Climate mitigation performance assessment based on agronomic and environmental indicators

ORGANIKO LIFE+ PROJECT

Revamping organic farming and its products in the context of climate change mitigation strategies

Type of deliverable: Report

Action C2, Activity 2.4

""Report on post-harvest performance of apple fruit grown under different farming systems""

Partner: Cyprus University of Technology

Author: George Manganaris

Contributors:Marina Christofi

FINDINGS AT A GLANCE

The agricultural system has no effect on the post-harvest characteristics of apple fruits

The implementation of organic farming nutrient schemes resulted in an increase of starch index in apple fruits

Executive Summary

Σκοπός

Στόχος της παρούσας έκθεσης είναι να παράσχει λεπτομερή στοιχεία για τα μετασυλλεκτικά χαρακτηριστικά καρπών μήλου σε οργανικά συστήματα του ΙΓΕ και να τα συγκρίνει με τα σε συμβατικό σύστημα παραγωγής. Η έκθεση αυτή εντάσσεται στο πλαίσιο της Δράσης C2 και ειδικότερα στο πλαίσιο της Δράσης C2.4.

Αντικτυπος

Μετρήσεις των ποιοτικών χαρακτηριστικών σε διαφορετικά συστήματα διαχείρισης θρέψης βιολογικής γεωργίας συγκρίθηκαν με αυτά του συμβατικού συστήματος για να διαπιστωθούν διαφορές μεταξύ των στρατηγικών θρέψης. Ειδικότερα, μετρήθηκαν ποιοτικά χαρακτηριστικά όπως χρώμα, συνεκτικότητα σάρκας, δείκτης αμύλου, διαλυτά στερεά.

Αποτελέσματα

Η εφαρμογή συστημάτων βιολογικής γεωργίας στα μήλα ως προς την μετασυλλεκτική τους ποιότητα δεν διαφέρει με αυτά των καρπών που παράχθηκαν στο σύστημα της συμβατικής γεωργίας. Οι τιμές του δείκτη αμύλου ήταν χαμηλότερη στους καρπούς που συλλέχθηκαν από τα συστήματα συμβατικής γεωργίας.

Συμπεράσματα

Η ποιότητα των καρπών μήλου στα συστήματα βιολογικής γεωργίας δεν διαφέρουν από αυτά της συμβατικής γεωργίας κατά τη μετασυλλεκτική τους διατήρηση.

Executive Summary

Purpose

The aim of this report is to provide detailed information on the post-harvest apple fruit characteristics in the pilot organic farms established during LIFE+ORGANIKO and compare them with apple fruits produced under the conventional production system. This report is part of the C2 action, particularly in the context of C 2.4. activity.

Outcome

Measurements of qualitative post-harvest properties of apple fruits grown under organic farming practices, using different nutrient management schemes and compared with apple fruits harvested from conventional farming system. In particular, firmness, starch index, soluble solids and colour were determined and evaluated.

Results

The implementation of organic farming system and the different nutrient management strategies had no significant effect on the post-harvest quality. The qualitative characteristics of the apple fruits harvested from trees received different organic farming nutrient management practices were similar with those of conventional farming system.

Conclusion

Under the conditions of Cyprus climate and inherent orchard characteristics, the implementation of organic farming practices does not substantially improve the post-harvest properties of apple fruits.

Introduction

Many of the European countries do not achieve minimal recommended intake of fruit and vegetables proposed by FAO/WHO. Increase fruit consumption is therefore a public health objective (WHO, 2003) that has been translated into several campaigns of promotion of fruit consumption but also research projects promoted from the European Union to diminish barriers to fruit consumption that could hamper the achievement of minimal fruit intake (Bonany et al., 2014). A possible barrier for increased fruit consumption is insufficient fruit quality and the concerns about the potential pesticide residues.

Apples (*Malus x domestica*) are the most popular temperate fruits, ranking first worldwide in terms of cultivated area and productivity. In addition to desirable gustatory and sensory attributes, apples constitute a reservoir of health-promoting compounds, resulting in the old saying 'an apple a day keeps the doctor away' (Weichselbaum et al., 2010). The most commonly cited economic indicator for organic food is the price premium. This premium is the price difference between organic and conventional fruit expressed as a percent. Many tree fruit producers enter into organic production for the potential increase in profits that higher organic price premiums may bring. However, reliable data on the cost of production for organic tree fruit is generally lacking, thus limiting the ability to determine whether organic production is profitable, regardless of high or low premiums. Nevertheless, a new WSU enterprise budget suggests that organic production can be a profitable option (Galinato et al. 2011).

Cyprus is characterized by small production volumes of apples (80th worldwide) and few growers have directed their efforts towards the production of organic apples (Goulas et al., 2015). The apple organic production is quite expanded in Italy (Europe) and at the Washington State (USA). The latter is excellent example of success story regarding organic apple production that represented nearly 10% of the state's total apple acreage and 7% of sales volume in 2010.

Following several years of rapid expansion in Washington (more than 100% from 2004 to 2009), certified apple acreage dropped 6%, from 15,735 acres in 2009 to 14,800 acres in 2010. Gala and Fuji varieties made up 45% of the total organic apple acreage, while less than 10% of the acres were Red Delicious. Despite the downturn in number of acres, Washington organic apple sales volume increased to 6.8 million boxes (40 lb. SEB) for the 2010/2011 market year, exceeding the 5.9 million boxes sold the previous year. Growth in sales volume despite a decline in acreage was likely due, in part, to less diversion of organic fruit to conventional markets.

It' s worth noting that Washington State University's Center for Sustaining Agriculture and Natural Resources (WSU-CSANR) has compiled statistics on organic tree fruit production in Washington since 1998 in order to provide annual updates containing current, detailed information that can be used for industry planning, decision making, and risk management. These reports have included historical information on certified organic and transition acreage by variety (where available), state distribution of acreage, and market information. Annual organic tree fruit statistical information is posted online at http://csanr.wsu.edu/pages/Organic_Statistics.

The current activity aimed to determine the quality attributes of apple fruits, subjected to different treatments, at harvest and after extended shelf life period.

Materials and Methods

A pilot organic certified orchard with 'Starking Delicious' apples, located in Kyperounda was used for the needs of the current study. Different nutrient management treatments within the orchard were applied in a completely randomized design with three replicates for each treatment. Treatments included:

(A) Manure

(B) Compost tea

(C) Mulching with pruning residues

(D) Compost

For comparative purposes, a neighboring commercial orchard was used. Forty eight fruits of similar size and free from defects have been carefully selected per treatments. Such fruit were analyze after 1 and 7 days maintenance (Fig. 1) at room temperature to dissect their post-harvest performance.

The following quality parameters were determined:

- color parameters
- flesh firmness
- starch index
- soluble solid content
- titratable acidity
- ripening index

Color was determined using the CR-400, Konica Minolta reflection colorimeter to indicate the coordinates L* (brightness or lightness; 0= black, 100= white), a* (-a*= greenness, +a*= redness) and b* (-b*= blueness, +b*= yellowness). Two measurements were made diametrically from equatorial sites of the fruit as technical replicates for both H and H+3 for the same fruit.

Hue angle [(H°) (0° = red-purple, 90° = yellow, 180° = bluish-green, 270° = blue)] and Chroma (degree of departure from grey to pure chromatic color) were also calculated as tan−1 (b*/a*) and (a*2 + b*2)½ respectively. The ratio a*/b* was also calculated.

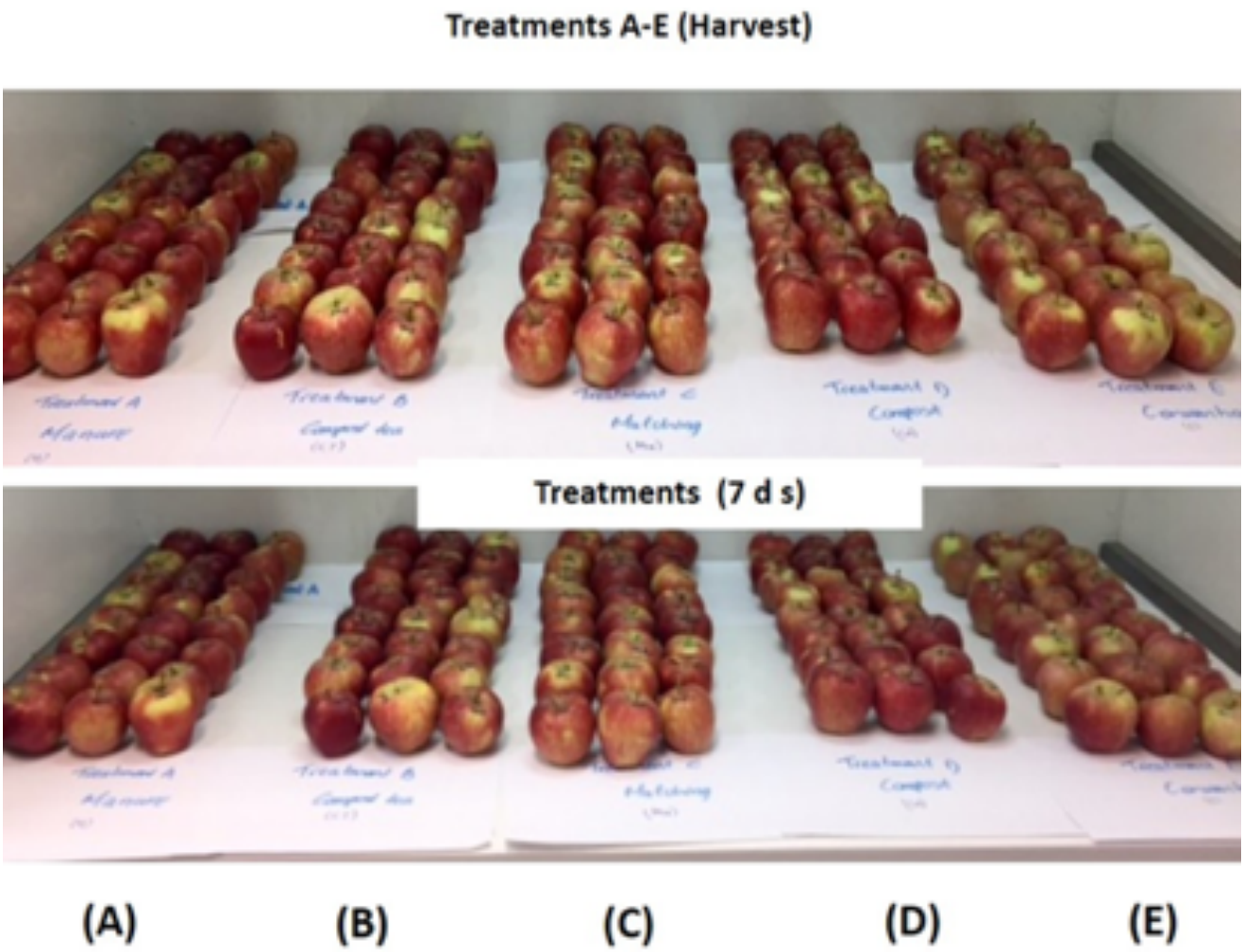

Fig 1. Phenotypic appearance of 'Starking Delicious' apples at harvest and after additional maintenance at room temperature.

Firmness was measured on two peeled sides of each fruit using a digital penetrometer (model 53205 TR, Turoni, Forl_ı, FC, Italy) equipped with an 11-mm-diameter tip and was expressed as Newtons. Fruit tissues (wedged shaped slices) were homogenized using a T 25 digital ULTRA-TURRAX (IKA_-Werke GmbH & Co.KG, Germany), followed by centrifugation at 15 093 g for 7 min.

The supernatants were used to determine soluble solids content (SSC) with a digital refractometer (DR103L, Sun Instruments Corp., Torrance, CA, USA). The supernatant titratable acidity (TA) was measured via potentiometric titration (Mettler Toledo DL22, Columbus, Ohio, USA) of 5 mL supernatant diluted to 50 mL with distilled water using 0.1 N NaOH. Styarch index was additionally determined in accordance with the Laimburg system.

Results and Discussion

Fruit ripened during shelf life without the treatments applied to affect any of the parameters analyzed. Ibn the following sections, results for each treatment at 1 and 7 days shelf life is presented.

Starch index

Starch index went descending during the 7 day shelf life period without evident changes among treatments applied (Table 1, Fig. 2).

Table 1. Starch index of 'Starking Delicious' apples at harvest and after additional maintenance at room temperature for the five treatments applied.

	Starch Index (H+1)				
	Manure	**Compost tea**	**Mulching**	**Compost**	**Conventional**
Mean	**2,77**	**2,58**	**2,46**	**2,79**	**2,17**
SD	**0,39**	**0,48**	**0,33**	**0,49**	**0,50**
SE	**0,08**	**0,10**	**0,07**	**0,10**	**0,10**
	Starch Index (H+7)				
Mean	**3,54**	**3,79**	**4,21**	**3,65**	**3,50**
SD	**0,29**	**0,46**	**0,51**	**0,48**	**0,15**
SE	**0,06**	**0,09**	**0,10**	**0,10**	**0,03**

In particular, 7 days after harvesting starch index was significantly increased in all fruits irrespectively of the nutrient management scheme followed. However, one day after harvesting, the starch index was significantly higher from that measured in conventional cultivated apples. These findings suggest that the maturity of organic farming crops were less mature compared to those harvested in organic farming.

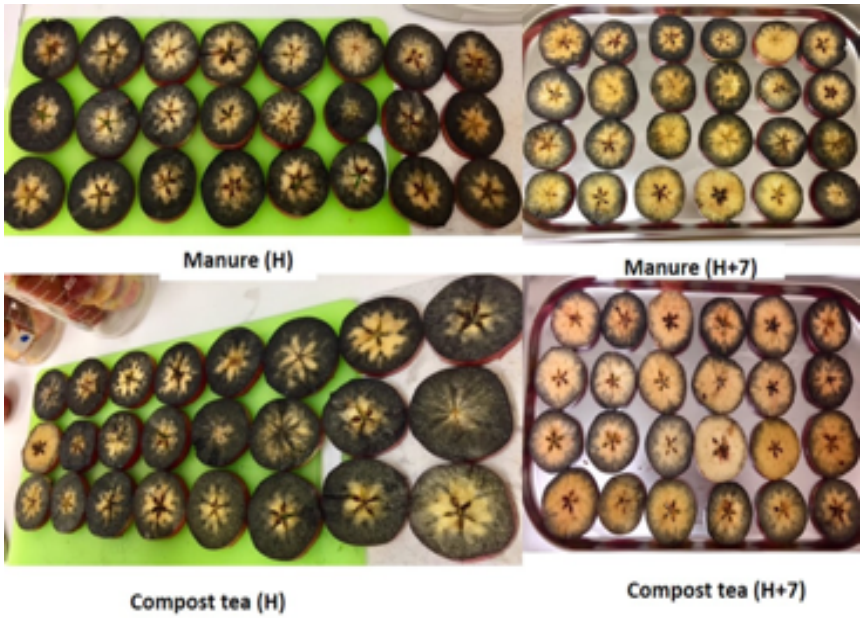

Fig 2. Starch index according to Laimburg scale (1-5) of 'Starking Delicious' apples at harvest and after additional maintenance at room temperature of 'manure' and 'compost tea' treated orchards.

Quality attributes

Phenotypic data, tissue firmness and other quality attributes are depicted in Tables 2, 3 and Fig. 3

Table 2. Firmness of 'Starking Delicious' apples at harvest and after additional maintenance at room temperature for the five treatments applied.

	Firmness (H+1)				
	Manure	**Compost tea**	**Mulching**	**Compost**	**Conventional**
Mean	85,04	81,07	79,55	82,22	81,35
SD	5,40	7,77	7,21	7,95	7,01
SE	1,10	1,59	1,47	1,62	1,43
	Firmness (H+7)				
Mean	74,15	72,93	68,49	71,90	72,75
SD	5,75	6,53	4,48	4,89	5,22
SE	1,17	1,33	0,91	1,00	1,06

Table 3. Soluble solids content, titratable acidity and ripening index of 'Starking Delicious' apples at harvest and after additional maintenance at room temperature for the five treatments applied.

	H1				
	Manure	**Compost tea**	**Mulching**	**Compost**	**Conventional**
Titratable Acidity (%)	0,35	0,34	0,33	0,32	0,37
Brix (%)	12,00	13,20	11,85	14,20	13,45
Ripening Index	34,19	38,37	36,02	44,79	36,16
	H7				
Titratable Acidity (%)	0,35	0,34	0,33	0,32	0,37
Brix (%)	12,00	13,20	11,85	14,20	13,45
Ripening Index	34,19	38,37	36,02	44,79	36,16

An overview of all results are provided in the Appendix of the current report.

Conclusions

One of the main drawback of Cyprus organic apples is the small size. Smaller fruit have typically received lower average box prices. For example, values obtained using Washington Growers Clearing House sales data (unpublished) revealed that in the fall of 2007, Organic Gala Washington Extra Fancy (WAXF) #1 grade (size 80-100) brought premiums ranging from 66%-82% compared to 22% for size 113. The recommendation is such small fruits to be packaged appropriately and destined for children in accordance with the main aims of LIFE+ORGANIKO that aims to produce organic apple consumption among them.

References

Bonany J, Brugger C, Buehler A, Carbó J, Codarin S, Donati F, Echeverria G, Egger S, Guerra W, Hilaire C et al: Preference mapping of apple varieties in Europe. Food Quality and Preference 2014, 32(PC):317-329.

Galinato, S., D. Granatstein, and M. Taylor. 2011. 2010 Cost estimates of establishing and producing organic apples in Washington. Washington State University Extension Fact Sheet FS041E. https://pubs.wsu.edu/ItemDetail.aspx?ProductID=15437.

GOULAS V, KOURDOULAS P, MAKRIS F, THEODOROU M, FELLMAN JK, MANGANARIS GA. Comparative polyphenolic antioxidant profile and quality of traditional apple cultivars as affected by cold storage. International Journal of Food Science & Technology 2014, 49, 2037-2044.

Weichselbaum, E., Wyness, L. and Stanner, S. Apple polyphenols and cardiovascular disease- a review of the evidence. Nutrition Bulletin 2010, 35, 92–101.

APPENDIX

No of fruit	Color parameters (Manure H+1)					Color parameters (Manure H+7)				
	L*	a*	b*	C*	h	L*	a*	b*	C*	h
1	38,74	26,07	14,58	29,87	29,24	37,43	26,92	15,18	30,92	29,58
2	47,46	21,49	21,54	30,88	45,56	49,57	19,97	21,87	29,69	47,74
3	46,91	23,88	20,40	31,63	40,48	44,41	23,94	20,26	31,55	39,95
4	53,02	8,48	27,60	33,39	70,60	54,09	7,68	28,60	29,61	74,96
5	40,92	28,64	17,62	33,63	31,59	40,36	27,45	17,61	32,61	32,69
6	38,51	27,59	17,19	32,51	31,92	41,90	25,17	18,78	31,60	36,61
7	42,89	25,59	17,58	31,15	34,36	42,92	23,63	17,64	29,54	36,71
8	41,73	25,93	17,22	31,37	33,22	39,58	26,46	15,69	30,90	30,04
9	33,97	26,92	11,58	29,36	22,79	31,64	26,20	10,55	28,25	21,94
10	43,92	28,30	18,73	33,98	33,69	41,09	26,62	17,42	31,84	33,38
11	39,54	26,42	13,98	29,93	27,60	38,35	25,11	15,86	29,90	31,46
12	52,38	15,70	25,87	31,53	59,29	46,42	23,74	22,49	32,90	43,75
13	43,54	27,60	17,99	32,95	33,10	42,36	26,79	17,95	32,27	33,97
14	41,22	28,24	17,18	33,06	31,31	40,74	29,21	17,47	34,06	30,94
15	52,71	15,95	24,74	29,44	57,18	50,89	17,17	23,93	29,51	54,39
16	52,91	17,96	24,32	30,58	53,94	46,84	22,99	22,32	32,05	44,16
17	56,46	10,05	28,09	29,87	70,28	52,08	14,69	24,98	29,01	59,37
18	42,51	24,90	18,45	31,32	36,11	42,50	22,46	18,82	29,97	40,06
19	46,71	26,99	23,02	35,56	40,58	43,32	28,21	22,76	36,25	38,90
20	49,71	17,17	24,58	31,37	55,47	46,66	20,15	22,04	31,23	47,28
21	41,68	24,91	16,92	30,12	34,20	40,37	25,01	16,64	30,04	33,64
22	49,42	19,72	21,98	30,14	48,50	50,65	17,29	23,01	30,21	53,70
23	43,45	26,50	19,44	33,03	36,27	41,71	22,03	19,44	30,14	40,66
24	43,08	27,43	21,30	34,87	37,74	45,78	26,06	25,71	36,76	44,60
Mean	45,14	23,02	20,08	31,73	41,46	43,82	23,12	19,88	31,28	40,85
SD	5,64	5,86	4,31	1,75	13,22	5,20	4,95	4,03	2,11	11,47
SE	1,15	1,20	0,88	0,36	2,70	1,06	1,01	0,82	0,43	2,34

No of fruit	Color parameters (Compost H+1)					Color parameters (Compost H+7)				
	L*	a*	b*	C*	h	L*	a*	b*	C*	h
1	38,09	31,55	17,20	35,93	28,61	39,30	29,12	16,43	33,44	29,40
2	49,18	21,91	22,67	32,35	47,19	50,24	20,57	23,34	31,64	49,56
3	47,72	26,30	23,38	35,39	41,78	49,60	24,44	24,79	34,95	45,49
4	45,30	26,71	18,73	32,69	35,04	43,95	26,19	19,62	32,86	36,86
5	37,24	28,26	14,39	31,73	26,96	36,03	27,66	15,00	31,51	28,18
6	45,77	26,12	18,08	32,26	34,38	46,74	22,15	22,10	33,10	45,18
7	56,96	9,96	26,66	31,21	68,79	54,83	13,29	27,24	31,84	63,86
8	39,92	29,45	15,19	33,16	27,32	38,28	28,54	16,04	32,80	29,25
9	46,90	24,66	21,54	32,90	41,03	45,62	26,37	22,46	34,67	40,32
10	40,44	26,11	17,92	31,78	34,22	39,40	12,87	19,93	12,90	15,46
11	46,25	30,47	20,43	36,76	33,96	42,29	31,78	20,28	37,71	32,54
12	49,60	23,10	23,13	33,30	45,65	50,10	20,96	23,99	32,75	49,46
13	46,60	24,16	21,19	32,27	41,62	46,34	21,06	21,84	30,65	46,51
14	46,20	24,41	20,57	32,33	40,52	44,50	25,77	20,71	33,17	38,87
15	40,34	29,37	15,96	33,44	28,56	40,19	26,95	17,36	32,16	32,99
16	53,23	17,37	25,24	31,14	55,71	50,33	21,22	25,70	33,42	50,52
17	48,58	21,72	20,91	31,47	45,25	50,13	17,92	26,56	33,06	55,87
18	41,50	25,87	16,98	31,34	32,69	41,75	24,71	18,21	31,14	34,94
19	43,29	25,08	16,99	30,44	34,30	38,93	26,64	16,23	31,22	31,14
20	48,23	25,37	21,52	33,31	40,38	58,10	11,83	27,16	33,00	67,29
21	56,12	11,90	26,29	28,95	65,60	54,93	11,45	26,48	29,81	66,38
22	44,14	28,71	19,22	34,60	33,75	45,59	27,45	20,13	34,04	36,26
23	54,29	12,88	23,84	28,20	61,67	49,00	17,82	23,41	29,86	52,91
24	44,58	27,30	20,19	34,07	36,66	43,51	26,67	18,90	32,72	35,37
Mean	46,27	24,11	20,34	32,54	40,90	45,82	22,64	21,41	31,85	42,28
SD	5,33	5,74	3,40	1,98	11,71	5,80	5,84	3,78	4,38	13,06
SE	1,09	1,17	0,69	0,40	2,39	1,18	1,19	0,77	0,89	2,66

No of fruit	Color parameters (Mulching H+1)					Color parameters (Mulching H+7)				
	L*	a*	b*	C*	h	L*	a*	b*	C*	h
1	45,52	30,04	21,96	37,22	36,22	42,10	31,57	20,39	37,59	32,80
2	42,41	24,86	18,91	31,57	37,09	41,21	26,27	20,45	33,59	37,60
3	49,95	14,05	23,31	29,63	59,02	45,56	18,15	19,96	28,27	46,85
4	44,95	25,00	20,10	32,10	38,83	46,33	23,02	21,68	31,62	43,28
5	49,03	20,49	20,96	29,37	45,65	48,61	19,37	24,84	32,09	52,66
6	39,99	28,44	18,26	33,80	32,69	40,82	26,85	19,29	33,07	35,68
7	46,47	24,16	21,32	32,28	41,42	42,99	27,29	22,10	35,30	38,86
8	46,67	18,98	21,89	31,06	49,38	43,30	25,75	18,73	31,93	35,95
9	40,19	28,34	16,61	32,95	29,85	39,87	30,12	19,49	35,92	32,75
10	43,27	26,79	17,72	32,15	33,54	40,91	27,32	18,61	33,07	34,17
11	41,84	26,63	17,97	32,13	33,99	44,10	25,23	20,61	32,59	39,21
12	45,36	24,72	21,45	32,76	40,91	46,71	22,61	22,45	31,86	44,79
13	45,64	24,57	22,21	33,12	42,09	43,86	25,92	22,56	34,38	40,98
14	55,05	8,32	26,41	29,93	70,72	48,25	18,00	23,80	30,00	53,04
15	47,22	24,67	22,52	33,46	42,52	45,56	26,15	23,33	35,10	41,79
16	48,56	15,97	20,62	29,41	51,67	43,03	22,91	18,96	30,58	38,54
17	42,20	27,12	19,37	33,33	35,54	43,13	24,84	21,54	33,52	40,36
18	50,34	17,46	23,43	31,31	54,55	48,05	20,96	22,67	31,81	47,54
19	44,57	30,55	20,19	36,62	33,48	49,77	25,80	25,86	36,63	45,09
20	51,61	20,17	24,96	32,10	51,06	54,95	16,99	27,74	33,56	58,74
21	46,18	24,13	20,25	31,80	40,39	40,09	27,17	17,87	32,53	33,34
22	53,65	18,95	26,04	32,24	53,96	54,00	17,27	27,33	32,37	57,69
23	41,66	29,90	19,09	35,53	32,39	41,70	30,88	21,50	37,72	34,78
24	51,73	19,85	25,58	33,26	52,88	52,56	18,80	27,58	33,43	55,76
Mean	46,42	23,09	21,30	32,46	43,33	45,31	24,14	22,05	33,27	42,59
SD	4,16	5,55	2,69	2,01	10,18	4,33	4,32	2,91	2,29	8,09
SE	0,85	1,13	0,55	0,41	2,08	0,88	0,88	0,59	0,47	1,65

No of fruit	Color parameters (Compost H+1)					Color parameters (Compost H+7)				
	L*	a*	b*	C*	h	L*	a*	b*	C*	h
1	45,55	26,41	22,98	35,01	41,01	51,07	25,33	26,82	36,97	46,83
2	53,42	18,41	25,59	33,29	56,62	41,42	31,03	22,51	38,40	36,10
3	54,46	16,19	24,69	31,77	58,86	48,76	20,08	20,31	28,61	45,52
4	49,13	22,61	22,19	32,83	46,13	48,83	24,34	23,64	34,21	44,44
5	47,25	22,92	22,07	32,61	44,43	40,86	27,60	19,64	33,94	35,47
6	52,34	19,14	24,46	31,87	52,52	50,92	18,94	24,58	32,32	53,29
7	46,76	20,77	22,76	30,90	47,71	49,25	17,50	25,29	30,75	55,31
8	45,19	25,33	20,85	32,99	39,57	46,55	22,10	20,98	30,88	43,37
9	41,48	28,05	17,37	33,08	31,57	41,35	26,04	18,12	31,85	34,62
10	43,00	31,31	19,77	37,04	32,30	41,72	29,72	19,94	35,79	33,86
11	49,82	24,24	22,98	33,56	43,61	50,76	22,63	24,54	33,60	47,45
12	44,61	30,69	20,17	36,73	33,32	44,14	29,08	21,82	36,36	36,92
13	49,89	23,25	22,29	32,78	44,55	50,75	19,90	23,32	31,44	50,03
14	49,65	20,61	22,73	31,00	48,50	51,28	16,93	22,69	29,23	53,70
15	48,82	22,44	21,56	31,13	43,86	47,42	22,96	22,56	32,27	44,41
16	44,51	27,29	19,84	33,74	36,08	45,37	26,26	19,64	32,79	36,83
17	45,56	24,79	20,54	32,41	39,60	47,46	20,37	21,85	30,79	47,43
18	47,71	21,49	21,23	31,20	45,10	47,73	20,64	21,87	30,75	46,90
19	54,85	14,60	23,02	27,65	58,60	55,46	10,47	27,76	29,69	69,53
20	44,27	24,95	20,21	32,14	39,01	51,21	17,26	24,54	31,06	55,65
21	41,23	28,17	15,54	32,17	28,87	39,68	28,91	17,03	33,56	30,49
22	49,47	22,41	23,27	33,21	47,14	48,36	24,51	25,24	35,80	46,35
23	49,40	26,39	22,21	35,30	41,65	47,74	26,54	22,15	34,90	40,36
24	40,38	31,09	18,83	36,35	31,22	41,27	28,99	17,88	34,07	31,68
Mean	47,45	23,90	21,55	32,95	42,99	47,06	23,26	22,28	32,92	44,44
SD	4,05	4,42	2,29	2,09	8,42	4,21	5,04	2,77	2,57	9,21
SE	0,83	0,90	0,47	0,43	1,72	0,86	1,03	0,57	0,52	1,88

No of fruit	Color parameters (Conventional H+1)					Color parameters (Conventional H+7)				
	L*	a*	b*	C*	h	L*	a*	b*	C*	h
1	58,35	8,33	26,59	30,95	70,79	56,01	10,47	27,30	30,31	68,09
2	49,62	21,29	21,01	30,12	45,02	47,51	24,18	23,32	33,95	43,57
3	48,23	21,13	20,59	30,33	44,58	44,19	26,68	20,51	33,72	37,66
4	54,08	15,57	22,76	27,58	55,58	62,79	1,54	32,18	33,22	84,15
5	51,69	17,33	20,17	27,98	50,24	53,14	15,94	25,39	30,21	58,05
6	50,37	17,99	22,50	30,24	52,18	48,40	18,52	24,07	30,89	52,67
7	55,23	10,92	24,39	27,39	65,10	58,77	7,48	26,77	27,88	74,14
8	46,16	25,56	20,55	33,33	38,68	50,57	20,24	28,54	35,00	54,68
9	47,97	25,34	20,07	32,39	38,51	53,16	19,05	24,82	31,29	52,50
10	52,33	18,02	20,96	29,01	50,88	52,51	17,52	23,22	29,40	53,20
11	44,57	26,19	18,17	31,88	34,78	54,62	13,57	23,86	28,88	60,56
12	47,63	26,05	20,76	33,34	38,67	45,77	25,22	19,71	32,20	38,36
13	47,43	26,17	18,87	32,47	35,94	48,49	23,87	21,36	32,20	41,61
14	47,74	24,17	19,58	31,11	39,03	46,85	23,25	20,19	30,85	41,12
15	49,50	22,96	21,32	31,78	43,50	49,92	20,80	24,15	32,58	49,70
16	52,82	17,12	22,51	30,10	53,30	49,67	20,76	20,64	29,61	44,68
17	49,68	18,23	22,64	31,70	52,10	45,18	20,72	20,26	30,11	44,63
18	55,52	17,77	22,60	28,81	51,89	56,39	14,91	23,64	28,52	58,37
19	50,93	19,41	22,50	30,64	49,87	48,99	20,56	21,59	30,61	46,52
20	49,05	20,65	21,51	29,82	46,18	47,46	21,21	21,81	30,46	45,87
21	54,78	18,13	24,34	30,71	53,38	53,74	18,43	24,89	31,62	53,99
22	49,43	18,78	22,30	31,28	50,10	43,68	25,04	20,64	32,78	39,37
23	48,39	20,21	21,50	30,76	46,85	47,28	19,44	21,89	29,78	48,37
24	52,51	18,41	20,91	28,94	50,69	51,91	19,40	24,61	32,00	52,06
Mean	50,58	19,82	21,63	30,53	48,24	50,71	18,70	23,56	31,17	51,83
SD	3,33	4,56	1,85	1,65	8,63	4,76	5,85	3,02	1,81	11,40
SE	0,68	0,93	0,38	0,34	1,76	0,97	1,19	0,62	0,37	2,33