abcde	39,4 c	26,3 a
100% 1x used not steamed	24,7 abcde	36,8 a	24,8 a
20% 1x used steamed	27,6 ef	48,8 def	32,3 b
40% 1x used steamed	26,6 bcdef	48,6 def	31,8 b
60% 1x used steamed	28,2 f	48,7 def	32,9 b
100% 1x used steamed	26,6 bcdef	47,6 e	32,2 b
20% 4x used not steamed	25,2 abcde	38,7 bc	24,8 a
40% 4x used not steamed	25,0 abc	39,3 c	25,6 a
60% 4x used not steamed	25,7 abcde	39,4 bc	25,6 a
100% 4x used not steamed	23,7 a	38,1 ab	25,6 a
20% 4x used steamed	26,7 bcdef	48,5 def	31,6 b
40% 4x used steamed	27,1 cdef	48,8 f	32,3 b
60% 4x used steamed	27,4 ef	48,3 de	31,6 b
100% 4x used steamed	25,9 bcdef	48,4 def	32,1 b

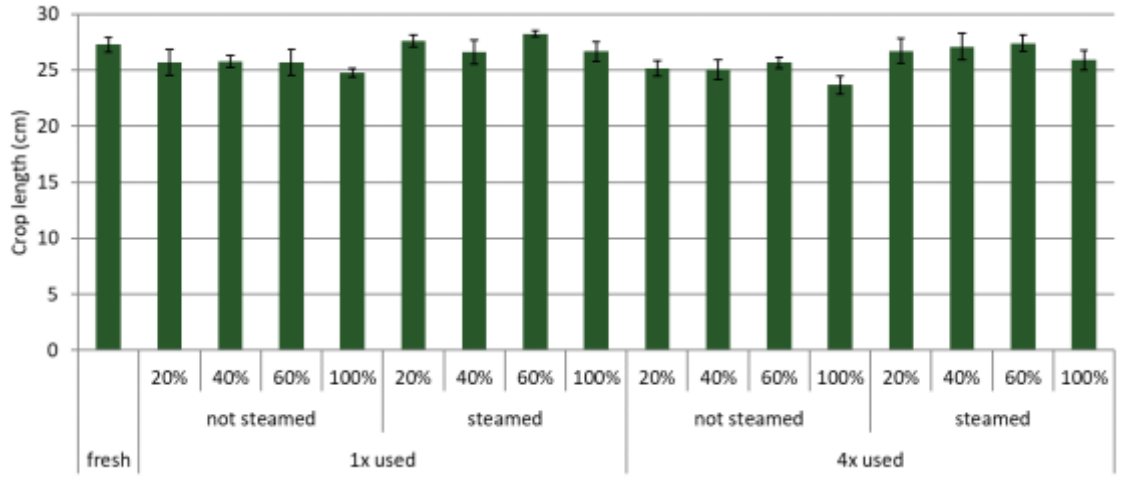

Figure 3-1 Crop length in cm on 4 April 2025

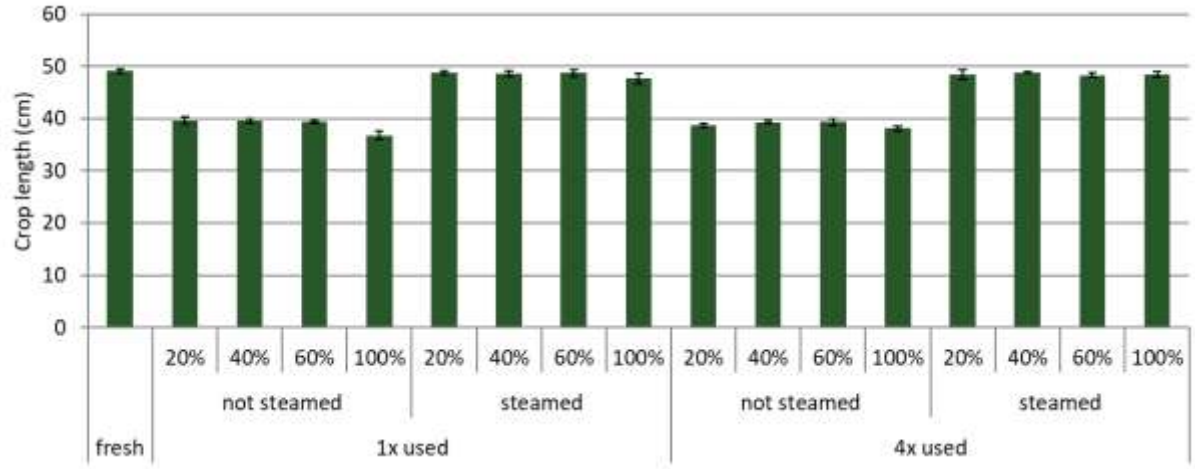

Figure 3-2 Crop length in cm on 3 June 2025

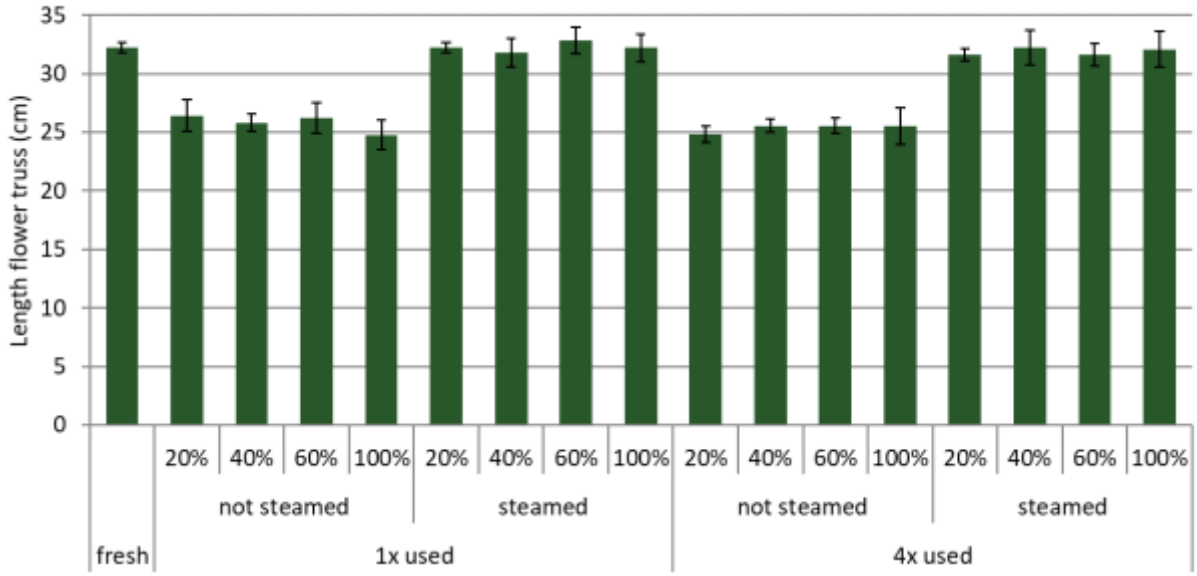

Figure 3-3 Length of the longest flower truss in cm on 12 June 2025

Figure 3-4 On the left 100% reuse of 1x used substrate without steaming, on the right with steaming. Photo 16 April 2025

3.2 Crop assessment on 15 May 2025

Fresh

20% 1x used not steamed

40% 1x used not steamed

60% 1x used not steamed

100% 1x used not steamed

20% 1x used steamed

40% 1x used steamed (photo from 8 May)

60% 1x used steamed

100% 1x used steamed

20% 4x used not steamed

40% 4x used not steamed

60% 4x used not steamed

100% 4x used not steamed

20% 4x used steamed 	40% 4x used steamed 
60% 4x used steamed 	100% 4x used steamed 

3.3 Plant loss

There was no loss of plants due to root diseases in the cultivation. Plant loss was countend on 3 June 2025.

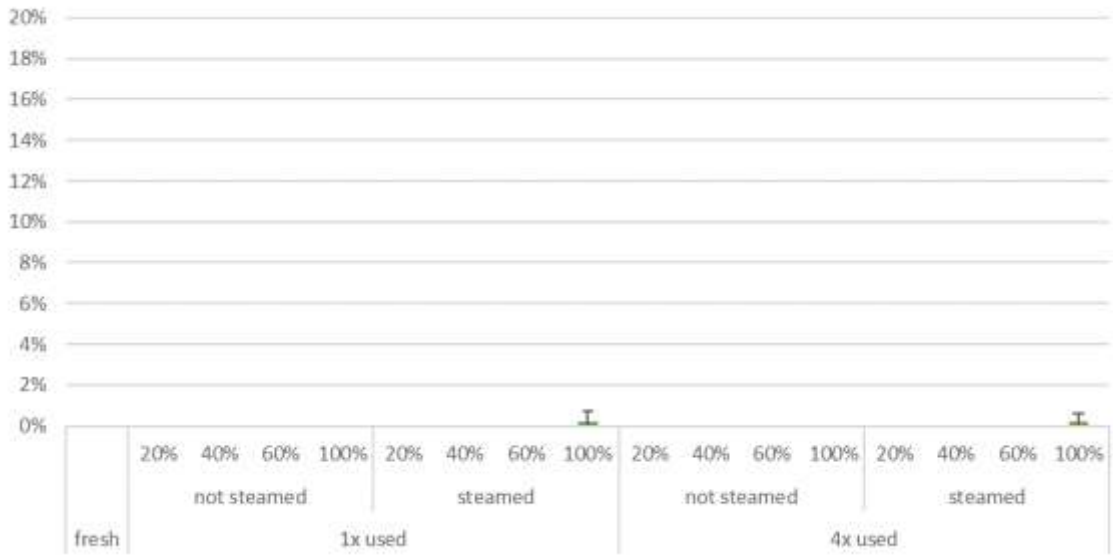

Figure 3-5 Plant loss in %

3.4 Yield and Grading

Harvest started on 15 May, the last fruits were picked on 16 June. Reuse without steaming suffers production loss. On the fresh substrate we harvested 5,36 kg/m². At 20% reuse of 1x used substrate we harvest 5,14 kg/m². When we look at higher reuse mixtures production loss gets bigger, with 4,51 kg/m² at 100% reuse. Using a substrate for the fifth time, even at 20% reuse yield drops down to 4,80 kg/m².

Steaming is a corrective treatment and all reuse objects suddenly produce at least as good as the fresh control. First time reuse gives 5,49-5,82 kg/m² in the different resue mixtures. Reuse for the fourth time and after steaming yields in the range of 5,38-5,67 kg/m² in the different mixtures. In grading we see the most important differences in the largest fruits.

The stress that not steamed reused substrate is giving we also see in the mid harvest date (the day 50% of the total yield is picked). Forced growth is advancing this date, meaning that yield is mainly lost in the second part of the harvest period. Steaming results in a later mid harvest date, similar to the fresh substrate.

Tabel 3-2 Yield and grading in kg/m²

Object	kg/plant	kg/m²	Large 2A	Large A	Small	Misshapen	Waste
Statistics	*F(16,51)=7,953 p=5,548e-9*	*F(16,51)=7,953 p=5,548e-9*	*X(16)=43,999 p=1,973e-4*	*F(16,51)=1,800 p=0,057*	*F(16,51)=0,888 p=0,586*	*X(16)=35,793 p=0,031*	*X(16)=14,902 p=0,532*
Fresh	0,54 bcdefg	5,36 bcdefg	2,96 ns	1,07 ns	1,11 ns	0,22 ns	0,01 ns
20% 1x	0,51 abcdefg	5,14 abcdefg	2,56 ns	1,24 ns	1,16 ns	0,17 ns	0,01 ns
40% 1x	0,47 ab	4,74 ab	2,38 ns	1,07 ns	1,12 ns	0,16 ns	0,02 ns
60% 1x	0,47 ab	4,73 ab	2,33 ns	1,11 ns	1,07 ns	0,21 ns	0,02 ns
100% 1x	0,45 a	4,51 a	2,29 ns	1,04 ns	1,05 ns	0,09 ns	0,03 ns
20% 1x S	0,57 efg	5,65 efg	3,13 ns	1,22 ns	1,08 ns	0,20 ns	0,02 ns
40% 1x S	0,58 g	5,82 g	3,22 ns	1,15 ns	1,19 ns	0,24 ns	0,02 ns
60% 1x S	0,56 defg	5,63 defg	3,17 ns	1,10 ns	1,14 ns	0,20 ns	0,01 ns
100% 1x S	0,55 cdefg	5,49 cdefg	3,09 ns	1,16 ns	1,10 ns	0,12 ns	0,02 ns
20% 4x	0,48 abc	4,80 abc	2,46 ns	1,05 ns	1,09 ns	0,18 ns	0,02 ns
40% 4x	0,50 abcdef	5,03 abcdef	2,58 ns	1,15 ns	1,11 ns	0,16 ns	0,02 ns
60% 4x	0,49 abcde	4,94 abcde	2,53 ns	1,08 ns	1,19 ns	0,12 ns	0,02 ns
100% 4x	0,49 abcd	4,92 abcd	2,57 ns	1,08 ns	1,15 ns	0,09 ns	0,02 ns
20% 4x S	0,57 fg	5,67 fg	3,02 ns	1,27 ns	1,14 ns	0,22 ns	0,01 ns
40% 4x S	0,56 defg	5,57 defg	2,97 ns	1,20 ns	1,18 ns	0,20 ns	0,02 ns
60% 4x S	0,52 abcdefg	5,20 abcdefg	2,60 ns	1,17 ns	1,22 ns	0,18 ns	0,02 ns
100% 4x S	0,54 bcdefg	5,38 bcdefg	3,00 ns	1,16 ns	1,06 ns	0,14 ns	0,02 ns

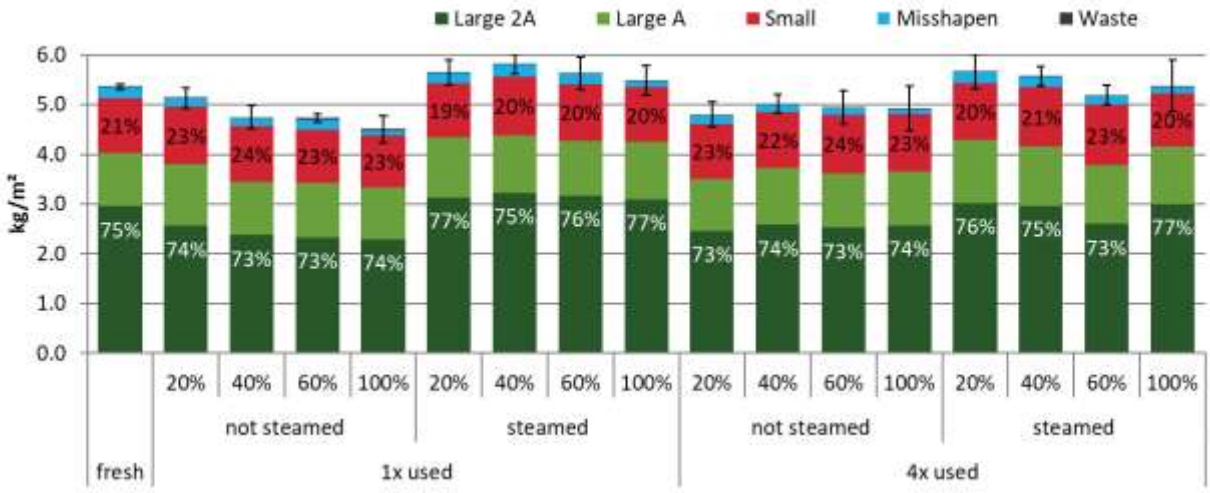

Figure 3-6 Yield and grading in kg/m²

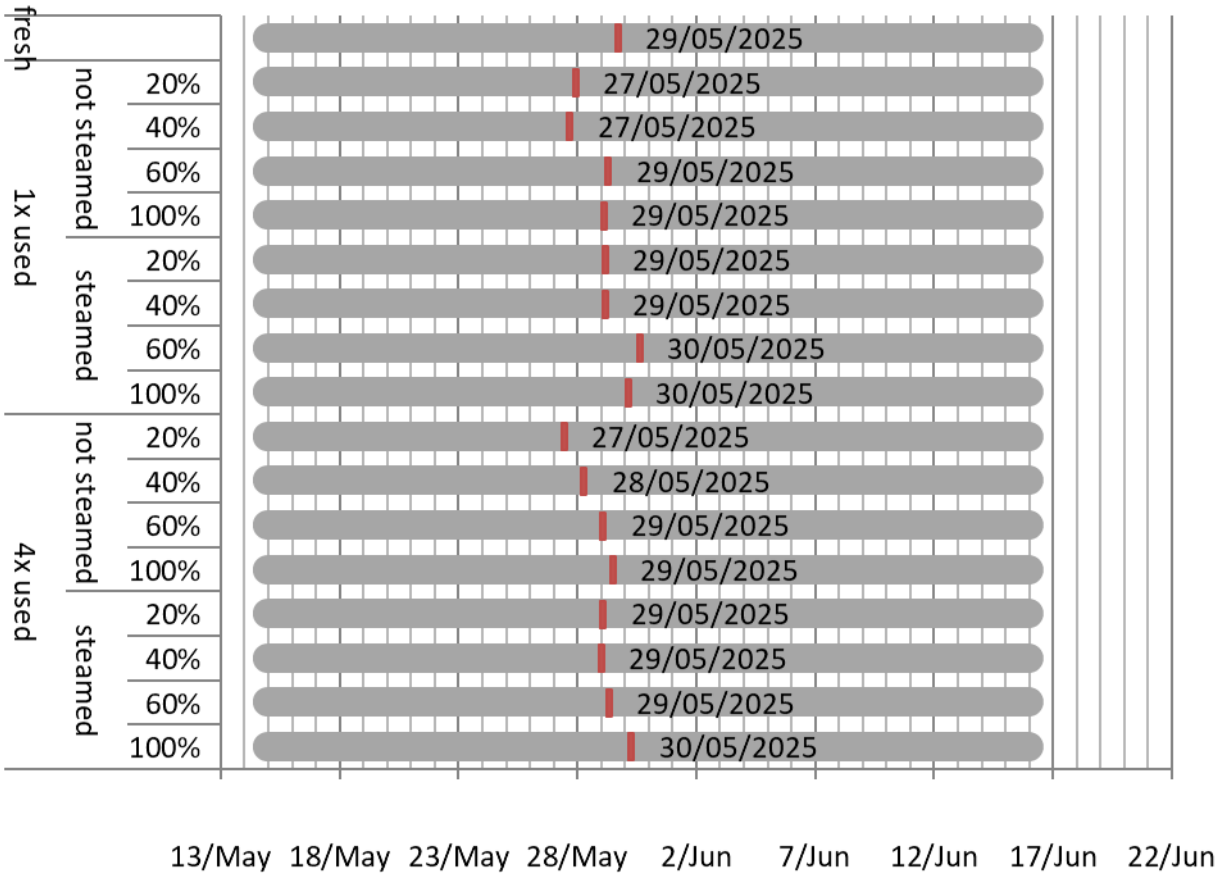

Figure 3-7 Visual representation of the harvest period per object and the midharvest date

3.5 Fruit Quality

3.5.1 Fruit assessment

Fruits were visually assessed on 19 May and on 12 June. In all objects we found high quality Sonsation fruit. At none of the two picking dates there was a visual difference between the seventeen objects. Photos were taken on the harvest of 19 May.

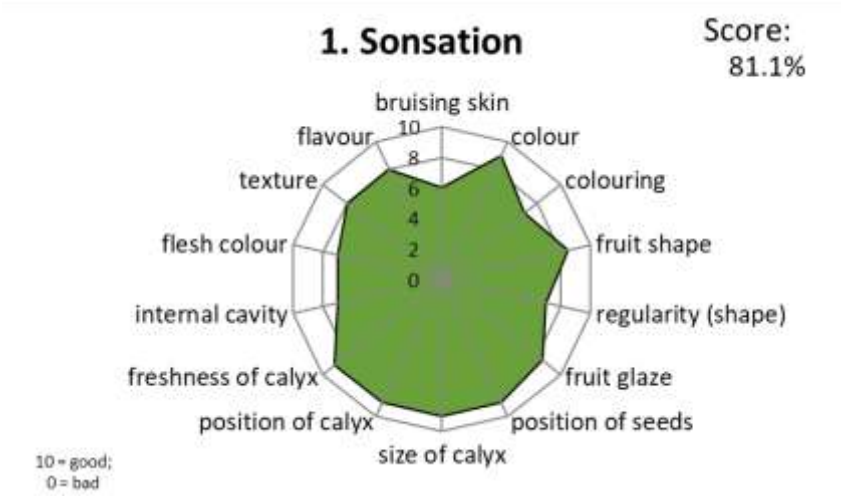

Figure 3-8 Overal score of Sonsation fruit In the different objects (>75% is excellent fruit quality).

Fresh 	
20% 1x used not steamed 	40% 1x used not steamed 
60% 1x used not steamed 	100% 1x used not steamed 

20% 1x used steamed 	40% 1x used steamed 
60% 1x used steamed 	100% 1x used steamed 
20% 4x used not steamed 	40% 4x used not steamed 

60% 4x used not steamed 	100% 4x used not steamed 
20% 4x used steamed 	40% 4x used steamed 
60% 4x used steamed 	100% 4x used steamed 

3.5.2 Firmness and brix

There are some differences measured between the objects on 19 May and 12 June, but non correlating with the steam treatment or with the reuse of the substrate. Therefore there is no indication of an influence on these parameters of fruit quality.

Figure 3-9 Firmness and brix

3.5.3 Shelf life assessment

Fruits of the harvest of 19 May and 12 June were stored during 8 days at 12°C to see how fruit quality declines in storage. There was no measurable difference spotted between the objects. Photos were not taken.

4 CONCLUSION

In this trial we see a similar effect of reuse of substrate after shredding. Strawberry plants are hampered in stretching of both the leaves and the trusses. The crop stays more compact resulting in production loss. In this trial we lose up to 1 kg/m² in the objects with a high percentage of reuse compared to the yield with the fresh substrate. Reusing substrate for the first time seems to give a better result than reusing substrate for the fouth time, especially in the blends at al low percentage of substrate reuse. In previous trials it looked like the shredding is making the substrate finer and therefore draining becomes more difficult. Salty and wet root circumstances hamper the development of the plants. However, the results in this trial indicates something else going on.

Steaming seems to revitalise the substrate. In all objects with reuse and steaming we see a similar crop development to the fresh substrate. Strong stretched leaves with long vigourous trusses reasure the full use of the production potential of the plants. With steaming the reuse of shredded substrate becomes possible. Even at 100% reuse for the fourth time we did see a very good crop development.

In this trial we had the opportunity to reuse substrate for a first and for a fourth time. Shredding does make the substrate finer, therefore we made blends with 20%, 40%, 60% and 100% reuse of substrate. With the substrate reused after steaming for the first time, we see a decline in yield starting from 60% reuse. However, even at 100% reuse yield is just as good as the control on the fresh substrate. Reuse for the fourth time and after a steam treatment gives similar results. With a slight decline in yield starting from 60% reuse, but more importantly with no production loss compared to the control even at 100% reuse.

This trial took into account several important factors for growers to consider reuse. The trial looked at multiple reuse, mixing in reused with fresh substrate, shredding, adaptive water supply,… One big conclusion can be drawn. Steaming with the SoilSaver P8 of SoilSteam can reset a substrate to act as fresh substrate. Although the texture becomes fine due to shredding and possibly steaming, in the spring Sonsation cultivation of this trial we can match the yield and quality result of the fresh substrate with steamed reused substrate.