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Eğitim ve İnovasyon
Yılı 2014

New Approaches in Apple and Cherry Growing and Breeding Techniques

WORKSHOP BOOK

MAY, 22 – 24 2014

Adana

TURKEY

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Workshop President

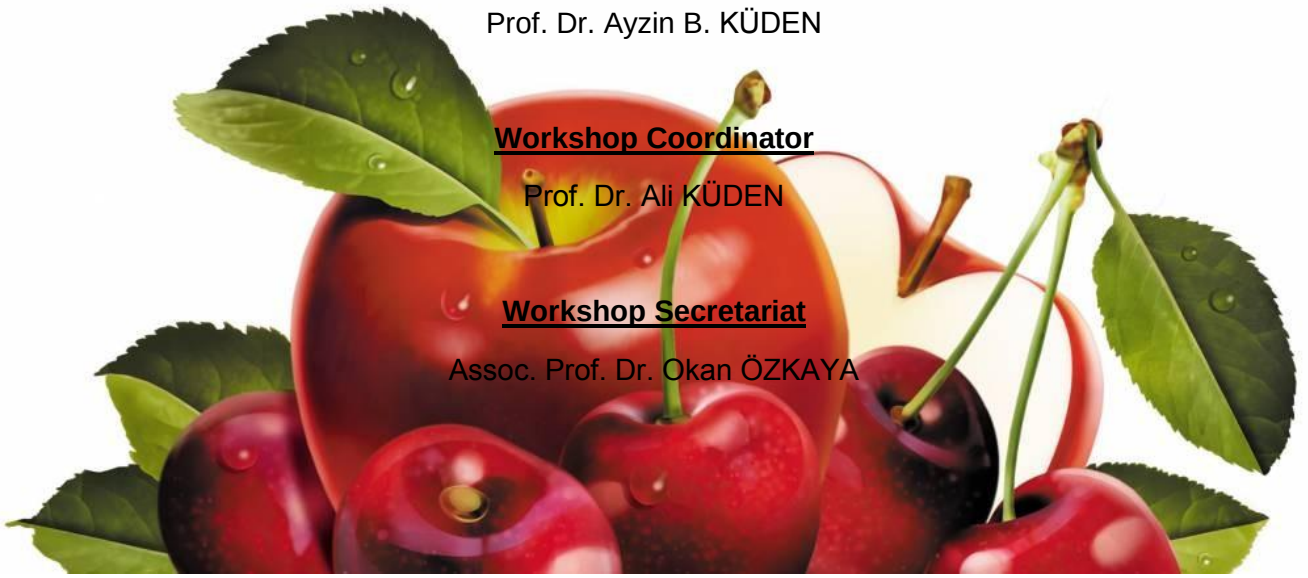
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FOREWORD

The workshop on **"New Approaches on Apple and Cherry Growing and Breeding Techniques"** was sponsored by **TUBITAK** under the organization of Cukurova University and the Ministry of Food, Agriculture and Livestock with the collaboration of the German Institutes of KOB and JKI during **22-24 May, 2014**.

Three main goals of the workshop were: 1) To encourage collaborative research between Turkey and Germany to solve important agricultural problems on apples and cherries which are very important crops of the two countries; 2) To inform local agricultural industries about cutting edge science that is happening both here and in Germany, and 3) To spur further exchanges of graduate students and researchers between our institutions working on similar research projects. It is important to improve knowledge transfer between research institutions in Germany and Turkey and between research institutions, industry and farmers in both countries. The results of the workshop should assist in the development of a collaborative bridge between two countries' research institutes e.g. under Horizon 2020 within EU or governments funded projects. These collaborative efforts, we believe, will provide an important boost to both quantity and quality of the research undertaken as well as to the fruit production sectors.

The large number of researchers from the Research Institutes of the Ministry of Food, Agriculture, and Livestock is indicative of the importance the Ministry places on the topics discussed in this workshop. During the workshop, 21 papers were presented orally on various topics concerning mainly cherry and apple production, storage and marketing.

Briefly, the topics discussed in the workshop include: genetics – classical and molecular; agricultural economics; cultivar development issues; germplasm conservation; breeding and molecular marker studies; training, pruning, thinning studies; chilling requirement studies; fertilization biology; physiological development studies (e.g. decrease double fruit formation); disease resistance research; postharvest physiology studies. These papers were presented mainly on cherries and apples, but also a few peach and apricot studies on breeding and disease resistance were discussed.

After the presentations, participants discussed the next steps for the development of collaboration and information transfer between Turkish and German agricultural institutes as well as knowledge transfer from science to application on farms. The results of this workshop were discussed. At the end of the meeting a technical tour was provided opportunities to discuss topics informally, learn more about each other.

Prof. Dr. Ayzin B. KÜDEN
Workshop President

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FARM MANAGEMENT IN FRUIT PRODUCTION

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Abstract

Fruit farmers in Germany´s second largest fruit production area lake of Konstanz region are facing hard competition within international fruit markets. As they have to accept yearly and seasonal changing prices they have to look for solutions inside farm but also for extern sales management to stay alive in low price market situations.

For selling and marketing of their products producers have unified themselves to effective producer organizations as they know only together they may have a counterweight to the few retail store companies ruling the market. Fruit farmers can get all kind of service from storing and packing to extension, supply with production goods and takeover of sales marketing of fruits. So these producer organizations are quite effective, 80% of fruit farmers are organized.

On farm level generally great difference with regard to economic results can be found between fruit farms. These differences mainly result from management, i.e. the skills and ability to run a farm, i.e not only to produce fruits but also to do it in effective way and producing best quality to achieve best prices.

Looking for reasons of different success in these fruit farms there are various factors to be identified. With view to gross margins sales have main influence while costs e.g. pruning, plant protection, investments, labour and machine cost are mostly constant as there is no pos-sibility for reduction. Sales are product from yield and price, price comes from quality. So all efforts have to be oriented to maximum yield and fruit quality. Of course there are differences between varieties, but quality always sells. High yields reduce production cost per production entity.

With view to production costs investments, labour and plant protection get into focus as high-est share of costs. Cost for cultivas or weather protection are indispensable. It is never useful to plant cheap trees while losing yield the first 5 years. Further there are no compromises in plant protection as bad looking fruits will lead to immense reduction in price. Reducing labour costs means looking for efficient work organization, so this is main task of farm management besides optimizing quality and yield.

Frequently second step after optimizing production is increase production capacity. This could be a high risk process if this is done without any business plan for work, finanzing, organization and risk management. This includes a prior analysis of situation in market but also with regard to farm resources. Further development has to be controlled consequently. This recipe sounds easy but frequent failures prove that basic management work has not been done and decisions have followed just a “certain sense for business”. Better way is to rely on a strict analysis, planning and controlling process.

DEVELOPMENTS IN APPLE PRODUCTION AND TRADE IN TURKEY AND IN THE WORLD

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Abstract
Apple is a very important fruit for human nutrition and Turkish economy. An increasing trend is observed in harvested areas, yields and production, exports and imports of apple in the world. This study evaluates production and yields, harvested areas, value and quantity of exports and imports of apple during last 25 years. Based on these variables countries were ranked accordingly. This study also evaluates place of Turkey in world apple farming and trade. The current situation of Turkey and improvement opportunities were discussed.
Keywords: Apple Production, Apple Trade, World, Turkey

INTRODUCTION

Apple is grown both for its economic and trade benefits in Turkey and around the world. There is a wide consensus on its nutritional benefits to human health and development. These benefits make it one of the commonly produced and consumed fruit in the world.

The geographical location of Turkey and the favorable climatic conditions make Turkey one of the countries with the huge potential. Turkey has a high status in the world list of apple producing countries with productivity above the world's average.

Production and trade data on apple in both Turkey and the world in the last 25 years were examined. The historical progress of apple in terms of harvested area, yield, production, quantity and value of trade are also discussed. The situation in Turkey is then examined in the light of these variables.

MATERIALS AND METHODS

In the examination of the features of apple production and trade in the world and Turkey, secondary data were used. They were mostly acquired from FAO, TUIK and the Turkish Ministry of Agriculture.

Most updated data is considered under each title. Available and reliable data has been compiled for the past 25 years. Historical trends of these data were also discussed.

Developments in Apple Production in Turkey and in the World

World Apple Harvested Area

Table 1 gives the world apple harvested area from 1988 to 2012. Within the 25 years, the harvested area of apple for the first 3 years was at an average of 5.1 million ha, while the last 3 years recorded an average of 4.7 million ha, representing a decrease of 6-7%.

Table 1. World Apple Harvested Areas

Years	Areas (Ha)	Years	Areas (Ha)
1988	5,162,355	2001	5,155,269
1989	5,146,862	2002	5,010,789
1990	5,096,960	2003	4,799,102
1991	4,907,719	2004	4,767,129
1992	5,174,688	2005	4,802,697
1993	5,585,441	2006	4,722,396
1994	6,076,440	2007	4,813,675
1995	6,301,830	2008	4,619,561
1996	6,277,055	2009	4,735,832
1997	6,117,771	2010	4,751,202
1998	5,731,628	2011	4,782,073
1999	5,591,133	2012	4,842,822
2000	5,417,899		

According to the table 2, China was the leading country in the apple harvested areas in 2012. Out of the 4.8 million ha areas, China harvested 42% of it and followed by India, Poland, Russia and Turkey.

Table 2. World apple harvested areas (2012)		
Order	**Countries**	**Area (Ha)**
1	China	2,060,000
2	India	321,900
3	Poland	194,680
4	Russian Federation	183,300
5	Turkey	150,847
6	Iran (Islamic Republic of)	134,000
7	United States of America	132,656
8	Pakistan	115,000
9	Ukraine	105,500
10	Democratic People's Republic of Korea	73,500

The order of countries in table 2 has averagely around the same area of cultivation with the exception of china. Turkey is ranked 5th in the world.

World Productivity

In the last quarter century world's mean apple yield was increased significantly. This is seen in Table 3, from 1988 to 2012. With the same comparison as production, the first 3 years' within the 25 years period recorded an average productivity of 82,000 hg/ha. This figure was about 155,000 hg/ha for the last 3 years representing a 91% increase.

Table 3. World apple productivity			
Years	**Yield (Hg/Ha)**	**Years**	**Yield (Hg/Ha)**
1988	82,692	2001	111,727
1989	82,505	2002	111,268
1990	80,532	2003	121,359
1991	74,145	2004	131,321
1992	86,636	2005	129,908
1993	86,239	2006	135,992
1994	77,362	2007	135,441
1995	78,245	2008	149,468
1996	87,458	2009	149,922
1997	92,586	2010	148,555
1998	96,561	2011	159,200
1999	101,349	2012	157,715
2000	108,994		

Table 4. Apple productivity of the countries (2012)		
Order	**Countries**	**Yield (Hg/Ha)**
1	Austria	779,077.84
2	Israel	555,308.02
3	Switzerland	548,830.35
4	New Zealand	506,500.85
5	Chile	445,205.48
6	Libya	369,369.37
7	Italy	364,148.93
8	Netherlands	353,548.06
9	South Africa	347,492.58
10	Brazil	347,265.26

Considering only the data of 2012, Austria came first followed by Israel, Switzerland, New Zealand and Chile. Table 4 represents the top ten world apple producing countries according to productivity. Countries which are in top ten ranking for production and productivity aren't placed the both

lists at the same time. Only exception of this situation is Chile. Chile is in top ten ranking both production and productivity lists.

World Production

Table 5 represents data of world production of Turkey from 1988 to 2012. The first 3 years recorded within this 25 years period recorded and average of 42 million tons and increased to an average of 75 million tons for the last 3 years. This represents an 80% increase.

Table 5. World Apple Production

Years	Production (Tones)	Years	Production (Tons)
1988	42,688,532	2001	57,598,697
1989	42,464,226	2002	55,754,074
1990	41,046,985	2003	58,241,859
1991	36,388,511	2004	62,602,407
1992	44,831,521	2005	62,391,053
1993	48,168,250	2006	64,221,055
1994	47,008,795	2007	65,197,338
1995	49,309,075	2008	69,047,693
1996	54,898,141	2009	71,000,803
1997	56,642,036	2010	70,581,491
1998	55,345,213	2011	76,130,690
1999	56,666,035	2012	76,378,738
2000	59,052,229		

According to the ranking for only 2012 in terms of world apple production, China is the leader as in ranking in terms of harvested area. Out of the 76.4 million tons produced in 2012, China accounted for 37 million tones representing 48% of world production. The USA, Turkey, Poland, and India follow in order.

Table 6. World apple production order (2012)		
Order	**Countries**	**Production (Tons)**
1	China	37,000,000
2	United States of America	4,110,046
3	Turkey	2,889,000
4	Poland	2,877,336
5	India	2,203,400
6	Italy	1,991,312
7	Iran (Islamic Republic of)	1,700,000
8	Chile	1,625,000
9	Russian Federation	1,403,000
10	France	1,382,901

In Table 6, it shows the order of countries in terms of apple production reveals that, apart from China, the production value of the other countries are close to each other. USA which is 7th in the harvested area ranking is not the 2nd using the productivity criteria. Similarly, Turkey also ranked 5th in the former criteria and 3rd in the later. These differences in ranking with different criterion could be attributed to differences in climatic conditions as well as technological progress in apple cultivation.

Apple Harvested Areas in Turkey

Data on apple harvested areas in Turkey from 1988 to 2012 is shown in table 7. There haven't been any significant changes in apple harvested areas between these years untill 2000. At the beginning of the 25 years' period, the area was about 104,000 hectare but was increased to 150,000 which was an increase of 45%.

Table 7. Apple harvested areas in Turkey			
Years	**Area (Ha)**	**Years**	**Area (Ha)**
1988	104,000	2001	108,500
1989	104,000	2002	110,000
1990	105,000	2003	116,667
1991	106,134	2004	118,333
1992	104,900	2005	121,000
1993	105,667	2006	121,480
1994	105,290	2007	127,700
1995	108,433	2008	129,700
1996	107,117	2009	133,200
1997	107,080	2010	165,078
1998	106,460	2011	142,408
1999	106,826	2012	150,847
2000	107,700		

In the same table, apple harvested area exhibited an irregular trend from 1988 till 2002. The growth in the harvested area was consistent from 2002 till 2010, which recorded the highest within that period. It decreased thereafter and increased again in 2012.

The Number of Apple Tree in Turkey

The number of bearing and non-bearing apple trees in Turkey is given in table 8. In 1988, the population of bearing apple trees stood at 31,000 and that of non-bearing was 8,580, majority of which were new plantations. This brings the total number of trees in 1988 to 39,780. This figure has been relatively stable till 2000, where the number started to increase. As at 2013, the number of apple bearing trees was 47,077 whiles non-bearing was 16,305. New plantation was responsible for the increase in the number of apple trees. Proportionally, between the 25 year period, there has been a 60% increase in the number of bearing trees while the number of non-bearing trees has increased by 90%.

Table 8. The Number of Apple Tree and Production in Turkey		
Years	**Bearing Tree Numbers**	**None Bearing Tree Numbers**
1988	31,200	8,580
1989	31,200	8,800
1990	31,500	8,150
1991	31,840	7,611
1992	31,470	7,115
1993	31,700	6,605
1994	31,587	6,471
1995	32,530	6,080
1996	32,135	6,085
1997	32,125	5,900
1998	31,970	6,030
1999	32,080	5,850
2000	32,300	6,080
2001	32,550	6,080
2002	33,000	6,300
2003	35,000	7,100
2004	35,498	6,902
2005	36,294	7,005
2006	36,444	7,803
2007	38,328	8,868
2008	38,906	10,714
2009	39,951	12,084
2010	41,423	12,929
2011	42,720	14,417
2012	45,254	15,846
2013	47,077	16,305

Source: Ministry of Food, Agriculture and Livestock
Source: Turkish Statistical Institute

When we observed the number of apple trees in Table 8, the number of apple trees increased in 2000s and it is the same with increase of apple planting areas in Table 7.

Productivity in Turkey

The average productivity per hectare in Turkey from 1988 to 2012 is given in table 9. Starting with 187,500 hg/ha, from the beginning, the productivity has been fluctuating but recorded an overall increase at the end of the period with 191,518 hg/ha. The minimum productivity was 157 501 hg/ha recorded in 2010 whiles the maximum was 238,139 hg/ha in 1997.

Table 9. Apple productivity in Turkey

Years	Yield (Hg/Ha)	Years	Yield (Hg/Ha)
1988	187,500	2001	225,806
1989	177,884	2002	200,000
1990	180,952	2003	222,856
1991	179,018	2004	177,465
1992	200,190	2005	212,396
1993	196,844	2006	164,803
1994	198,974	2007	192,470
1995	193,667	2008	193,098
1996	205,383	2009	208,886
1997	238,139	2010	157,501
1998	230,133	2011	188,196
1999	234,025	2012	191,518
2000	222,841		

Source: FAO

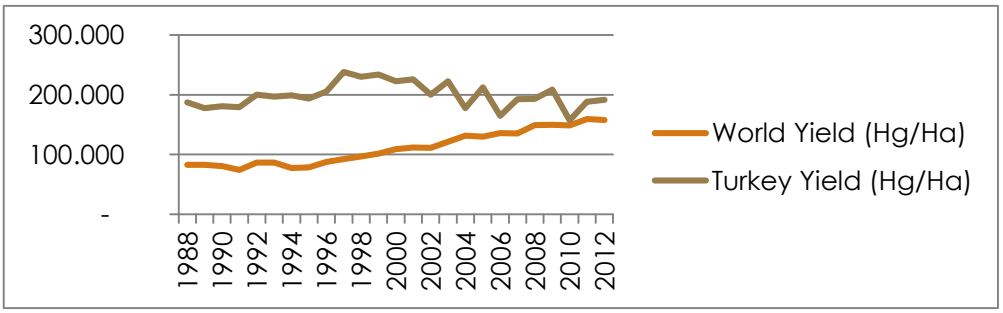


Figure 1. The Mean Apple Yield Comparison in Turkey and in the World

Figure 1 compares the mean apple yield of the Turkey against that of the world. It shows that Turkey has an advantage in the productivity of apple growing, which is largely due to its geographical location and favorable climatic conditions. Over the course of the 25 year period, the world apple productivity has been increasing gradually closing the gap between the world and Turkey. The gap was nearly closed in 2010 when Turkey experienced a sharp fall in productivity. The average yield of apple in Turkey hasn't had an important increase for 25 years but the yield in the world has increased regularly. This causes a danger for Turkey, since Turkey may loose its advantage in growing apples in decades. This has shown that Turkey has failed to use its own potential in growing apples.

Production in Turkey

The volume of apple production in Turkey from 1988 to 2010 is given in table 10. At the beginning of the 25 year period, the mean apple production for the first 3 years was 1.9 million tonnes which eventually increased to 3.1 at the end of the period, representing about 60% increase. However, within the same time period the world apple production increased by 80% and it is shown that it's significantly higher than that of Turkey.

Table 10. Apple Production in Turkey (Tonnes)

Year	Production (Tonnes)	Year	Production (Tonnes)
1988	1,950,000	2001	2,450,000
1989	1,850,000	2002	2,200,000
1990	1,900,000	2003	2,600,000
1991	1,900,000	2004	2,100,000
1992	2,100,000	2005	2,570,000
1993	2,080,000	2006	2,002,033
1994	2,095,000	2007	2,457,845
1995	2,100,000	2008	2,504,494
1996	2,200,000	2009	2,782,365
1997	2,550,000	2010	2,600,000
1998	2,450,000	2011	2,680,075
1999	2,500,000	2012	2,888,985
2000	2,400,000	2013	3,128,450

Source: Ministry of Food, Agriculture and Livestock

According to table 10, apple production in Turkey started to increase slightly after 1990 but significantly increased after 2008. The increase in could not attributed to increase in productivity, but increase in cultivation area and new apple plantations. The Turkish situation was opposite to the world situation in apple production. While the world was experiencing a decrease in the area of cultivation and increasing the productivity, Turkey was increasing the apple cultivation areas and decreasing the productivity.

3.8. Apple Price in Turkey

It is known that, the most important factors affecting the production of apple is producer prices of apple. The producer prices of apple from 1991 to 2011 are given in table 11. In 1991, the producer price of apple was 292 US dollar/ton, which eventually increased 2.5 times by 2011 recoding 762 US dollar /ton.

Table 11. Apple producer price in Turkey

Years	Producer Prices (USD/Tons)	Year	Producer Prices (USD/Tons)
1991	292	2002	337
1992	332	2003	419
1993	297	2004	486
1994	280	2005	595
1995	388	2006	648
1996	325	2007	784
1997	344	2008	832
1998	350	2009	667
1999	342	2010	748
2000	353	2011	762
2001	242		

Source: FAO

It can be seen from the table 11 that, the producers' prices of apple in Turkey between 1991 and 2003 were increased slowly. But after 2003 a fast increase has been seen. It could be the reason of increasing production. Apple producers often take time to react to changes in producer prices due to the long gestation period of apple.

Apple Trade Developments in Turkey and in the World

World Import and Export

The world's export and import values considering the first 3 years' period, an average of 3.5 million tones was recorded. However this figure increased to 8.2 in the last 3 years representing an increase of about 138%. The export value began with 1.6 million dollars and ended with 7-8 million dollars.

Table 12. World apple export, import amounts and values

Years	Export (Tons)	Export (1000$)	Import (Tons)	Import (1000$)
1988	3,477,563	1,511,053	3,728,564	2,118,029
1989	3,437,269	1,450,592	3,604,324	1,917,392
1990	3,693,013	1,978,830	3,704,839	2,508,649
1991	4,007,072	2,467,621	3,948,179	2,802,260
1992	4,038,060	2,486,477	4,289,283	3,197,347
1993	4,648,579	2,090,704	4,395,257	2,209,026
1994	4,710,369	2,461,260	4,402,955	2,722,725
1995	5,187,444	3,020,460	4,881,802	3,213,892
1996	5,092,561	3,264,338	4,971,114	3,483,527
1997	5,298,100	2,811,223	4,860,527	2,961,248
1998	5,118,445	2,638,123	4,677,908	2,825,702
1999	5,308,225	2,609,462	4,879,291	2,841,834
2000	5,276,762	2,282,756	4,880,638	2,522,144
2001	5,325,710	2,422,297	5,008,704	2,773,198
2002	5,668,121	2,882,748	5,391,982	3,074,697
2003	6,235,831	3,422,570	5,984,271	3,791,377
2004	6,422,427	3,820,727	6,249,462	4,285,795
2005	7,015,291	3,887,038	6,579,801	4,107,603
2006	6,999,746	4,370,178	6,959,689	4,850,951
2007	7,822,642	5,594,679	7,421,524	5,944,937
2008	7,807,968	6,379,302	7,367,001	6,569,463
2009	7,915,610	5,605,320	7,445,165	5,674,209
2010	8,595,195	6,480,009	8,250,673	6,636,347
2011	8,262,933	7,146,938	8,057,892	7,138,444

Source:FAO

At the beginning of the period under study, only 8% of apple produced were traded, however this figure has increased to 11% by 2011.

Table 13. World Apple Amount of Export Order (2011)			**World Apple Export value Order (2011)**		
Order	**Country**	**Export (Tons)**	**Order**	**Country**	**Export (1000$)**
1	Italy	976,131	1	Italy	993,141
2	United States of America	833,249	2	United States of America	952,814
3	Chile	801,167	3	China	914,326
4	France	726,609	4	France	737,773
5	Poland	532,058	5	Chile	676,119
6	Netherlands	341,296	6	Netherlands	346,571
7	South Africa	333,435	7	South Africa	290,613
8	New Zealand	296,931	8	New Zealand	283,674
9	Belgium	269,144	9	Poland	278,063
10	Argentina	234,148	10	Belgium	208,375
World Apple Amount of Import Order (2011)			**World Apple Import Value Order (2011)**		
Order	**Country**	**Import (Tons)**	**Order**	**Country**	**Import (1000$)**
1	Germany	665,662	1	Russian Federation	756,954
2	United Kingdom	459,068	2	Germany	667,254
3	Netherlands	310,635	3	United Kingdom	508,746
4	Spain	253,056	4	Netherlands	346,863
5	Indonesia	212,685	5	Spain	238,981
6	Canada	198,618	6	Mexico	213,259
7	Mexico	198,481	7	Canada	200,554
8	Saudi Arabia	181,280	8	Indonesia	186,405
9	India	179,015	9	India	186,279
10	Egypt	168,459	10	Saudi Arabia	176,547

Source:FAO

The ranking of the countries in terms of apple import and export is recoded in table 13. It considers that the top 10 in both cases and used only 2011 figures. In 2011, Italy led in the volume of export of apple in the world followed by USA, Chile, France and Holland respectively.

Italy again led in the value of export followed again by USA, and China becoming the third, though it was not among the first 5 in the volume of export categorization and by France and Chile. The data revealed that though Chile exported more apples than China, the producer price in China was higher resulting in the higher export value.

In terms of imports, Germany is the world's biggest apple importer in 2011 with England, Holland, Spain, and Indonesia following in order. Ironically Russia led in terms of import values followed by Germany, England, Holland, and Spain. Holland is found in the top in both volume and value of apple import and export. The other interesting country's case is that of Russia, which is not ranked among the top ten in volume of import becoming the first in import value.

Turkey Import and Export

Table 14 represents the volume and value of export and import of apple in Turkey between 1988 and 2011. Though Turkey had a lot of fluctuation within this period in terms of volume of export, it was in overall stable. The average export volume of the first 3 years is the same as the average value of the last 3 years which was 75,000 tons. The case of export value was different, it experienced an increase of 27%; recording 24 million US dollars for the first 3 years to 30 million us dollars for the last 3 years.

In table 14, it can be observed that the volume of apple importation to Turkey fluctuated between 1990 and 1994 and became stable afterwards. Considering from 1995, the volume of apple importation for the first 3 years was 1,800 tons. This increased drastically to 4,100 tons for the last 3 years, representing an increase of 127%. Within the same period, i.e from 1995, the value of import for the first 3 years was 560,000 us dollars. This figure increased 7 fold at as 2011 to reach 4 million us dollars.

Table 14. Apple Export, Import Amount and Values in Turkey				
Years	**Export (Tons)**	**Export (1000$)**	**Import (Tons)**	**Import (1000$)**
1988	65,007	16,301	-	-
1989	72,611	23,047	-	-
1990	92,416	33,031	57	2
1991	80,969	35,686	223	24
1992	40,878	15,760	24,356	3,112
1993	42,794	17,498	39,008	2,584
1994	32,552	13,722	15,284	1,642
1995	27,824	12,082	1,844	252
1996	56,445	34,190	1,525	479
1997	47,581	27,231	2,121	968
1998	24,686	13,073	3,632	1,489
1999	13,739	5,378	4,482	1,835
2000	12,897	5,394	3,417	1,265
2001	21,124	7,534	1,426	574
2002	14,504	5,891	3,189	1,250
2003	19,442	9,879	2,866	1,370
2004	20,023	9,950	2,465	1,544
2005	29,043	11,960	4,021	3,007
2006	24,868	8,363	3,963	3,110
2007	9,644	3,837	5,037	4,401
2008	19,972	12,314	2,866	2,807
2009	59,791	22,821	4,237	4,081
2010	80,569	32,829	2,643	2,548
2011	87,303	36,605	5,592	5,383

Source:FAO

DISCUSSION AND CONCLUSION

Apple is among the most important fruit in terms of fruit cultivation and trade in the world. The production and trade in apples has been increasing in the world due to its importance to human health and nutrition. The nutritional and health benefit of apples has been supported by most scientific studies. All countries try to get a bigger portion of the growing apple

international trade. In this competition some countries have geographical and climatic advantages than others. To achieve this, more countries invest in the technical aspect with the aim of increasing productivity as can be seen from the above 25 year period data. New production and marketing strategies are developed to minimize cost and increase profit in the world apple market.

Turkey has the potential to take a bigger share in the world apple market by being more effective in terms of production and marketing. The best indicator of this is the higher productivity of Turkey above the world average. Also 6 of the top apple importers in the world are neighbors with Turkey. This provides a strong possibility to capture the apple international market. It is clear from the 25 year period macro level data on apple production, area, import, export and prices, that Turkey has an advantage in terms of location and climate but not relatively strong in terms of the production and trade. The productivity per hectare has not changed much during the 25 year period. This is a sign of lack of improvement in the technical studies of apple production. The driving fact for increase in production has been good producer prices and increase in cultivation area. The volume of apple exported during that period has not changed; the increase in world price of apple is responsible for the increase in export earnings from apples. Within this period Turkey could not improve international trade in apple probably because of internal problems within the sector even though they are very close to world leading importing countries. Turkey cannot use the current external trade potential. This situation is one of the reasons of not increasing of apple production.

From this study, if Turkey will like to take a higher place in the growing international apple market, then they should invest in the scientific and agronomic research in apple production as well as revise their trade policies. The scientific and agronomy research and application will lead to increase in productivity which has been stable over the 25 year, while the trade policies will find new countries to export.

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DEVELOPMENTS IN CHERRY PRODUCTION AND TRADE IN TURKEY AND IN THE WORLD

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Abstract
Cherry is a very important fruit for nutritional value and Turkish economy. An increasing trend is observed in harvested areas, yields and production, exports and imports of cherry in the world. Cherry harvested area, yield, production and export have been significantly improved in Turkey. Through these improvements, Turkey has been rated one of the top countries in the production and export of cherry in the world. The purpose of the study is providing developments about production and trade of cherry in Turkey and in the world and introduces position of Turkey in the world cherry market.

Keywords: Cherry Production, Cherry Trade, World, Turkey

1. INTRODUCTION

Having a good geographical location, Turkey has very suitable weather and climatic conditions to grow many fruit and vegetable varieties. From this point of view, Turkey is a mother land for orchards, and for many other fruit varieties. Thus 75 different varieties of fruits out of 138 which are cultivated in the world are grown in Turkey. (Demircan et al., 2004). Cherry is the earliest matured fruit among mild climate fruits. This circumstance arises from its genetic features. Motherland of cherry is between the land of Caspian Sea and Black Sea. With the reformed of new varieties production of cherries time of maturity begins early to late period of the season. Recently cherry has been demanded by the market due to its sleek and attractive features. (Çakaryıldırım, 2003). Almost all cherry production comes from north side of semi globe and especially mainly in Europe continent. Turkey's geographical structure and climate conditions are very suitable for cherry production in many areas. European countries are competitor for Turkey in the way of cherry production. Turkey is one of the main cherry producers in the world among main producers. Normally trend is tending to grow, with using new techniques, the growth has accelerated. Having no problems while selling and trading, this also affects its popularity and growth in the world. (Çakaryıldırım, 2003).

In this study, developments of the last 25 years of production and trading of cherry were mentioned. Within this concept cherry areas, yield,

production, foreign trade numbers and its value have been covered according to developments in the past 25 years. With this study, Turkey's and other leading countries places in the market have been identified.

2. MATERIALS AND METHODS

In this study, secondary data have been used with the aim of production and trading in Turkey and in the world. Data used in this study taken from FAO, TUIK institutions, also some thesis and articles and reports published with similar subjects with current data. Data in the last 25 years have been used according to their availability and trust ability and examined by simple indicator and simple rating methods.

3. Developments about Cherry Production in the World and Turkey

3.1. World Cherry Area

Improvements of world cherry area are given in table 1. World cherry area tends to increase as it is seen. World cherry area in 1988 was 290 thousand ha, in 1995 it was 315 thousand ha, in 2000 it was 326 thousand ha, and in 2012 it was 402 thousand ha. World cherry area increased according to 1988 year rates shown respectively, 9 %, 13 %, 21 %, 39 %.

Table 1: Developments in Cherry Grown Areas in the World

Years	Area (Ha)	Index=1988=100	Years	Area (Ha)	Index=1988=100
1988	289,768	100	2001	333,637	115
1989	288,589	100	2002	335,138	116
1990	292,481	101	2003	342,212	118
1991	275,659	95	2004	344,334	119
1992	326,981	113	2005	350,305	121
1993	319,489	110	2006	358,113	124
1994	303,532	105	2007	364,421	126
1995	315,100	109	2008	358,772	124
1996	323,764	112	2009	377,165	130
1997	322,516	111	2010	385,523	133
1998	321,172	111	2011	396,417	137
1999	323,557	112	2012	401,656	139
2000	326,439	113			

Source: FAO, 2014

For 2012, world's 10 biggest countries in world cherry area as shown in table 2. These 10 countries covered 64 % of the world total cherry area. According to table 2, Turkey is the first country with the cherry grown area of 48 thousand ha, USA is the second with 35 thousand ha, and Italy is the third with 30 thousand ha. In respect to area proportion these three countries is respectively 12 %, 9 %, 7 %.

Table 2. Cherry Grown Areas in Different Countries

Ranking	Countries	Alan (Ha)	Share in the World (%)
1	Turkey	48,331	12
2	United States of America	35,123	9
3	Italy	29,736	7
4	Syrian Arab Republic	29,674	7
5	Iran (Islamic Republic of)	29,000	7
6	Spain	24,000	6
7	Russian Federation	16,000	4
8	Chile	15,500	4
9	Austria	14,500	4
10	Bulgaria	14,443	4

Source: FAO, 2014

As shown in table 2, areas of Italy, Syrian Arab republic and Iran are close to each other except Russian Federation's, Chile's, Austria's and Bulgaria's plantation areas.

3.1. Yield in the World

During 1988-2012, although there were some fluctuations on the yield, some improvements were also seen. World cherry yield in 1988 was recorded 50,373 hg/ha, in 1995 48,524 hg/ha, in 2000 54,468 hg/ha, in 2005 52,882 hg/ha, in 2012 56,180 kg/ha. According to cherry yield between 1988 and 2012, 12 % increase is seen.

Table 3: Developments in Cherry Yield in the World

Years	Yield (hg/ha)	Index=1988=100	Years	Yield (hg/ha)	hg/ha =1988=100
1988	50,373	100	2001	51,641	103
1989	52,885	105	2002	48,757	97
1990	47,775	95	2003	50,288	100
1991	45,495	90	2004	49,461	98
1992	48,908	97	2005	52,882	105
1993	49,206	98	2006	52,096	103
1994	49,909	99	2007	53,769	107
1995	48,524	96	2008	51,491	102
1996	51,992	103	2009	58,163	115
1997	49,334	98	2010	53,757	107
1998	48,132	96	2011	54,461	108
1999	52,780	105	2012	56,180	112
2000	54,468	108			

Source: FAO, 2014

Cherry yield rate is given according to the countries shown in table 4. Remarkable point of this table is, no country in top ten list was played an important role in world area and production. Two countries USA and Turkey took place respectively 2nd and 5th in the list which were very important for the first and the second place in world cherry area and production.

Table 4: Cherry Yield in Cherry Grown Countries

Ranking	Countries	Yield (hg/ha)
1	Slovenia	204,853
2	United States of America	109,514
3	Switzerland	103,849
4	Romania	103,298
5	Turkey	99,470
6	Uzbekistan	96,000
7	Canada	92,450
8	Israel	87,458
9	Armenia	81,820
10	Croatia	81,250

Source: FAO, 2014

3.3. Production in the World

Cherry production of the world significantly increased during 1988–2012. There were about 1 M 460 thousand tons cherry produced in 1988, in 1995 it was 1 M 529 thousand tons, in 2000 it was 1 M 778 thousand tons, in 2005 it was 1 M 853 thousand tons, in 2012 the production reached 2 M 257 thousand tons. According to year 1988, cherry production increased in 1995, 2000, 2005 and 2012 by 5 %, 22 %, 27 %, and 55 % respectively.

Table 5. Developments of Cherry Production in the World

Years	Production (Tons)	Index=1988=100	Years	Production (Tons)	Index=1988=100
1988	1,459,639	100	2001	1,722,947	118
1989	1,526,215	105	2002	1,634,046	112
1990	1,397,332	96	2003	1,720,907	118
1991	1,254,111	86	2004	1,703,125	117
1992	1,599,193	110	2005	1,852,470	127
1993	1,572,070	108	2006	1,865,631	128
1994	1,514,901	104	2007	1,959,472	134
1995	1,528,991	105	2008	1,847,361	127

1996	1,683,318	115	2009	2,193,691	150
1997	1,591,086	109	2010	2,072,455	142
1998	1,545,854	106	2011	2,158,934	148
1999	1,707,729	117	2012	2,256,519	155
2000	1,778,045	122			

Source: FAO, 2014

Cherry production according to countries stated in the table 6. Turkey is leading the production with 481 thousand tons while USA ranked second with 385 thousand tons and Iran ranked third with the production of 200 thousand tons. Proportion of these countries in the world production is 21 %, 17 %, 9 % respectively.

Table 6: Cherry Production According to the Countries

Ranking	Countries	Production (Tons)	World Rate (%)
1	Turkey	480,748	21
2	United States of America	384,646	17
3	Iran (Islamic Republic of)	200,000	9
4	Italy	104,766	5
5	Spain	98,400	4
6	Chile	90,000	4
7	Uzbekistan	84,000	4
8	Syrian Arab Republic	82,341	4
9	Ukraine	72,600	3
10	Russian Federation	72,000	3

Source: FAO, 2014

If we consider the differences between the countries in terms of production quantity, significant differences were seen among the first 4 countries.

3.4. Cherry Grown Areas in Turkey

Developments in cherry grown areas concerning the period of 1988-2012 is shown in table 7.

Table 7: Improvement of Cherry Area in Turkey

Years	Area (Ha)	Index=1988=100	Years	Area (Ha)	Index=1988=100
1988	15,643	100	2001	21,800	139
1989	15,953	102	2002	22,400	143
1990	16,413	105	2003	24,000	153
1991	16,667	107	2004	25,000	160
1992	17,200	110	2005	26,800	171
1993	17,790	114	2006	30,331	194
1994	18,483	118	2007	34,400	220
1995	20,167	129	2008	35,800	229
1996	20,767	133	2009	37,900	242
1997	21,227	136	2010	42,054	269
1998	22,811	146	2011	45,246	289
1999	23,810	152	2012	48,331	309
2000	21,300	136			

Source: FAO, 2014

In this period, cherry areas in Turkey were grown sharply. While cherry areas in Turkey in 1988 were approximately 16 thousand ha, it was 20 thousand ha in 1995, 21 thousand ha in 2000, 27 thousand ha in 2005 and finally reached to 48 thousand ha in 2012. Cherry areas in Turkey grew by 209 % in the period of 1988-2012.

When chart 7 is examined, it is seen that cherry area in Turkey has increased and expanded year by year versus the previous year except 2000. In 2000 cherry area in Turkey decreased by 11 % versus 1999.

3.5. Number of Cherry Trees in Turkey

In Turkey numbers of cherry trees have been increasing. When in 1991 numbers of trees were 6 M 391 thousand in 2013 it increased and reached about 25 M 158 thousand trees. Between 1991 – 2013 period, numbers of cherry trees increased by 294 %. Total of cherry trees is comprised by bearing trees and nonbearing trees in Turkey. When bearing trees number were 5 M in 1991, in 2013 according to numbers in 1991 increased by 258 % and reached 18 M trees. When numbers of nonbearing cherry trees were 1 M 391 thousand, in 2013 increased by 420 % versus 1991 and reached 5 M 236 thousand trees. In 1991, while proportion of

bearing cherry trees in total cherry trees was 78 %, in 1995 it was 74 %, in 2000 it was 75 %, in 2005 it was 68 %, in 2013 it was 71 %, proportion of nonbearing cherry trees was 22 % in 1991, in 1995 it was 26 %, in 2000 it was 25 %, in 2005 it was 32 %, in 2013 it was 29 %.

3.6. Cherry Yield in Turkey

Improvement of cherry yield between 1988 and 2012 was shown on the chart 9. At this period despite some fluctuations the trend was going up. When yield was 86.301 hg/ha in 1988, in 1995 it was 92,230 hg/ha, in 2000 it was 107,981 hg/ha, in 2005 it was 104,478hg/ha, in 2012 it was 99,470 hg/ha. When chart 9 is examined yield of cherry in Turkey is doubled if compared to world average cherry yield between 1988 and 2012. In 2012 according to 1988, cherry yield increased by 15 % in Turkey, when world's cherry yield increased by 12 %.

Table 8: Improvement in Number of Cherry Trees in Turkey

Years	Bearing	Index= 1991=100	Nonbearing	Index= 1991=100	Total	Index= 1991=100	Bearing Rate (%)	Nonbearing (%)
1991	5,000,000	100	1,391,000	100	6,391,000	100	78	22
1992	5,160,000	103	1,550,000	111	6,710,000	105	77	23
1993	5,337,000	107	1,507,000	108	6,844,000	107	78	22
1994	5,545,000	111	1,735,000	125	7,280,000	114	76	24
1995	6,050,000	121	2,100,000	151	8,150,000	128	74	26
1996	6,230,000	125	2,090,000	150	8,320,000	130	75	25
1997	6,368,000	127	1,965,000	141	8,333,000	130	76	24
1998	6,850,000	137	2,460,000	177	9,310,000	146	74	26
1999	7,150,000	143	2,525,000	182	9,675,000	151	74	26
2000	7,450,000	149	2,515,000	181	9,965,000	156	75	25
2001	7,620,000	152	2,630,000	189	10,250,000	160	74	26
2002	7,850,000	157	2,670,000	192	10,520,000	165	75	25
2003	8,400,000	168	3,200,000	230	11,600,000	182	72	28

2004	8,750,000	175	3,750,000	270	12,500,000	196	70	30
2005	9,385,000	188	4,447,000	320	13,832,000	216	68	32
2006	10,615,900	212	5,237,273	377	15,853,173	248	67	33
2007	12,048,104	241	6,433,506	463	18,481,610	289	65	35
2008	12,542,380	251	7,001,642	503	19,544,022	306	64	36
2009	13,283,527	266	6,935,070	499	20,218,597	316	66	34
2010	14,740,131	295	7,409,434	533	22,149,565	347	67	33
2011	15,836,172	317	7,553,126	543	23,389,298	366	68	32
2012	16,916,568	338	7,264,177	522	24,180,745	378	70	30
2013	17,922,171	358	7,235,721	520	25,157,892	394	71	29

Source: TurkStat, 2014

Table 9: Improvement of Cherry Yield in Turkey

Years	Turkey's Yield (hg/ha)	Index = 1988 = 100	World Yield (hg/ha)	Index = 1988 = 100	Turkey/World
1988	86,301	100	50,373	100	2
1989	83,997	97	52,885	105	2
1990	87,126	101	47,775	95	2
1991	89,998	104	45,495	90	2
1992	90,116	104	48,908	97	2
1993	87,128	101	49,206	98	2
1994	86,566	100	49,909	99	2
1995	92,230	107	48,524	96	2
1996	96,307	112	51,992	103	2
1997	101,286	117	49,334	98	2
1998	85,485	99	48,132	96	2
1999	104,998	122	52,780	105	2
2000	107,981	125	54,468	108	2
2001	114,679	133	51,641	103	2

2002	93,750	109	48,757	97	2
2003	110,417	128	50,288	100	2
2004	98,000	114	49,461	98	2
2005	104,478	121	52,882	105	2
2006	102,289	119	52,096	103	2
2007	115,739	134	53,769	107	2
2008	94,514	110	51,491	102	2
2009	110,210	128	58,163	115	2
2010	99,373	115	53,757	107	2
2011	96,926	112	54,461	108	2
2012	99,470	115	56,180	112	2

Source: FAO, 2014

3.7. Cherry Production in Turkey

Cherry production data in Turkey related to 1988-2013 is shown in table 10. At this period, trend tends to increase. Cherry production in Turkey was 135 thousand tons in 1988. It was 186 thousand tons in 1995, 230 thousand tons in 2000, 280 thousand tons in 2005 and it was around 494 thousand tons in 2013. Cherry production in Turkey was increased about 266 %. This production increase has affected by growth of cherry areas and yield. As a result of this production growth, it allows Turkey to become the first cherry producer in the world.

Table 10: Improvement of Cherry Production in Turkey

Years	Production (Tons)	Index=1988=100	Years	Production (Tons)	Index=1988=100
1988	135,000	100	2001	250,000	185
1989	134,000	99	2002	210,000	156
1990	143,000	106	2003	265,000	196
1991	150,000	111	2004	245,000	181
1992	155,000	115	2005	280,000	207
1993	155,000	115	2006	310,254	230
1994	160,000	119	2007	398,141	295

1995	186,000	138	2008	338,361	251
1996	200,000	148	2009	417,694	309
1997	215,000	159	2010	417,905	310
1998	195,000	144	2011	438,550	325
1999	250,000	185	2012	480,748	356
2000	230,000	170	2013	494,325	366

Source: FAO, 2014; TurkStat, 2014

3.8. Producer Prices of Cherry in Turkey

Providing sustainability in agriculture, producer prices are very important. In this respect, according to period 1991-2011 improvement of producer price in Turkey is given in table 11. Considering table 11, although some fluctuations happened during 1991-2011 prices trend were upside. Producer prices were 717 $/tons in 1991, it was 821 $ /tons in 1995, in 2000 it was 703 $ /tons, it was 1,318 $ /tons in 2005, it was 1,955 $ /tons in 2011.

Table 11: Improvement of Producer Prices of Cherry in Turkey

Years	Prices ($/Ton)	Years	Prices ($/Ton)
1991	717	2002	821
1992	638	2003	1,008
1993	889	2004	1,232
1994	515	2005	1,318
1995	821	2006	1,461
1996	614	2007	1,687
1997	587	2008	1,810
1998	708	2009	1,445
1999	611	2010	1,483
2000	703	2011	1,955
2001	587		

Source: FAO, 2014

4. Developments of Cherry Trade in the World and Turkey

4.1. Export and Import in the World

Relating to cherry trade in the world, data related 1988-2011 are shown at chart 12 and 13. At this period world cherry export trend tends to increase as a quantity and value. According to chart 12, as a quantity world cherry export was around 79 thousand tons in 1988, despite there were some fluctuations, it reached 376 thousand tons in 2011. Increase rate between 1988 and 2011 was 374 %. As a value, world cherry export in 1988, it was around 133 million $, in 2011 it grew by 11 times versus 1988, and reached 1 billion 538 million $. According to data 17 % of the total production of the world was exported.

Table 12: Improvement of Cherry Export in the World

Years	Quantity (Tons)	Index=1988=100	Value (1000$)
1988	79,366	100	132,921
1989	87,182	110	161,325
1990	86,756	109	186,644
1991	86,216	109	196,194
1992	112,773	142	229,206
1993	101,961	128	214,141
1994	107,183	135	262,274
1995	104,142	131	295,466
1996	112,610	142	293,496
1997	117,427	148	307,183
1998	105,762	133	259,432
1999	149,905	189	337,904
2000	144,630	182	334,891
2001	138,913	175	348,359
2002	153,783	194	382,306
2003	185,211	233	485,681
2004	194,257	245	600,222
2005	214,776	271	647,759
2006	259,363	327	727,584

2007	244,145	308	812,072
2008	250,750	316	972,771
2009	308,328	388	1,063,507
2010	324,343	409	1,271,092
2011	376,306	474	1,537,619

Source: FAO, 2014

According to 2011, first 10 countries having important role in cherry export in the world is shown in table 13. Both export quantity and import value top 3 ranked countries are USA, Chile and Turkey respectively. These 3 countries captured 50 % of the world export quantity and 63 % of the value of export in the world. While some countries having place in top ten as a quantity rate, as a value there is no countries in top ten or their places have changed.

Table 13: Cherry Export According to the Countries

Order	Countries	Quantity (Tons)	World Rate (%)	Order	Countries	Value (1000$)	World Rate (%)
1	USA	78,298	21	1	USA	449,223	29
2	Chile	64,612	17	2	Chile	377,513	25
3	Turkey	46,477	12	3	Turkey	131,001	9
4	Spain	29,268	8	4	Spain	79,842	5
5	Austria	17,342	5	5	China, Hong Kong SAR	73,845	5
6	China, Hong Kong SAR	15,070	4	6	Austria	72,652	5
7	Italy	11,189	3	7	Italy	44,304	3
8	Serbia	10,771	3	8	Canada	42,703	3
9	Greece	9,448	3	9	France	27,119	2
10	Syrian Arab Republic	9,036	2	10	Greece	27,099	2

Source: FAO, 2014

World cherry import data related to 1988-2011 is given in table 14. The trend of world cherry import was upside in quantity and in value. When in 1988 world cherry import quantity was around 84 thousand tons, in 1995 it was 102 thousand tons, in 2000 it was 137 thousand tons, in 2005 it was 216 thousand tons, and in 2011 it was 371 thousand tons. Between 1988 and 2011, world cherry import has increased by 342 %. When world import value was 155 million $ in 1988, in 2011 it increased by 9 times from 1988 and reached to 1 billion 556 million $.

Table 14: Improvement of Cherry Import in the World

Years	Quantity (Tons)	Index=1988=100	Value (1000$)
1988	83,957	100	154,746
1989	104,301	124	189,585
1990	102,975	123	195,342
1991	136,056	162	245,405
1992	155,991	186	282,696
1993	94,487	113	233,129
1994	113,931	136	277,613
1995	102,064	122	316,676
1996	112,679	134	320,502
1997	128,361	153	356,347
1998	106,284	127	299,607
1999	152,942	182	379,784
2000	136,599	163	362,845
2001	149,112	178	421,684
2002	147,644	176	423,156
2003	187,917	224	544,275
2004	206,425	246	677,917
2005	216,290	258	718,339
2006	261,681	312	841,917
2007	263,028	313	949,402
2008	272,706	325	1,071,961
2009	314,543	375	1,047,609

2010	318,417	379	1,246,875
2011	370,811	442	1,555,869

Source: FAO, 2014

According to 2011, 3 countries having important role in world cherry importation was given on chart 15. Top 3 countries considered by import quantity are Russian Federation, Germany, and Canada; as an import value, top 3 countries are China, Hong Kong, SAR, China, mainland, Canada. In table 15 there were some differences on countries' quantity ranking and value ranking. For example as a quantity ranking Russian Federation is the first with 19 %; as a value ranking Russian federation is the 5th with 8 %.

Chart 15: Cherry Import According to the Countries

Order	Countries	Quantity (Tons)	World Rate (%)	Order	Countries	Value (1000$)	World Rate (%)
1	Russian Federation	71,982	19	1	China, Hong Kong SAR	179,401	12
2	Germany	34,364	9	2	China, mainland	178,324	11
3	Canada	32,548	9	3	Canada	160,578	10
4	China, Hong Kong SAR	31,859	9	4	Germany	128,950	8
5	China, mainland	23,773	6	5	Russian Federation	125,580	8
6	USA	20,395	6	6	Japan	104,364	7

7	United Kingdom	18,170	5	7	USA	82,794	5
8	Austria	16,979	5	8	China, Taiwan Province	80,412	5
9	China, Taiwan Province	12,058	3	9	United Kingdom	76,399	5
10	Japan	10,351	3	10	Austria	70,766	5

Source: FAO, 2014

4.1. Export and Import in Turkey

Related to 1988-2011, data on Exportation of Turkey is given on chart 16. When examined chart 16, Turkey's cherry export quantity and value trend is upside. In 1988 cherry export quantity was around 3 thousand tons, in 1995 it was 13 thousand tons, in 2000 it was 12 thousand tons, in 2005 it was 35 thousand tons, and in 2011 it was 46 thousand tons.

At this period Turkey's cherry export quantity has increased by 15 times. When Turkey's export value was 2 Billion 565 million $ in 1988, in 2011 it increased by 50 times versus 1988 and reached 106 Billion 666 million $. Main part of total production of cherry for fresh consumed in Turkey and some quantity is for industry (Çakaryıldırım, 2003). For the year 2011 around 11 % of the total production was exported.

Table 16: Improvement of Cherry Export in Turkey

Years	Quantity (Tons)	Value (1000$)
1988	2,977	2,565
1989	3,155	2,740
1990	5,445	6,933
1991	7,063	10,184
1992	6,443	7,498
1993	5,807	8,411
1994	10,060	10,606
1995	13,126	22,667

1996	15,888	25,496
1997	17,771	28,323
1998	8,731	16,509
1999	26,564	38,390
2000	11,940	23,652
2001	24,553	48,702
2002	19,042	49,276
2003	32,688	76,944
2004	39,732	117,987
2005	34,793	92,146
2006	53,867	101,981
2007	57,019	106,666
2008	28,549	113,445
2009	50,785	132,579
2010	65,294	147,828
2011	46,477	131,001

Source: FAO, 2014

As Turkey is ranked important place in the list for production and export quantity, it has nearly no import of cherry. Cherry import quantity related to 1988-2011 is given on chart 17. At this period import quantity always below 100 tons except year 1995. The biggest outlay for import (488 thousand $) is in 2008.

Chart 17: Improvement of Cherry Import in Turkey

Years	Amount (Ton)	Value (1000$)
1988	0	0
1989	1	6
1990	0	0
1991	0	0
1992	0	0
1993	2	4
1994	0	0

1995	115	26
1996	3	2
1997	63	41
1998	39	4
1999	18	22
2000	0	0
2001	0	0
2002	16	59
2003	0	0
2004	16	62
2005	17	82
2006	4	10
2007	18	110
2008	74	488
2009	7	49
2010	4	31
2011	6	16

Source: FAO, 2014

5. CONCLUSION

As examined the period of world cherry area, yield production, export and import between 1988-2011-2012 the trend was upside for the related topics. Turkey is taking place in front of USA, Iran, Italy, and Spain in terms of area and production. Although these countries are taking strategic place in the way of acreage and production, only USA and Turkey taking places from top ten. For export USA, Chile and Turkey having significant positions; while Russian Federation, Germany, Canada, China, Hong Kong SAR, and China mainland are important countries for import.

As considered itself Turkey, Turkey's cherry area, yield, production and export capacity Ha increased year by year. Thus Turkey took significant place among important countries in the world by having important cherry area, production, and yield and export numbers. Being important cherry exporter, import quantity was nearly none between 1988 and 2011, even there was any import in some years.

Turkey's cherry area, yield, production and some important moves in the cherry trade, allows Turkey to keep its one of the first and important places in the world cherry market.

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APPLE GROWING IN TURKEY

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Abstract

Apple is one of the most important fruit species in Turkey. However, growing of summer types apples commercially have been neglected many years. The first apple variety adaptation experiment was begun in 1981. Three summer, two autumn and twelve winter varieties were experimented. Jerseymac (summer variety), Yellowspur Cooper-900 and Lutz Golden (winter varieties) gave good results for the yield and fruit quality. In the experiments began in 1988, Early Redone (autumn variety), Golden Weinsberg, Golden Smothee and Redchief (winter varieties) were determinated as promising varreties. Some low chilling requiring varieties such as Anna and Golden Dorset have also been recomended to Aegean and Mediterranean regions. In last 5 years many new apple varieties were put into production such as; Fuji Kiku8, Granny Smith, Gala and mutants,and therefore apple exportation was increased. But it is still too low. The studies on new apple cultivars should continue both by introducing from other countries and also with breeding studies.

Keywords: Apple growing, adaptation, new varieties

Apple Growing

In Turkey apples are the most economically and traditionally grown deciduous fruit crop and followed by table grapes and pear.

Apples are grown in many regions across the country but approximately 50 percent of all commercial apple production comes from three provinces; Isparta, Karaman and Nigde. These provinces are located in the southern part of Central Anatolia and Northern Mediterranean Regions. Commercial apples are also grown in Antalya, Eregli, Denizli, Yalova and Amasya (Kaşka et al. 1988).

First apple variety studies was started in Ataturk Central Horticultural Research Institute (YALOVA 1964) in Amasya with new cultivars (Starking Delicious, Golden Delicious, Jonathan, Hüryemez, Demir, Rome Beauty,

Cox's Orange, Renette, Canada Renette, Stayman Winesap, Champion, Belle Fleur Jello, Astrachan Ruge).

The second apple variety trial plantation in Pozantı was established in 1988 with other new varieties (Kaşka and Küden 1997) (Clearrred, Early Redone, Elite, Elstar, Elite, Stark Jumbo, Breaburn, Fuji, Jonagored, Golden Weinsberg, Sky Spur, Super Early Stripe, Wayne Spur, Arlet, Royal Gala, Stark Earliest, Jonica). Also, other apple varieties which is brought from abroad in 1993 within DPT project (Table1).

Table 1. Apple Varieties Adaptation Project Started In Pozantı Agriculture and Resources Center and Development

Project Name	Years	Apple Varieties
Apple Variety Trial 1 (Meyseb)	1981 - 1987	Raritan, Jersymac, Summer Red, Rubra Precoce, Hi Early, Lutz Golden, Yellow Spur, Erwin Spur, Cooper4, Auvil Spur, Cooper 1-RB, Red Spur, Cooper 7Sel-B-2, Top Red, Eden Spur, Cooper900, Mor Spur
Apple Variety Trial 2 (Çukurova Univ.)	1988 - 1994	Clear Red, Early Red One, Elite, Golden Smothe, Stark Jumbo, Breaburn, Fuji, Jonagored, Golden Weinsberg, Sky Spur, Super Early Stripe, Red Chief, Wayne Spur, Arlet, Royal Gala, Stark Eraliest, Jonica.
Apple Variety Trial 3 (DPT)	1994 - 2000	Mantet ,Summerregent, Delbart Estivale, James Grive, Fiesta, Arlet, Gravenstaine, Breaburn, Red Breaburn, Jonica, Jonagold, Fuji, Red Fuji, Rubinstar, Elstar, Highwood, Pinova, Piros, Astromel, Discovery, Del Prim, Prima, Priam, Gala Royal, Gala Prince, Red Breaburn, Berlepsh, Jonagored, İdared, Malling Kent, Rubinette, Golden Reinders, Wilmuta, Pilot, Picant.
Apple Variety Trial 4 (TÜBİTAK)	2000 - 2006	Galaxy Gala, Mondial Gala, Royal Gala, Williams Pride, (Anna, Vistabella, Golden Dorset), Scarlet Spur, Fuji, Fuji Kiku 8,

Apple Variety Trial 5 (Phd Thesis)	2006 - 2008	Galaxy Gala, Mondial Gala, Royal Gala, Buckey Gala, Williams Pride, (Anna, Vistabella, Golden Dorset),(Subtropic Conditions / ADANA)

About half of the apples grown in Turkey are Red Delicious (Starking) and about one third are Golden Delicious. Amasya is the most popular native variety that is grown, which constitutes about ten percent of total production. The Granny Smith, Fuji, Gala, Jonagold, and Braeburn varieties are also becoming more popular (Küden 1988) (Fig 1).

New varieties are becoming increasingly popular among growers due to their higher export potential USDA Agricultural Service 2012.

Table 2. Number of Apple Trees (1000) In TURKEY

Year	Bearing	Non bearing	Production (Tons)
2008	38 906	10 714	2 504 494
2009	39 951	12 084	2 782 365
2010	41 423	12 929	2 600 000
2011	42 720	14 417	2 680 075
2012	45 254	15 846	2 888 985
2013	47 077	16 305	3 128 450

Minıstery of Food, Agriculture and Livestock 2014

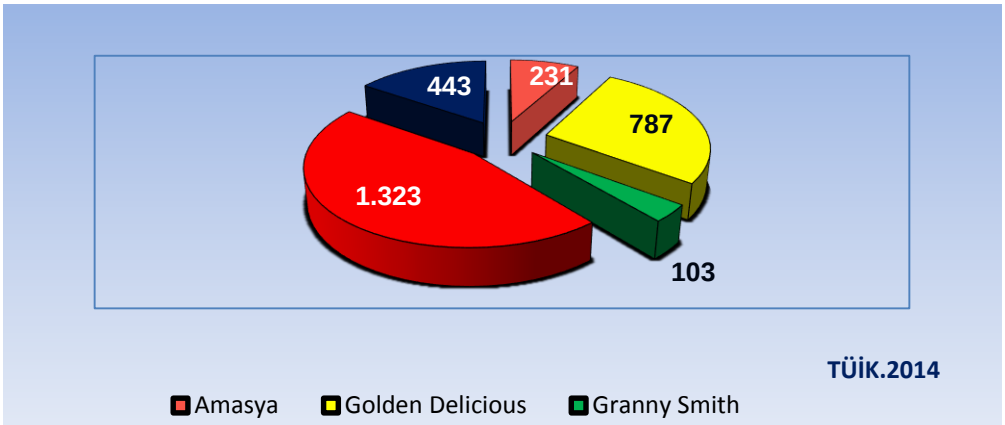


Fig 1. Apple Production In Terms of Varieties in Turkey (1000Tons) 2012

Apple consumption, traditionally about 90 percent of Turkey's apple production is consumed as fresh fruit. About five percent are processed into juice, canned products, vinegar or dried products, and about one or two percent are exported. The remainder was damaged, and added into domestic consumption.

Turkish consumers prefer medium-sized apples weighing approximately one kilo per 6 pieces. Turkish consumers usually prefer Red Delicious at the beginning of the season, and Golden Delicious later. This is because Red Delicious apples become softer in a few months after harvesting unless they are kept in cold storage properly. Controlled atmosphere storage facilities allow apples to be marketed throughout the year. Amasya apples can be marketed longer than Delicious without controlled storage facilities. Recently apple export capacity was increased (Table 3).

Table 3. Fruit Exportation of Turkey in 2012 - 2013 (January-November)

	01.01.2012/30.11.2012		01.01.2013/30.11.2013		İncrease-Decrease (%)	
Fresh Fruit	**Quantity (Ton)**	**Value (x1000$)**	**Quantity (Ton)**	**Value (x1000$)**	**Quantity (KG)**	**Value ($)**
Grape	203.511	156.517	193.206	180.018	-5	15
Cherry	56.600	159.486	54.679	155.443	-3	-3
Pomegranate	64.059	54.206.	97.469	81.561	52	50
Apricot	56.715	42.287	42.016	42.968	-26	2
5-Apple	**65.595**	**27.282**	**97.796**	**39.993**	**49**	**47**
Fig	14.386	29.813	16.368	34.990	14	17
Peach	44.114	28.426	34.996	28.292	-21	0
Strawberry	21.675	20.244	19.729	24.909	-9	23
Plum	25.507	13.625	26.510	14.830	4	9
Chestnut	3.644	10.933	3.719	13.168	2	20

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APPLE AND CHERRY GENETIC RESOURCES OF TURKEY AND STUDIES OF EĞİRDİR FRUIT RESEARCH STATION OF APPLE AND CHERRY GENETIC RESOURCE

Şerif ÖZONGUN, Turgay SEYMEN, Figen ERASLAN

Abstract

Turkey is a region which has genetic abundance in a good number of species. Turkey, which includes both Mediterranean and Asia Minor regions that are defined as two important genetic resources, is in a host position for many annual and perennial species. Apple, one of those species, is one of well-known fruit species in Turkey (Erişli, 2004). Turkey is one of the most apple and cherry producing countries.

Turkey is among the countries in the world that comes to mind first when you think of cherry and sour cherry. Although our country is rich in cherry-sour cherry genetic resources, it has not yet to reach the desired level of works with regard to evaluation and using of especially the local cherry-sour cherry genetic resources in classic and modern breeding. Cherry (*Prunus cerasus* L.) and sour cherry (*Prunus avium* L.) have a great importance for Turkey's economy and our country, in both species dominates the world production. Turkey has the species which found in wild and included in cherry-sour cherry group. The European continent has an important place in world cherry and spurs cherry production.

Apple is one of the most well known fruit species in Turkey and Turkey is one of the world's most producing countries. Although Turkey is one of the homelands of apple, there is the domination of foreign varieties. Amasya apple is the most well known of local varieties but these varieties are grown in the local area, unfortunately.

In Turkey, having rich genetic resources, protection and evaluation studies for many fruit species are being continued in research institutions allied to Ministry of Food, Agriculture and Livestock. Within the scope of the project named “Protection and Evaluation of Fruit Genetic Resources Egirdir Horticulture Research Station”, which is one of those institutions, studies on 330 of local and foreign apple cultivars and are continuing. Variety descriptions, phenological observations and pomological analyses are being carried out on Genetic Resources parcels in accordance with UPOC criteria and data are being logged. With this study, protection and evaluation of wild, local or developed varieties and types, spread in Turkey and collected

in previously surveying studies, is aimed. Material and data supplying for breeding studies will also be provided.
Key Words: Turkey, apple, genetic resources

INTRODUCTION

Apple is a fruit cultivar which is coeval with world history. Retrospective information about apple has been mentioned in many studies (Robinson et al., 2001). Cultured apple is one of most important products which could be grown in cold and mild regions (Harris et al., 2002). Dobrzanski et al. (2006), reports that origin of “apple” word comes from “alma” word used in Kazakhistan in the same meaning.

Apple genetics resources consist of a large-scaled genetic pool. Species resistant to black spot, species and cultivars that bloom slowly (blooming after 15 days from average blooming period), genotypes that grows weakly, existing international reference cultivars in parcel, presenting native cultivars that can compete with qualified foreign cultivars in apple adaptations parcel are conspicuous properties of apple.

Genetic pools of many products which are used for human nutrition in the world are very narrow. In terms of macro scale, apple production in the world is limited with two cultivars (Delicious ve Golden Delicious). While cultivars belong to *Malus* specie have very large genetic pool, identified cultivars are in a very narrow genetic band. But Ragan (1926) reported that the number of identified cultivars between 1804 and 1904 was 7000 (Way et al., 1999). A big proportion of those were lost between 19 and 20 centuries. It has been stated that genetic destruction was prevented with establishing collection orchards by apple breeders in the mid of 20’th century (Büttner, 2004). The biggest genetic resources parcel about *Malus* species in the world exists in USA and 3739 of different material are preserved by various methods in a unit found in Geneva (Fosline, 2000).

Turkey has so rich apple genetic resources that it is one of homelands of apple. It is stated that about 500 apple cultivars are present for today in our country. Amasya apple has an important place in those cultivars and even it is in danger of extinction since it is commercially evaluated.

Stone fruit species (*Prunus* sp.) are among the important fruit species of *Prunoidea* subfamily of the *Rosaceae* family. *Prunus* genus is basically separated to three main sub-genus (subgenera) including *Prunophora* (plums and apricots) *Amygdalus* (peaches and almonds) and Cerasus (cherries and sour cherries)

Sweet Cherry (*P. avium* L.) is grown in all countries of the northern hemisphere of the world where temperate climate is seen. However,

commercial sweet cherry cultivars has been born in Caucasus between the Black Sea and the Caspian Sea and Northeastern Anatolia and has named from Kerasun town, whose current name is Giresun, located in the Eastern Black Sea Region of our country. North Anatolian Mountains between Istanbul and the Caspian Sea constitute the primary gene center of sour cherry (*P. cer*asus L.). Mahalep (*P. mahaleb* L.), which takes place in cherry-sour cherry group, has no table value and is the classical cherry-sour cherry rootstock, has been born in South and Central Europe and Anatolia (Faust and Surányi, 1997). Despite being pretty much the number of species in the group of cherries, only cherry and sour cherry has gained commercial importance and has played a major role in the occurrence of their cultivars. A part from other species has gained importance as a rootstock for cherries.

Existence of Cultivars Belonging To *Malus* Species in Turkey

Turkey is a region which has genetic abundance in a good number of species. Turkey, which includes both Mediterranean and Asia Minor regions that are defined as two important genetic resources, is in a host position for many annual and perennial species. Apple, one of those species, is one of well-known fruit species in Turkey. Turkey is one of the most apple producing countries (Erişli, 2004).

According to record, culture of apple reaches to 5600 BC in Anatolia. In the years of 500 BC, there have been evidences about apple growing in Anatolian and North Mesopotamia. Cultured cultivars have spread out to West Europe through Roman Empire. It has been thought that those cultivars were crossbred of *Malus sylvestris* (Luby, 2003).

Büttner (2004) reported that some cultivars belonging to *M. orientalis* had been growing in ancient Greek civilization. It could be thought that apple culture reached to a great development in Hittite civilization because Anatolian was one of homelands of apple and Turks played a great part in selection and spreading of various fruit cultivars and species (Özbek, 1978). A large region, which covers Asia minor, Caucasia and Central Asia also involving Turkey, has been accepted as origin of some cultivars belonging to *Malus* species (Zagaja, 1983) (Figure 1).

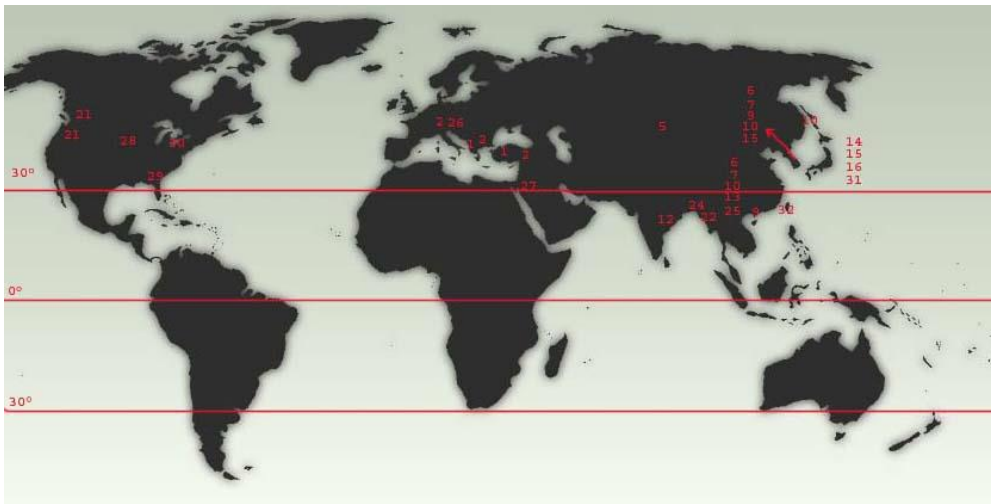


Figure 1. Distribution of cultivars belonging to *Malus* species on the world (Way et al.,1999; Robinson et al.,2001; Harris et al., 2002)

Davis (1972) mentioned that plants of species of European form of *M. slyvestris*, *M. orientalis* and *Malus domestica* Borkh have been existed in the regions except Central Anatolia in Turkey. They were generally centered in the east of North Anatolian line and East Anatolian. Hybrid type of *Malus* Miller x *Sorbus* L. was located in North Anatolian region (Figure 2). Cultivar of *Eriolubus trilobatus* (*Malus tribolata*) was discovered North Aegean and Mediterranean region, especially Kahramanmaraş part of East Mediterranean region (Figure 3).

Suitability of ecological factors for apple growing enables to spreading of apple production in Turkey to large regions. Production has been made by foreign cultivars and native cultivars have not been produced as commercially. It was stated in inventory study edited by Aegean Region Agricultural Research Institute which is connected to Ministry of Agriculture that there were 177 cultivars in ministerial institutions about 1970s (Anonymous, 1981). Taking inventory of those cultivars by a careful study and putting them under protection are obligatory.

Akça (1990a) stated that Turkey is one of the countries which have the most number of cultivars. Ülkümen (1938) conducted studies for the first time in Turkey about pomological properties of apple, pear and apricot grown in Malatya and determined various local cultivars. In the following years, many studies were performed about determination of local cultivars and their

properties (Güleryüz, 1977; Akça ve Şen 1990, a, b; Edizer ve Güneş, 1997).

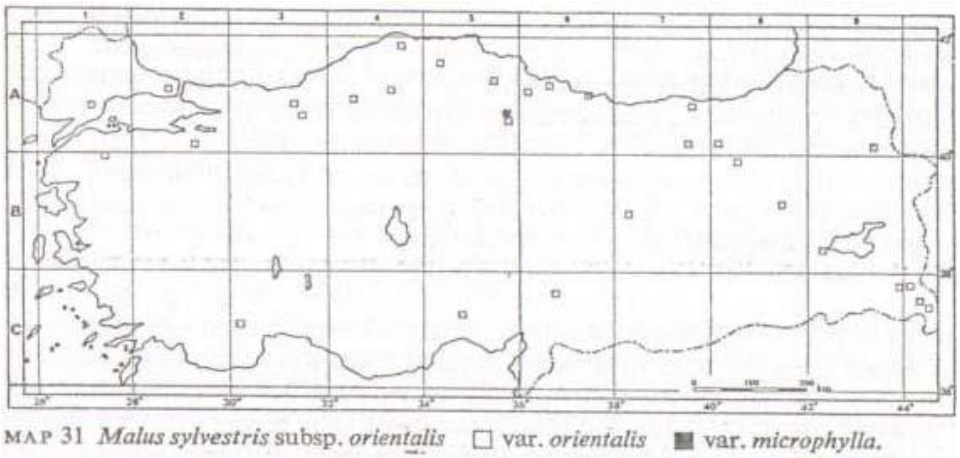


Figure 2. Natural growing areas of *Malus slyvestris* in Turkey (Davis, 1972)

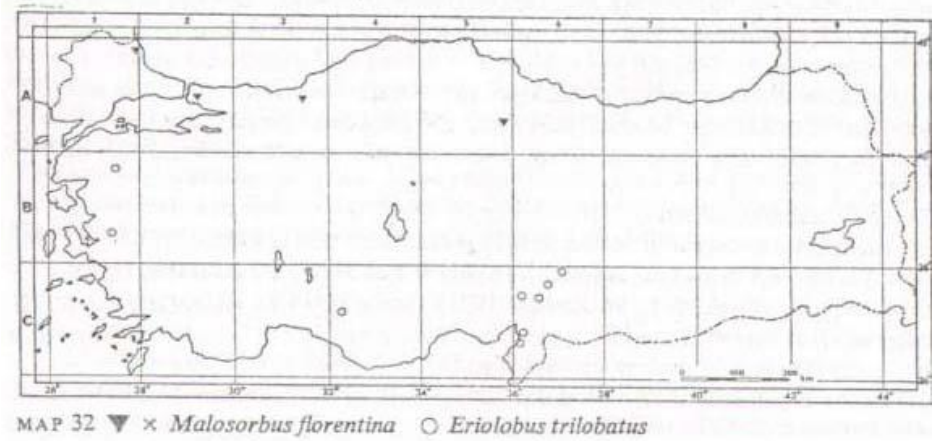


Figure 3. Natural growing areas of *Malosorbus florentina* ve *Eriolobus tribolatus* in Turkey (Davis, 1972)

Cherry (*Prunus avium*) and sour cherry (*Prunus cerasus*) presence in Turkey

Major cherry and sour cherry producing countries on the European continent are and Turkey, Poland and Germany, respectively. In our country, the major species of sweet cherry-sour cherry group are P. avium, P. cerasus, P.

mahaleb, P. laurocerasus, P. prostrata, P. brachypetala, P. incana, P. angustifolia, P. hippophaeoides and P. microcarpa (Ercisli, 2004).
In Turkey, sour cherry cultivation is executed based on Kütahya breeding varieties, but genotypes having numerous outstanding features are present in different regions (Tanış, 2010). Earlier studies on this subject have reported that regional types can compete with that kind of Kütahya in the same conditions, which sometimes even better results have also emerged. Also, sour cherry types named Kütahya sour cherry have significant variations in it (Onal, 2002).
Our country is very rich in terms of genetic resources of sweet cherry – sour cherry groups within the local varieties and wild species. Nowadays, the issue of plant genetic resources in many countries is attracting the attention of the government. The topic is being discussed at the international level, interest and sensitivity towards plant genetic resources is increasing. By the means of complete and rapid completion of 'Assessment' step, which constitutes the most significant obstacles to the use of genetic resources, contribute of plant genetic resources to our economy will access to very large values by increasing the possibilities for use. However, it is unlikely to say that our country benefit sufficiently from the vast potential of sweet cherry-sour cherry (Ercişli, 2004).

Apple and Cherry Genetic Resources Studies of Directorate of Eğirdir Horticulture Research Station

Within the scope of the project named "Eğirdir Apple Genetic Resources Preservation and Evaluation", there are native and wild cultivars of 330 of apple, 93 of sweet cherry and 82 of sour cherry. While apples on MM106 rootstock were planted with range of 4 m x 3 m in the year of 2000 of present 330 varieties/types are native and 98 of are foreign, sweet cherries and sour cherries on cherry seedlings have been planted with range of 4 m x 3 m in the year of 2013.
Species and cultivars in parcel are evaluated according to IBPGRI and UPOV criteria and phonological observations, pomological analysis and morphological measurement are conducted.
Pomological properties (width, length and weight of fruit, thickness and length of stalk, hardness of pulp, water-soluble solids, pH and acidity) of 295 of cultivars were determined. Harvesting time of these cultivars is determined by criteria such as starch test, color of ground, putting off from

branch, flavor (Table 1). Also, cultivar properties document is filled for 189 of species/cultivars according to UPOV criteria.
Blooming time (Table 2), upper coloring (Table 3) and fruit largeness (Table 4) have been determined for cultivar present in project .

Table 1. Harvesting time of identified species/cultivars in apple genetic resources parcel

Harvest Time	Date of Harvest	Number of Genotype/Cultivars
Early season	1 July-15 August	43
Middle season	15 August -15 September	39
Fall term	15 September -15 October	173
Late season	After 15 October	40

Table 2. Blooming time of identified species/cultivars in apple genetic resources parcel

Starting Time of Blooming	Number of Genotype/Cultivars
Very early	8
Early	88
Middle	211
Late	17
Very late	6

Table 3. Upper coloring of identified species/cultivars in apple genetic resources parcel

Upper Color of Fruit	Number of Genotype/Cultivars
Red	220
Yellow	60
Green	50

Table 4. Fruit size of identified genotype/cultivars in apple genetic resources parcel

Fruit Size	Number of Species/Cultivars
Very small	11
Very small-Small	11
Small	54
Small-Medium	93
Medium	97
Medium-Large	44
Large	17
Large – Very large	2
Very large	1

Performed Studies in Genetic Resources Parcel of Eğirdir Research Station

Fruit Genetic Resources Protection and Evaluation projects ensure protection and identification of available cultivars and species and also provide research material for other breeding projects. Within this scope, Genetic Resources parcel of Directorate of Eğirdir Orchard Research Station procures logistic support to many project. These studies are;

- Material supplying for **"**Breeding Project of Development of New Apple Cultivars Resistant to Black Spot"
- Material supplying for "Breeding of National Apple and Pear Rootstock"
- Scanning of some apple cultivar and species by DNA markers related with fruit pulp and peel color
- Scanning of some apple cultivar by molecular markers in terms of apple black spot disease (Venturia inaequalis (Cke. Wint.) resistance genes
- Investigation of Turkey apple genetic resources for origin and genetic diversity through chloroplast DNA (cpDNA) and ISSR markers.
- Determination of genetic diversity and similarity in native and foreign pear cultivars by SSR markers.
- Determination of genetic diversity in some native apple cultivar and species by morphological and molecular markers.

RESULTS

Survey studies should be taken into consideration for enlarging of variation in genetic resources parcels, which have an important duty of material supplying to breeding studies. By considering Anatolia as a genetic centre, survey studies have to be maintained in all regions.

Apple trees and other cultivars belonging to *Malus* species, having large population, disappear in those large lands. Monoculture agricultural systems also cause these disappearing (Büttner, 2004). A big interest to the cultivars, which are larger, red skin and having good quality, has restricted diversity of cultivars belonging to *Malus*. This process blocks reproducing and spreading of apple types and causes to genetic erosion. For example, many of cultured cultivars have less resistance to black spot disease than those of ancestors. A great deal of researches has to be made upon genetic transfer of environmental, biotic resistance and fruit quality. After completing of these researches, breeders could constitute new apple cultivars. By the means of breeding of new cultivars, some developments, such as well nutrition, edible quality, high productivity, resistance to cold, well adaptation to environmental factors, tolerance to temperature fluctuation, resistance to insecticides, restoration of rootstocks, should be maintained.

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FRUIT GENETIC RESOURCES IN GERMANY, THE FRUIT GENEBANK IN DRESDEN-PILLNITZ

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Abstract
Based on the Convention on Biological Biodiversity and the Global Plan of Action several countries have strengthened efforts for the conservation and sustainable use of plant genetic resources. In Germany the preservation of fruit cultivars has a long-lasting tradition reaching back to the early decades of the 20th century. Since that time, cultivars of different fruit crops species are preserved in public and private germplasm collections. The aim for the future is to develop an effective conservation strategy of genetic resources for fruits in Germany and to evaluate the fruit genetic resources in order to allow their sustainable utilization in fruit production, breeding and research.
The base is the 'National Program for Genetic Resources of Agricultural and Horticultural Plants' in Germany. For a suitable and efficient conservation the German Fruit Genebank was established as a decentralized network, which is aimed at the coordination of different germplasm collections in Germany to minimize the risk of losing fruit genetic resources. The work is organized in species-specific networks. Currently, the five networks include 28 collections held at federal and state institutions as well as in communities and towns. The Fruit genebank in Dresden-Pillnitz is with the genebank collections in apple, cherry, strawberry, plum and *Rubus* partner of all established fruit specific networks. In addition to the cultivar collections, the genebank of the Institute comprises wild species collections of the genera *Malus, Fragaria, Prunus, Pyrus and Sorbus.* The *Malus* as well as and the *Fragaria* collection are the largest collections in Europe. For building a backup cryopreservation, the method using winter vegetative buds was successfully applied to the first *Malus* accessions maintained at the JKI genebank and strawberry meristems were cryopreserved with a high efficiency.
Ongoing projects were started for a comprehensive evaluation of resistance of scab, mildew and fire blight in apple. In addition, the characterization of fruit traits and the analysis of biochemical components as well as the genetic characterization by using SSR-markers is in progress.

Beside *ex situ* activities the Institute for Breeding Research on Fruit Crops supported by scientific consulting the project *In situ* conservation of *Malus sylvestris* in the East Ore Mountains. The aims were the preservation and sustainable use of the crab apple in the East Ore Mountains and the development of a management plan using the East Ore Mountains as an model to preserve the crab apple as a genetic resource in other areas of Germany.

GENETIC MAPPING AND QTL ANALYSIS FOR FRUIT QUALITY IN APPLE AND S-ALLEL GENOTYPING IN CHERRY

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Abstract

The most important character in apple trade is fruit quality. The most famaous local cultivar in Turkey is 'Amasya' which is a very important genetic source with a good fruit quality. 'Amasya' cultivar produces firm, juicy, highly aromatic and long storable fruits, whereas its some characters such as alternate bearing make it a unpreferable cultivar by the growers. However, unfavorable characters of this cultivar can be improved by the cultivar breeding programs. Fruit-tree cultivar breeding programs are time consuming due to their long juvenile periods. Molecular breeding strategy in the breeding programs can reduce time and cost by omitting seedlings which have undesirable characters. There are a few QTL (Quantitative Trait Locus) and genetic mapping studies in apple in the literature. Only several of them stuided aroma compunds by using 'Fiesta', 'Prima', 'Discovery', 'Royal Gala' and 'Granny Smith' cultivars as parents. There is no any study in Turkey studying genetic mapping and QTL analysis in apple. In this study, it was aimed to construct especially genetic map of Amasya cultivar and to determine quantitative trait loci of fruit quality characters such as aroma compounds, sugars etc. by using F1 populations that was created by crossing 'Kaşel-37' (female parent; selected from Amasya cultivar) and 'Delbarestivale' (male parent), and 'Kaşel-41' and 'Williams Pride' cultivars. A total of 180 and 96 F1 seedlings budded on M9 rootstock were used in this study, respectively. The orchards were established with F1 seedlings and parents in Eğirdir, Malatya and Samsun locations with two replicates in the spring of 2011. Genetic maps of the parents were constructed by SSR, AFLP, E-STS and RGA markers. Fruit quality analysis were performed in 2013 season in the fruits harvested from two locations. QTL analysis were done in 91 characters for two locations, and QTLs that are important in two locations were considered. 83 QTLs were detected for 40 characters. Location specific QTLs were also detected. In a conclusion, the data obtained from this project can be used in the breeding programs, and further characterization and QTL analysis should continue to find new QTLs for important characters.

SELECTION OF DOMESTIC AND FOREIGN SWEET CHERRY CULTIVARS AT YALOVA ECOLOGY

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Abstract
Sweet cherry is one of the earliest maturing fruit in temperate climates and Turkish sweet cherry has a significant importance in world markets. Currently 0900 Ziraat is the main cultivar consumed with appreciation in our country as well as in some other countries in the world. Quality, yield and profitability of sweet cherry is generally determined by its fruit characteristics such as color, firmness, size, flavor and resistance to cracking. In addition, self-fertility is one of the most important factor and stable and high yielding sweet cherry cultivars are preferred.
In this study, sweet cherry cultivars were tested in different ecologies with foreign cultivars that had superior characteristics with the best cultivars when compared to the current commercially grown cultivars.
Study has been carried out on 5 trees from all cultivars that were grafted on seedlings at research plots of Yalova Atatürk Horticultural Central Research Institute between the years 1999-2011. Yield and quality of sweet cherries were examined and phenological observations and pomological measurements were recorded. According to harvest time at Yalova ecology; Precoce de Bernard, Techlovan, Sylvia, Summit, Noir de Meched, 0900 Ziraat, Octavia, Belge, Sweetheart and Regina varieties had the highest scores on tests and they were advised to the growers.

Key words: Cherry, Variety, Domestic, Foreign, Selection

INTRODUCTION

Turkey with a production of 494,325t is the biggest sweet cherry (*Prunus avium* L.) producer in the world. There are hundreds of cherry varieties grown in the world and this number is increasing rapidly as a result of new breeding studies. After 1990, Cherry growing gained a special

importance and has an increasing trend in Turkey due to the increased consumption in the country and export of main Turkish Cherry variety (0900-Ziraat) (Akcay and Ozyigit 2007, Akcay et al. 2010).

Due to the high yield, high quality, high commercial value and prolonged harvest period, determination of late sweet cherry varieties may add value to foreign trade. This research is planned to determine the performance of these varieties in different ecological zones.

There are some literature results on sweet cherry. Turkey has favorable ecology for cherry cultivation. So that there is a long period of time for harvest Kaşka et al. (2005), reported that cherry harvest is started from Kemalpaşa (İzmir) and continued by Honaz (Denizli), Sultandağı, Dereçine (Afyon), Akşehir, Hadim (Konya) and Andırın (Kahramanmaraş) for long time.

Sweetheart, Lapins, Summit, Sunburst, Regina, Octavia, Kordia, Belge, Rainier, Cristalina, Newmoon and other cultivars are tested at different countries and advised for producers (Kapel et al. 2003, Long et al. 2005, Meland et al. 2005). Sweetheart, Lapins, Summit, Sunburst, Rainier, Cristalina and Newmoon cultivars are produced at Canada and America continent (Kapel et al. 2003, Long et al. 2008). Regina, Octavia, Kordia, Belge, Fercer Arcina, Techlovan, Precoce de Bernard and some other cultivars were tested in Europe and advised to producers (Sansavini and Lugli, 2008).

MATERIALS AND METHODS

All cultivars were grown on Mazzard (*Prunus avium L.*) and planted in 1999 Belge, Lapins($S_1S_{4'}$), Newmoon, Sylvia(S_1S_4), No:6, Precoce de Bernard, Rainier(S_1S_4), Star(S_3S_4), Summit(S_1S_2), No:1, Techlovan(S_3S_6), Venüs, Veysel, 0900 Ziraat(S_3S_{12}), Kordia(S_3S_6), Cristalina(S_1S_3), Ferbolous Verdel, Fercer Arcina, Glacier($S_{4'}S_9$), Macleinheimer, No:7, Noir de Meched, Octavia, Regina(S_1S_3), Sunburst($S_3S_{4'}$), Sweetheart($S_3S_{4'}$). (Webster and Looney 1996, Kappel, et al, 2003). Kappel, 2005, Gulen et al. 2010, Ipek et al. 2010).

The trees were planted 5.0m x 5.0m and trained to a modified leader system at Yalova Atatürk Horticultural Central Research Institute-Turkey. 5 trees were used for each variety in this research. Implicit tillage and drip irrigation systems are used, while other cultural operations were carried out in full. Soil properties were as follows: Loam, pH; 7.2, organic material % 2,4.

For evaluation of cultivars; Fruit width (mm), fruit length (mm), fruit weight (g), SSC (%), Seed weight (g), pedicel weight (g) pedicel length (mm), Yield (kg/tree), cumulative yield(kg/tree), Fruit color and brightness (1-5), fruit taste and flavor (1-5), Fruit firmness (1-5), Fruit sugars, antioxidant activity and phenolic content, Quality losses during storage were studied (Akcay et al. 2005, Kankaya et al. 2005).

RESULTS AND DISCUSSION

The data for the earliest and latest dates of the phenologic stages, collected at Yalova ecology during the project are given on Table 1. As the earliest blooming varieties are self fertile there was no major pollination problem. All the other varieties those require pollination had also no major pollination problem as the bloom time overlapped with the other varieties compatible with each other.

According to phenologic observations; Sweetheart, Lapins and No:6 cultivars were early bloomed, 0900 Ziraat, Regina, Ferbolus Verdel, Sunburst, Octavia, Kordia and Summit were determined as latest bloomed varieties. Although there are some differences from year to year, most of the cultivars were harvested from last week of MAY to JULY at Yalova ecology. The results of the phenologic observations are found to be in parallel with the literature and realized within the same ranking. The leaf fall for all varieties occurred in December (Kappel, et al, 2003, Lech et al. 2008) .

In the last 2 years of the experiment, there is a result of adverse climatic events 2010 (221 mm of rain in June, which is the harvest time) and 2011 (flowering period in April with 71 mm of rain and an average temperature of 10.2 °C). So that cumulative increase in yield could not be obtained.

Table 1 .Phenological records of sweet cherry cultivars during the 2004-2011 period.

Cultivars	Bud Burst	First Bloom	Full Bloom	End of Flowering	Date of Harvest	Leaf Fall
F.Verdel	12-30/03	04-15/04	10-20/04	20-28/04	20-30/06	13-24/12
Kordia	11-22/03	01-18/04	11-25/04	15/04, 03/05	10-24/06	05-21/12
Regina	13-20/03	03-16/04	09-21/04	13/04, 02/05	20-28/06	20-27/12
Star	02-17/03	28-03, 06/04	02-14/04	07-20/04	16-24/05	12-22/12
Sylvia	13-25/03	08-15/04	11-20/04	18-27/04	27/05, 02/06	14-28/12
Sweetheart	06-15/03	20/03, 02/04	25/03, 10/04	01-16/04	18-26/06	18-24/12
Venus	03-12/03	05-09/04	09-12/04	15-16/04	27/05, 01/06	13-25/12
No:6	01-10/03	25-31/03	01-05/04	08-12/04	20-29/05	08-27/12

0900 Ziraat	10-22/03	04-14/04	08-20/04	13-29/04	13-17/06	11-25/12
Newmoon	03-12/03	01-04/04	05-15/04	09-21/04	28/05, 03/06	10-19/12
N.deMeched	12-20/03	01-12/04	10-20/04	14-27/04	08-20/06	21-26/12
No: 7	12-17/03	29-03, 04/04	03-13/04	10-17/04	03-10/06	11-23/12
Techlovan	01-10/03	02-11/04	07-14/04	13-18/04	04-13/06	08-22/12
Glacier	13-20/03	04-12/04	10-16/04	16-22/04	05-14/06	20-24/12
Veysel	18-24/03	10-15/04	13-20/04	18-26/04	22-25/05	11-25/12
Sunburst	09-20/03	11-15/04	15-21/04	22-29/04	10-12/06	07-20/12
Octavia	12-23/03	09-14/04	13-20/04	19-30/04	10-15/06	15-28/12
P.de Bernard	10-15/03	04-09/04	10-13/04	14-18/04	13-20/05	08-21/12
Summit	11-22/03	10-15/04	14-20/04	19-26/04	11-14/06	20-26/12
Macleinheimer	08-20/03	06-14/04	11-20/04	16-27/04	12-17/06	25-27/12
Lapins	01-13/03	03-06/04	09-11/04	14-18/04	10-15/06	21-26/12
Belge	02-15/03	06-11/04	11-16/04	15-23/04	10-16/06	20-21/12
FercerArcina	12-20/03	09-12/04	13-17/04	17-22/04	05-12/06	12-23/12
Cristalina	20-27/03	13-19/04	17-22/04	21-30/04	10-19/06	19-24/12
No:1	05-18/03	06-10/04	11-16/04	16-25/04	01-07/06	20-21/12
Rainier	02-11/03	04-05/04	09-11/04	14-16/04	12-18/06	23-27/12

The data about the fruit characteristics and total yield of 26 sweet cherry varieties are given on Table 2. The performances of the varieties those have larger fruit sizes (Sylvia, Sunburst, Summit, Kordia, Frecer Arcina) and better yielding (Sweetheart, Noir de Merched, Techlovan) than the widely grown and main export variety in Turkey 0900 Ziraat are found in this study (Akcay et al. 2005, Kankaya et al. 2005).

P. Bernard is determined as early variety and Techlovan, Sylvia, Summit, and Noir de Meched are determined as mid variety in this research. Similar results were found in parallel with the literature (Gratacos et al., 2005, Kankaya et al. 2005). 0900 Ziraat, Octavia, document and Regina stand out in many studies. Sweetheart is self pollinated variety. These cultivars were selected according to these characteristics.

Table 2. Pomological characteristics of sweetcherry cultivars during the 2004-2011 period.

Cultivars	Fruit Size			Solible solids (%)	Fruit stem weight(g)	Fruit stem length(mm)	Seed weight (g)	Cumulative yield (Kg/tree)
	Width (mm)	Length (mm)	Weight (g)					
F.Verdel	24.45	22.29	7.67	16.92	0.17	60.08	0.41	45.86
Kordia	26.60	27.55	10.07	15.24	0.17	58.73	0.30	16.38
Regina	25.73	23.48	8.47	15.89	0.18	55.63	0.40	70.25
Star	24.00	22.75	7.24	13.20	0.11	44.65	0.40	77.11
Sylvia	30.00	28.32	11.90	15.10	0.19	51.50	0.40	63.87
Sweetheart	26.75	23.60	9.04	14.54	0.12	43.54	0.43	108.82
Venus	24.20	23.54	7.59	14.30	0.12	43.40	0.31	23.99
Rainier	26.85	24.72	10.09	17.88	0.11	36.84	0.32	75.27

0900 Ziraat	28.70	24.47	9.90	13.85	0.11	52.29	0.40	67.42
Newmoon	26.70	24.00	8.98	12.90	0.14	47.45	0.36	53.74
Noir de Meched	27.08	21.59	9.67	15.42	0.17	58.60	0.30	106.63
No: 7	25.13	23.40	7.57	15.28	0.13	48.60	0.34	129.36
Techlovan	28.44	23.25	10.02	15.43	0.12	38.66	0.40	103.77
Glacier	26.96	25.34	9.25	14.00	0.13	47.23	0.35	37.95
Veysel	27.11	23.80	7. 89	13.90	0.12	50.10	0.38	55.86
Sunburst	29.52	26.25	11.87	15.66	0.14	45.23	0.36	37.14
Octavia	26.20	24.34	9.13	14.68	0.14	55.43	0.42	71.22
P.de Bernard	25.85	23.00	8.20	15.06	0.13	50.17	0.33	69.50
Summit	28.08	27.41	11.12	14.00	0.18	50.44	0.46	49.64
Macleinheimer	27.81	24.54	9.51	15.45	0.18	60.13	0.41	23.47
Lapins	26.15	24.38	9.85	15.60	0.11	40.42	0.44	67.45
Belge	29.16	25.81	10.78	13.76	0.12	48.57	0.44	70.55
Fercer Arcina	28.85	24.37	11.15	15.28	0.12	41.64	0.47	10.10
Cristalina	27.18	24.86	8.95	14.76	0.11	42.56	0.46	57.61
No:1	28.77	26.25	10.94	15.30	0.12	49.80	0.40	43.44
No:6	21.15	20.40	5.00	16.45	0.10	35.47	0.32	37.26

The data collected from the trees budded on seedlings and planted in 1999. Data collection period started in 2004 and continued till 2011. The scoring made from the data collected is given on Table 3. It is decided to select more than 1 variety in accordance with the need in Turkey within the same harvest period and different harvest periods.

Kordia, Regina, Lapins, Schneiders, Summit, Sweetheart, Karina, Noire de Meched, Samba and Sylvia cultivars were tested in Belgium by Vercammen et al., 2005, Vercammen and Toon 2009. They reported that Schneiders has difficulty to keep fruit, and Sweetheart and Summit are most crack varieties. Santos and Palma (2009) reported that Sweetheart was stored in polypropylene pack with modified atmosphere during 27 days and fruits lost their fresh consuming quality after 20 days.

Also we should point out that some of the cultivars will be more suitable for some specific areas (with cold climate) than the ones that take higher results in table.

Table 3. Modified weighted ranking table prepared by data during 2004-2011 period

Maturity Period	Cultivars	Cumulative yield per tree (kg) (30)	Fruit width (mm) (25)	Fruit color and brightness (between 1-5) (10)	Fruit firmness (15)	Fruit taste (between 1-5) (10)	Fruit stem (10)	Total
I. Period (4. week of May)	P.de Bernard	150	150	40	45	30	60	475
	Star	180	100	10	15	10	80	415
	Veysel	120	100	10	15	30	80	355
	No:6	90	50	10	15	10	20	195
II. Period (1st week of June)	Techlovan	240	150	30	60	40	60	580
	Sylvia	200	250	30	60	30	20	590
	No:7	300	100	40	45	30	60	575
	No:1	90	250	50	60	40	60	550
	Newmoon	120	200	50	60	30	60	520
	Venüs	60	150	40	45	30	40	345
III. Period (2nd week of June)	N. de Meched	240	200	40	60	40	100	680
	Summit	120	200	50	60	50	60	540
	Sunburst	90	250	40	60	30	60	530
	Macleinheimer	60	150	30	45	20	80	385
	Glacier	90	200	40	60	40	60	490
	Fercer Arcina	30	200	50	75	40	80	475
IV. Period (3rd week of June)	0900 Ziraat	150	200	50	75	50	80	605
	Belge	180	200	40	60	40	80	600
	Octavia	180	200	40	60	30	80	590
	Lapins	150	150	40	60	40	40	500
	Rainier	180	200	20	60	30	20	510
	Kordia	30	150	50	60	40	100	430
	Cristalina	120	150	40	60	40	40	450
V. Period (4th week of June)	Sweetheart	300	200	40	75	40	80	735
	Regina	180	150	40	60	40	100	570
	F.Verdel	90	150	30	60	30	100	490

Sweet cherry varieties harvested at different maturity stages evaluated separately by the results from table 3 and grouped as early, mid and late varieties. And they are suggest to producers as the fallowing groups.

I. Period (Early); Precoce de Bernard

II-III. Period (Mid); Techlovan, Sylvia, Summit, Noir de Meched

IV-V. Period (Late); 0900 Ziraat, Octavia, Belge, Sweetheart, Regina,

CONCLUSIONS

Precoce de Bernard, Techlovan, Sylvia, Summit, Noir de Meched, 0900 Ziraat, Octavia, Belge, Sweetheart and Regina cultivars took high scores after all tests at Yalova ecology and they were advised to growers.

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FINGERPRINTING THE SWEET- AND SOUR-CHERRY CULTIVARS WITH SSRS

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Abstract
Sweet (*Prunus avium* L.) and sour cherries (*Prunus cerasus* L.) are two economically important species in Europe. The capability to distinguish among cherry cultivars in breeding, cultivation and germplasm collection is extremely important for cultivar registration, protection, cultivation and management as well as for economic reasons. Normally morphological traits are used to identify cultivars but these traits are often differently expressed in different environments and production practices.
DNA-based markers are useful for germplasm identification, diversity analysis and verification of rootstock identity. Among molecular markers, microsatellites, or SSRs, are known for being highly polymorphic, codominantly inherited, abundant and evenly distributed in the genome. The most widespread technique for SSR detection is PCR with specific primers, which is simple, reproducible and suitable for automation. SSRs provide a more reliable method for DNA fingerprinting compared with RAPDs, which can not fully match the advantages of SSRs to differentiate the cultivars. SSR markers have been used widely for cultivar identification, genetic mapping and phylogenetic studies.
Our objective was to establish one stable method to fingerprint sweet- and sour cherry cultivars with SSR primers. In this study, the works of extracting the DNA from different parts of cherry tree with different DNA extraction methods/kits, selecting the right primers from about 50 SSRs and testing the different PCR conditions are presented and the polymorphism information content (PIC), frequencies of 20 SSR loci distributed on a subset of about 100 cultivars are described and discussed.

CHERRY BREEDING STUDIES AT ATATÜRK CENTRAL HORTICULTURAL RESEARCH INSTITUTE, IN YALOVA

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Abstract

Since cherry is originated in Turkey, it is one of the leading countries in the world concerning both production and export. 0900 Ziraat local cherry cultivar is the most grown one in the country. Despite to excellent edible quality, attractiveness, and resistance to cracking, the cultivar show instability in yield concerning the years. Also, it has low fruit set because of flowering time are not matching to flowering of the pollinator cultivars.

The first cherry hybridization and mutation breeding program have been initiated to obtain new cherry cultivars at the beginning of the 2nd Millennium by Atatürk Central Horticultural Research Institute in Yalova. In this study, mutation breeding method was used to obtain higher quality fruit, a compact growth and better yielded cultivars than 0900 Ziraat. Cross breeding method was applied to obtain new self-compatible, good fruit characteristics and yielding cultivars, crossed 0900 Ziraat with self-compatible cultivars (Stella and Sweetheart).

A great number of mutant types of 0900 Ziraat cultivar were obtained since the breeding program has been started. At the first step of the breeding program 10 types with high quality and high yield characteristics were selected. Recently, registration studies were started for 2 new types.

Also good quality new hybrids were obtained from cross breeding program, which were over 27 mm calibration, 9.0-14.1 g fruit weight and self compatible. Using molecular methods are our main selection criteria. Selections are still continuing with several cherry types, among them 7 new types have been selected at the first step.

INTRODUCTION

The sweet cherry has a important position in Turkey's fruit production and export. 0900 Ziraat cherry cultivar plays significant role both these. Despite to excellent fruit quality and some other characteristics this cultivar shows low yield year by year since having some unfavorable traits.

The breeding program has focused on to obtain having cultivars with traits as fruit quality, tolerance to rain induced cracking, regular and desired fruit set, self fertile and, especially late maturity by using cross and mutation

breeding methods. Totally 1210 individuals and 400 mutant types have been obtained since the beginning (2001) to day in this program. Currently 7 cross bred individuals and 10 mutant types were selected at first step. Evaluating studies have been continued on these selected and the rest of cross and mutation bred types.

MATERIAL AND METHODS

In the first stage of crossing, three crossing combinations were formed as Stella X 0900 Ziraat, 0900 Ziraat X Stella and Sweetheart X 0900 Ziraat in 2001. Several progenies were obtained from those combinations. Then new three crossing combinations were established by using as parents two selected types amongst the first stage hybrids, both are self fruitful as following Ferbolus Verdel X B-13, Ferbolus Verdel X D-2 and Ferbolus Verdel X Sweetheart in 2009.

One day after emasculation of cherry flowers at white bud (just before blooming) stage were pollinated artificially. No bag was used for pollinated flowers on the branches for rarely visiting by bees and another pollinating insects (Hesse, 1975; Bargioni, 1996).

The fruits obtained by crossbreeding harvested at normal maturity and just after harvesting, fruits were pitted. The pits were dried a week by laying them in a semi-shaded place. After removing the seeds from dried pits, the seeds were stratified in a refrigerator at 4 °C for six-seven months. In general, germinating started 60 days after stratification and continued during given previously period. If seeds were not germinate in that time, warm stratification was implemented for 2-3 weeks at 21 °C and then germinating started and lasted up third month. Germinated cherry seeds were sown into pot trays that contained media of coco peat for 1-2 months and the plants were transplanted into small pots while still at the seedling stage. This time was coincided with autumn in greenhouse. The seedlings were transferred into larger pots in spring and were held in greenhouse up to transplanted in orchard next autumn.

Cross bred young trees were planted as both on own roots and on dwarfed rootstocks for getting precocity in orchard.

In order to determine “effective mutation dose” (EMD) for 0900 Ziraat, 20 cm long 50 dormant scions of were irradiated with 25, 30, 35, 40, 45, 50, 55 and 60 Gray per doses with gamma rays (Co60) as a source of mutagen. Irradiated buds were immediately grafted on *P.avium* rootstock by chip budding in spring. Grafted seedlings were developed in a shaded greenhouse. On the 60th day following the grafting, EMD was calculated by linear regression on the basis of shoot length (Donini, 1980, Saamin and

Thompson, 1998). The responsible dose of 50% reduce shoot length of non irradiated group is to be known (LD50). The general acceptation, EMD is between 10% down and 10% up of LD50 value. Mutant candidates young trees transferred to orchard in the next autumn with a spacing of 3x5 m. Bigarreau gaucher and Starks gold varieties were used as pollinator which are known well compatible with 0900 Ziraat.

In the mutant candidates' orchard, growth rates, shapes of tree, branching pattern, leaf pattern (and abnormalities, if any) and bud structures have been observed annually throughout juvenility. In the young trees that have completed juvenility, subsequent to flower formation, fruit setting, fruit quality, fruit pomology (weight, width, height, peduncle length, seed weight), fertility, cracking rate and soluble solid content rate determined in every 30 fruits through three repeated rounds. The trees and fruits of all mutant candidates were photographed and archived.

For monitoring the self compatibility status of the trees in population, branches were randomly selected from each tree during flowering phase, and a minimum of 100 flowers was isolated and observed.

The individuals obtained by cross and mutation breeding were evaluated with some properties that mainly were tree and fruit characters and sanitary status. Tree characters were self fertility, precocity, regular and desired yield, comparatively reduced tree size, compact tree (mutant in particular). Fruit characters were especially dark fruit/flesh color, large fruit size (≥27mm), cracking resistant, firm fruit, long stem and, comparatively later maturing. Also desired sanitary status were resistance to brown rot, bacterial canker, viruses (marked symptoms on leaves), powdery mildew (moderate / high), gummosis and, aphids as observational.

The cross-breed progenies also were evaluated in terms of self fertility using molecular methods. DNA was extracted from leaves and dormant buds collected in 2008 and 2010. The Qiagen Kit and CTAB methods produced to obtain sufficient and qualified DNA using both methods (Doyle and Doyle, 1987; Kafkas and Perl-Treves, 2001). S alleles of F1 hybrid cherry were determined by the use of the primers in the PCR reaction which were developed Sonneveld et al. (2001), Wiersma et al., (2001), Wünsch and Hormaza (2004).

The artificial fruit cracking tests were performed on fruits according to Christensen, 1996.

RESULTS AND DISCUSSION

Totally 550 progenies were obtained from given previously crossing combinations the first stage of cross-breeding studies. The best germination

rate was taken from the combination in which Stella is used as the maternal parent since its seeds are bigger than those 0900 Ziraat. Thus the most of progenies belong to this crossing combination.

Self-fertility status of 520 ones from obtained progenies were evaluated using molecular techniques in the young stages. The S alleles of 520 progenies from different combinations are presented in Table 1. The proportion of self fertile progenies was found 56,1 % while the rate of self incompatible progenies was 40,0 % and also the ratio of unwanted pollination products was merely 3,9 %. The progenies of unwanted pollinating have a different S allele from those of used crossing combinations. This confirmed the presence of at least some foreign pollination. Thus, self-fertility of F1 individuals yet to bear fruit before they were detected and this was an advantage in the selection and evaluation stages.

The progenies were planted on own root and grafted on dwarf rootstocks in the orchard. On own root trees were born some fruits at five and six years after planting in orchard while trees that grafted on dwarf rootstocks were born those with more quality and quantity at three or four years after grafting. The evaluations of traits of the progenies were carried out focusing on firstly desired fruit quality traits (Table 2.) and their regularity using at least a 3-4 years' period. As a result of observations within this period, the plants that do not meet the objectives and do not have aimed S allele were eliminated. Especially the efficiency and regularity in yield of the trees on their own roots was important for us.

According to the linear regression calculated on the basis of shoot length, “effective mutation dose” was calculated as “33.75 Gy”.

In the orchard, abnormal leaf patterns, chlorophyll mutations and chimeras growths have been observed in the first year which are named as “physiological injury and which reflect the effectiveness of irradiation dose. In M1V2 generation, among the 150 shoots that were randomly sampled for calculating the mutation frequency (MF), the ratio of leaves with normal morphology to those with abnormalities was calculated and MF was calculated as 4.1%, which is similar to the value obtained in Bing cherry variety (Saamin and Thompson, 1998).

Ongoing generations approximately 400 vegetative progenies were observed year by year and every vegetation period (sprouting to leaf fall) were accepted as a new generation year (M1V2, M1V3, M1V4 etc.). In each generation year not only general habitus but also every branch were observed in detail. According to observation we focused 110 vegetative progenies and selected 10 promising mutant showed dwarf growth, semi

dwarf growth, high yield, fruit quality (attractiveness, hard flesh, juicy, taste). Than each mutant types propagated and transferred advanced observation plantation on Gisela 6 and P.avium rootstock. Registration has been submitted to National Variety Registration and Seed Certification Center.
In addition to these variation, irradiation caused different growth habit between weak and strong, branching types between spread to upright. Also having different blooming time and harvest time on some branches. However no self-fertile types have been observed.
To obtain resistant to cracking varieties is one of the important objectives in cherry breeding (Brown et al., 1996). The best methods of in reducing the risk of cracking cherry fruits are to select very resistant varieties and to cultivate many varieties together with different ripening time in the same orchard (Christensen, 1996; Simon, 2006). The rainfall, recorded during some harvest seasons and the artificial cracking tests provide information about the resistance to cracking of types. The results of rain induced cracking rate and artificial cracking test data are given in Table 3 and 4. In terms of resistance to cracking, some of the mutant and hybrid types had lower values than 0900 Ziraat while the others showed higher levels than its in the table. Also, cracking on the fruits of some types mostly occurred only at the style end or on the side of fruits while in all others has been observed at the style end, the stem end and, on the side portion of fruits. The cracking at the style end was usually as small, circular and semi-circular cracks on the fruits. There were deep cracks in the side of fruits while cracks in the stem end were shallow, circular and semi-circular in type.

When the cracking tests of types carried out as long-term, this will provide more accurate results about resistance to cracking of the types to us. Therefore, these all data were taken into account in the selection of the types and types that showed low cracking rate were selected in the first stage.

CONCLUSION

Seven promising hybrid and 10 mutant types were selected, propagated and transferred to advanced observation plantation on Gisela 6 and P.avium rootstock at the end of first stage.
Selection studies on cross-bred progenies are continued the rest of trees from 550.
Up to now, totally 1660 progenies have been obtained from the second stage combinations. Also, observations have been continued on these progenies that have not borne fruit yet.

Registration studies have been started for 2 new mutant types

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(*Prunus avium* L.) cultivars. Genetic Resources and Crop Evolution , 51: 635-641.

Table 1. Status of F1 progenies concerning S alleles*

Parents	Progenies	$S_3 S_{12}$	$S_3 S_{4'}$	$S_{4'} S_{12}$	Undesired Pollination
Stella X 0900 Ziraat	481	202(42,0%)	31(6,4%)	228(47,4%)	20(4,2%)
0900 Ziraat X Stella	23	2(8,7%)	13(56,5%)	8(34,8 %)	---
Sweetheart X 0900 Ziraat	16	4(25,0%)	4(25,0%)	8(50,0 %)	---
Total	520	208(40,0%)	48(9,2%)	244(46,9%)	20(3,9%)

***0900 Ziraat $S_3 S_{12}$, Stella $S_3 S_{4'}$, Sweetheart $S_3 S_{4'}$**

Table 2. Some fruit characteristics, yield and maturity time of some hybrid types

Hybrid Types	Weight (g)	Size (mm)	Pit Weight (g)	Stem Length (mm)	Soluble Solids (%)	Yield* (Kg/tree)	Maturity
A-19	10,0	27	0,30	47	24,7	8,1**	14 . 06
B-13	10,3	28	0,46	59	18,2	7,3**	14 . 06
B-27	10,5	28	0,32	57	21,4	4,8**	16 . 06
B-42	8,4	26	0,31	53	19,4	17,2**	18 . 06
C-8	11,3	29	0,41	45	20,0	7,0**	14 . 06
C-30	9,0	26	0,36	44	22,4	5,2**	18 . 06
D-2	8,9	26	0,26	52	20,7	7,7**	11 . 06
E-18	12,9	31	0, 60	52	19,6	1,0	15 . 06
G-36	11,6	28	0,46	55	19,7	4,5	21 . 06
G-37	13,0	30	0,45	43	21,4	2,0	21 . 06
G-50	10,3	27	0, 43	49	20,1	4,8	14 . 06
H-15	9,7	27	0,36	47	16,5	8,6	21 . 06

H-17	10,9	27	0,50	68	16,8	3,0	06 . 06
H-38	12,1	29	0,46	64	20,0	3,6	16 . 06
J-39	12,1	29	0,56	39	23,2	3,5	20 . 06
J-51	10,7	27	0,47	44	17,8	7,0	20 . 06
M-21	10,8	28	0, 49	53	21,0	2,2	04 . 06
M-41	10,0	28	0,50	45	18,8	3,3	04 . 06
N-30	14,1	32	0,37	59	17,4	2,0	11 . 06
N-56	12,1	30	0,38	50	17,8	3,5	19 . 06

**Two years' cumulative yield on semi-dwarf rootstock

Table 3. Status of mutant types concerning fruit cracking

Mutant Types	**Artificial Cracking (%)**	**Fruit Weight (g)**	**Cracking on Fruits**
0900 Ziraat* **	**37,7**	**8,5**	style end , side
25-32	**43,3**	**9,1**	style end, side, stem end
25-55	**26,8**	**8,6**	side, style end, stem end
25-58	**55,3**	**9,7**	stem end, style end
25-65	**56,1**	**9,0**	style end, side, stem end
30-13	**28,0**	**9,4**	style end, stem end, side
30-32	**63,7**	**9,7**	style end, side
30-34	**34,0**	**8,9**	style end, stem end, side
35-49	**52,3**	**9,6**	style end, side
40-24	**14,4**	**9,4**	side
45-13	**48,4**	**11,5**	style end, side
45-26	**46,7**	**9,0**	side, style end, stem end
50-28	**42,0**	**10,0**	style end, side, stem end
50-29	**41,5**	**9,5**	style end, side, stem end

*** As control

Table 4. Status of hybrid types concerning fruit cracking

Hybrid Types	Artificial Cracking (%)	Fruit Weight (g)	Cracking on Fruits
0900 Ziraat* **	**37,7**	**8,5**	style end , side
B-1	**31,2**	**7,4**	style end, stem end
C-1	**36,8**	**7,2**	style end
C-26	**56,3**	**7,7**	style end
G-13	**19,2**	**10,3**	stem end
G-16	**58,0**	**9,1**	style end, side
G-38	**10,4**	**7,9**	style end
H-7	**52,0**	**8,7**	style end, stem end
H-27	**30,4**	**8,0**	side
H-50	**13,6**	**7,4**	style end
M-21	**16,0**	**8,6**	style end, side
M-22	**55,2**	**7,5**	style end
N-6	**42,4**	**7,3**	style end
R-2	**78,8**	**10,1**	style end

*** As control

MECHANICAL PRUNING AND THINNING IN SOUTH GERMAN APPLE ORCHARDS

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Abstract

At the present time many orchardists are interested in pruning their trees mechanically. Several types of devices are available and are more or less affordable. The aim is to save labour costs and not to be dependent on skilled workers, especially when the orchard production areas are increasing. The hours required for pruning can be reduced and other work can be done more efficiently (hand thinning, picking). Some additional mechanization steps also promising (mechanically thinning, picking robot). The idea to produce fruit using narrow, mechanically pruned 'fruit walls' evolved in Southern France, CTIFL Centre de Lanxade as 'Le Mur Frutier' system about twenty years ago. In the fruit production region of Lake Constance mechanical pruning is currently being tested under the given growing and climatic conditions in older apple orchards to adapt pruning systems for full production stages as well as in younger plantings.

Ten year old apple trees (varieties Braeburn 'Hillwell' and 'Pinova') where first changed to mechanical pruning in 2012 using a device with cutting bars. The 2.5 m height tree canopies were cut back to 60 cm hedge diameter on top and 80 cm diameter at the base. In the first year the pruning was done two times at 'pink bud stage' (BBCH 57) and at the 8-12 leaf stage. In the following years only one mechanical prune per year at BBCH 57 was made. After two seasons a correction pruning by hand was done, to lighten out the dense inner canopy. Compared to the standard winter hand-prune about 60% of working hours were saved. The mechanical pruning saved about 100 hours for 'Braeburn' and 60 hours for 'Pinova' trees over the two years. The mechanical pruning increased flower set and the crop load because of the developing young shoots produced many flower buds. The mechanical pruning enhanced effective crop load reduction. Chemical thinning was not successful. But the use of the thinning machine 'Tree-DARWIN' showed good results with a higher total yield, larger fruit size, doubled the fresh marketable yield (~ 17kgs/tree) and extra savings on labour time for the hand thinning (75 hours less/ha). Mechanical pruning has to go hand in hand with mechanical thinning.

BREEDING OF NEW SWEET CHERRY VARIETIES

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Abstract
"Breeding of new sweet cherry varieties" named project was begun at Fruit Research Station in 2007. With this project, it has been aimed improving of new sweet cherry varieties which will have to fit for market demand and will be fruitful and will have good quality and will wide sweet cherry supply. In this Project, It was obtained about 2000 hybrid seedlings from different crosses. This seedlings have been investigated for field performances and fruit characteristics.
Key words : Breeding, Sweet Cherry, Fruit quality,

INTRODUCTION

Turkey holds the first place in the world cherry production with about 400 000 tones, however it can only export %10-15 of this production (www.fao.org, 2011). '0900 Ziraat' variety constitutes almost all of this cherry export by itself. This high quality variety is known as "Turkish cherry" in the word. Depending on only one variety for export causes gaps in the export, thus leading to profit loses for cherry growers and exporters. Since this variety is a self-incompatible variety and requires cross pollination, very big drops in production can be observed in some years when the weather is unsuitable for cross pollination in spring months.
The goal of this project is to develop new high quality sweet cherry cultivars with high consumer appeal suitable for growing in Turkey.

MATERIALS AND METHODS

Controlled hybridization studies were carried out at Fruit Research Station in Eğirdir. Cultivars with the property suitable for the purposes were selected as parents. In this context, Celeste, Sweetheart, Sunburst, Lapins, Stella, 0900 Agriculture and Regina cultivars were used in crossing. The first controlled crossing studies began in 2007 and still continue.
Celeste : Celeste is an early maturing, self-fertile selection that ripens about five to seven days before Van. The fruit is dark fleshed, firm, and the size is

usually much better than other early varieties, The flavor of Celeste is very good and moderately sweet (Bargioni, 2004).
Sweetheart : Large, bright red fruit with good flavor. Precocious tree requires pruning to prevent size problems. Self-fertile. Matures 5-7 days after Lapins (Bargioni, 2004).
Sunburst : Self-fruitful, Large,. dark-skinned sweet cherry similar to Stella. Resists cracking. Ripens midseason, about with Bing and Van (Bargioni, 2004).
Lapins : Self-fruitful, dark red sweet cherry from Canada. Large, firm, good flavor. Similar to Van in color, Bing in shape. Ripens 4 days after Bing (Bargioni, 2004).
Stella : Self-fruitful, Large, nearly black, richly flavored sweet cherry similar to its parent, Lambert. Late harvest (Bargioni, 2004).
0900 Ziraat: Large, firmness, good flavor, colorful and cracking resistant fruits, self-incompatible (Kaşka, 2001).
Regina : Large, dark red cherry. Firm fruit with mild sweet flavor. Holds well in storage. Crack resistance, late blooming to avoid spring frosts. Ripens late, self-incompatible (Bargioni, 2004).

METHODS
The program consists of 3 sections:
1-Making crosses, planting own-rooted seedlings in the field and evaluating fruit,
2-Replicated trials of grafted advanced selections,
3-Rregistration.
Currently, breeding programmers focus on generating progeny from controlled hybridization. Pollen was collected from newly opened or opening flowers just before the petals separate (Hedhly et al, 2009). Following emasculation, the intended paternal pollens were applied to the pistil using a finger, glass rod or brush. The cherry seeds produced by controlled crossing were removed from the ripen fruits and then stratified (Fogle, 1975, Thompson, 1996). After 4 months, the seeds were periodically checked for germination and seedlings were transplanted to the greenhouse when the radicle was 1 cm in length. The seedlings were planted at 3x1 m. and pomological characteristics including fruit and fruit size, pH, skin and flesh coloration, stem length, total soluble solids were determined. Fruit diameter of 27 mm or larger were selected for advanced observation.

RESULTS AND DISCUSSION

2033 hybrid genotypes were obtained from different crosses and planted in pre selection parcels. Some traits were given at tables. Flowering was observed at 212 seedlings.

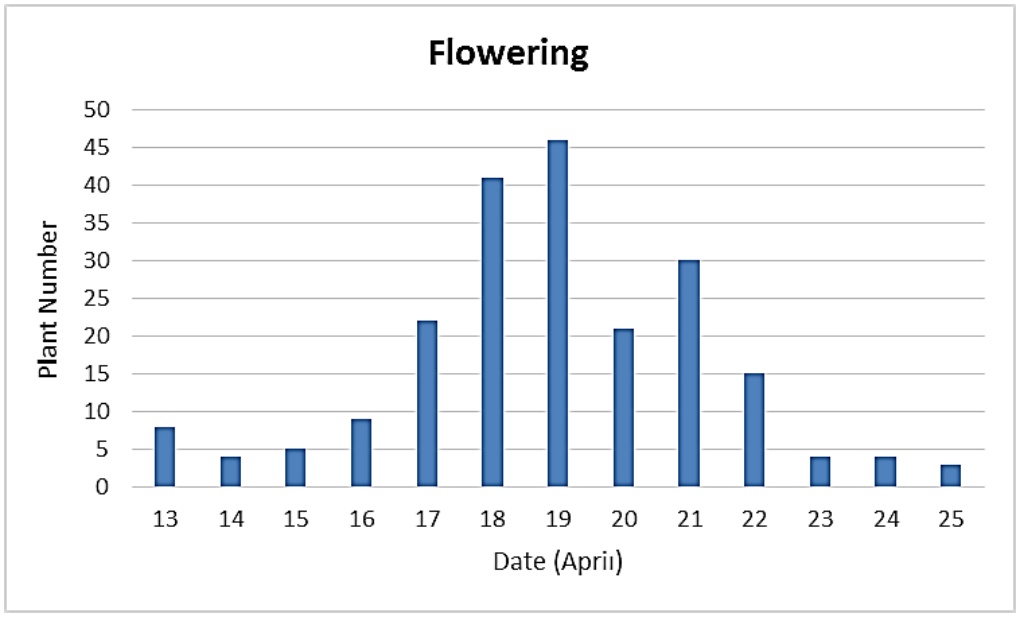


Figure 1. Full bloom dates and number of genotypes

On April 13 flowering in 8 genotypes, whereas 46 genotypes on April 19, on April 25 in 3 genotypes were seen in full bloom. 136 genotypes were evaluated in terms of phonological and pomology characters. Of these, 27 mm and larger ones to be transferred to the forward observation plots. 27mm diameter and larger fruit genotypes and some of their properties are given Table 2.

Table 2. Pomological dates of some genotypes

Kod	Fruit diameter(mm)	Stem Length (mm)	Color	Harvest Day/ Month
701-1	27	55	Yellow-Red	26/06
701-4	27	46	Red	28/06
701-7	27	45	Red	28/06
701-13	27	40	Yellow-Red	28/06
701-19	29	50	Dark-Red	24/06
701-21	28	60	Dark-Red	27/06
701-27	27	45	Dark-Red	24/06
701-31	27	49	Dark-Red	23/06
701-36	27	53	Dark-Red	24/06
701-37	27	48	Red	26/06
701-42	28	46	Yellow-Red	28/06
701-46	27	46	Dark-Red	26/06
701-48	27	36	Dark-Red	26/06
701-50	27	39	Dark-Red	30/06
701-51	29	48	Red	25/06
701-55	27	54	Dark-Red	24/06
702-5	27	35	Dark-Red	26/06
702-6	27	45	Yellow-Red	29/06
702-7	27	43	Yellow-Red	30/06
702-5	27	50	Red	25/06
703-3	30	40	Red	24/06
703-5	27	39	Yellow-Red	24/06
703-6	29	54	Red	26/06
703-35	30	65	Red	08/07
704-2	27	45	Dark-Red	22/06
704-4	27	37	Yellow-Red	21/06
705-1	27	48	Yellow-Red	30/06

Cherry growing of self-compatibility and quality are still significant problems. To develop new varieties are difficult and long-term studies are required.

The first results we have achieved us in achieving our aim is to give hope . Each year, we have been caring out controlled crosses among parents.

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MARKER ASSISTED SELECTION

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Abstract

Breeding is the development of genetic variability by means of crossing which is followed by the subsequent selection steps aimed at reducing unwanted phenotypes leading to the development of newly improved cultivars. Selection requires tools for the determination of traits. Traditional breeding used different methods for phenotyping which is only possible when the traits are developed. Molecular genetics offers a tool which predicts the expression of traits by using molecular markers for genotyping. This allows the projection of phenotypes when the trait itself is not developed. The application of molecular markers for selection purposes is extremely helpful in breeding fruit trees which have long juvenile periods and also for the purpose of pyramiding of resistance genes.

In apple breeding, molecular markers are mainly applied in marker-assisted parent selection (MAPS) to verify the genotypes and in marker-assisted seedling selection (MASS) to detect resistance genes. Until now, simple sequence repeats (SSRs) are mainly used; however, due to the development of new technologies and the completion of the Golden Delicious genome sequence annotation, other techniques like single nucleotide polymorphisms (SNPs) bulked on arrays have become increasingly important.

This paper will give an insight in to the development of molecular markers using markers for fire blight resistance from *Malus fusca* as example, the application of molecular markers in the apple breeding program at Dresden-Pillnitz and an outlook of new possibilities in breeding.

STONE FRUITS GERMPLASM, BREEDING AND CHILLING STUDIES IN TURKEY

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Abstract

Turkey is one of the main fruit production centers of the world. Stone fruits are generally heterogeneous plants and could be grown in different climates, ranging from tropical to subtropical zones, and latitudes from sea level to high mountains. Turkey is one of the secondary centers of many fruit species. Considering the stone fruits there is an important genetic diversity for apricots, plums, cherries and almonds in various parts of Anatolia. So, many accessions of local apricot and sweet cherry cultivars are mainly seen in the Middle Anatolia. Diversity in plums (*Prunus cerasifera*) and almonds is mostly observed in everywhere.

Plant germplasm collections are the most important sources for a breeder. If the breeder knew the detailed information about the germplasm stocks, he/she can plan a good breeding program. Although peach was not originated in the country, a lot of variation has been seen in peach grown areas. Peach is one of the most popular fruit species to be worked on by the breeders, because of its dominant characters, correlative precocities and very low juvenility period. These characters help us to get early selection among the hybrids before the fruit set.

Since 1985, studies on dormancy mechanism, chilling requirements and rest breaking methods were studied on several fruit species especially on peaches. The chilling requirements of cherry cultivars and the chilling durations of two different cherry growing areas were also investigated. Considering the latest study on cherries, Lapins and Larian gave the lowest (400-450 hours and 94 chill units) chilling requirement. They were followed by Nafrina with 500-550 hours and 120 chill units. Kordia found to be the highest chilling requiring cherry cultivar (700-750 hours and 150 chill units). The others were in between.

Calculating the chilling hours below 45°F, Pozantı (1100 m elevation) gave 3 or 4 times higher chilling accumulation comparing the subtropical conditions of Adana (23 m elevation). However, the chill unit values of Adana and Pozanti were quite similar to each other according to the Richardson's chill units. In comparison of cherry cultivars for dormancy breaking initiation of

the buds, Kordia, Larian, Nafrina and Sunburst showed an apical dominancy effect and this effect was the strongest in Sunburst while it was the lightest in Summit. Top cut cuttings of these four cherry cultivars broke dormancy earlier in lateral buds than apical buds. Bud break rates of apical and lateral buds in Lapins, Summit and 0900 Ziraat were quite similar to each other.

EMBRIYO RESCUE FOR BREEDING OF EARLY PEACH VARIETY RESISTANT TO PPV DISEASE

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ABSTRACT

In this study, commercial early peach variety of Flored inter-specific crosses with sharka resistant apricot (Stark Early orange) and *P. davidiana* clone of P 1018. The use of embryo culture is substantial in many classical breeding programmes for early ripening fruits. The aim of this study is to investigate the seed development and germination in vitro conditions. These crosses were germinated in MS medium WPM and Prunus medium with different PGR. The best result germination rate (%87,5) was obtained from MS + BAP 1 mg/L + GA_3 0.1 mg/L media.

Key words: Embryo rescue, sharka, early peach variety

INTRODUCTION

Embryo culture is one of the earliest forms of in vitro culture applied to practical problems and is probably the tissue culture technique that has proven of greatest value to breeders. Its major application in plant breeding has been for interspesific hybridization. Embryo culture can shorten the breeding cycle by overcoming dormancy in seeds. Dormancy may be caused by endogenous inhibitors, light requirements, low temperatures, dry storage requirements, and embryo immaturity. Seed dormancy factors may be localized in the seed coat, the endosperm, or both. By removing the embryos from the influences of these factors, the embryos germinate and grow quickly and the breeding cycle is shortened (Fathi et al., 2012). The aim of this study was to investigate the techniques for the germination of Prunus embryos *in vitro.*

MATERIAL AND METHODS

This study was carried out at the Beta Private Research Center in Adana, Turkey. The vegetative growth seasons lasts nearly 250 days. Mean July temperature is 25.6°C and mean January temperature is 9.6 °C. In this study were used Flored commercial variety which has 200-250 ha chilling units and it has average fruit size of 110-130 g, yellow fruit pulp color. The experiments were carried out from 2011 to 2013. Seeds and embryos of commercial early peach variety of Flored and interspesific *Prunus* hybrids were cultivated. As sterilization protocol; including % 70 alcohol 3 min and than 0.1% HgCl2 20 min were used. The germination of embryos on in *vitro* culture was examined. Embryos were cultured *in vitro* on Woody Plant Medium, Murashige and Skoog Medium, and Prunus Medium with 3.0 % sucrose, without agar with different combination of PGR. For the liquid media were placed on filter paper supports the embryos.

PGR Combinations

1. BAP 1 mg/L
2. BAP 0.5 mg/L
3. BAP 1 mg/L + GA_3 0.1 mg/l
4. BAP 0.5 mg/L+ GA_3 0.1 mg/l

Totally 126 embryos which are heart shape (Fig. 1) were used this study which are *Flored x Stark Early Oranges interspesific cross and Flored x P. davidiana's clones P1018* embryos development *in vitro.* We used 20 embryos for every different media concentrations on WP media, MS media and Prunus media. The all embryos are excised and placed directly onto culture medium. During this experiment cultures were kept at 23 to 25°C with a 16 h photoperiod with a light intensity of 3000 Lux. In this study for extracting immature embryos were picked from pollinated mother plants (Flored) and the seeds are extracted from the pits. The extracted seeds are placed into test tubes which are MS, WPM and Prunus Media as liquid media. After the seedlings have germinated, they are taken out of the test tubes and planted in potting trays. They are acclimated in the lab before they are moved to the greenhouse.

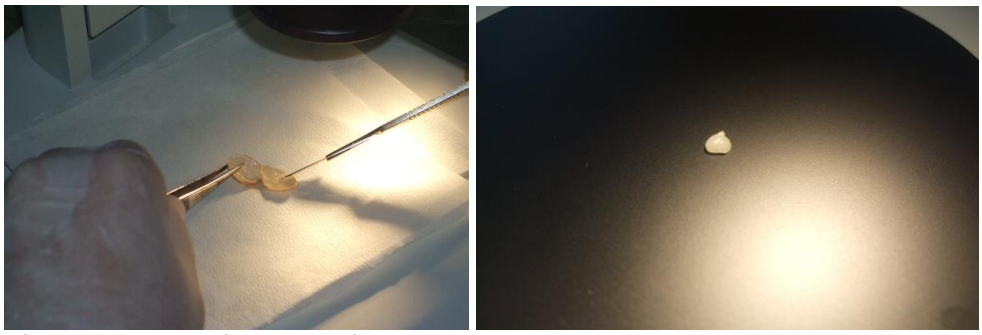


Figure 1. Heart shapes embryos

RESULT AND DISCUSSION

Inorganic elements in the medium did not have a significant effect on the *in vitro* development of peach embryos. For *in vitro* germination, we used MS, WPM and *Prunus* media. The best results were obtained containing 1 mg/l BAP + 0.1 GA_3 on MS medium. When the comparing all results that there is no big differences with different PGR concentrations **(Table 1.)**

Table 1. Embryos on different media and concentrations. Every media contains 20 embryos sample.

Media	BAP 0.5 mg/l	BAP 1 mg/l	BAP 1 mg/l, GA_3 0.1 mg/l	BAP 0.5 mg/l, GA_3 0.1 mg/l	% Embryos Survived
WPM	16	17	17	18	% 85
MS	17	18	19	16	% 87,5
Prunus	13	14	16	13	% 70

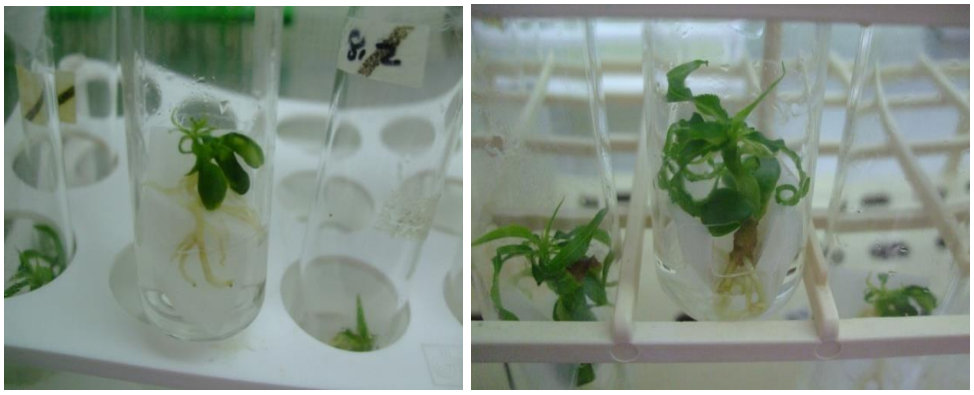


Figure 2. Germinated embryos on MS media (BAP 1 mg/l, GA3 0.1mg/l)

CONCLUSION

Embryo culture is most often used to rescue embryos from interspesific and intergenetic crosses to obtain fully developed embryos. Embryo rescue researches will be helped to assist plant breeders and plant biotechnologists.

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FERTILIZATION BIOLOGY PROBLEMS OF CHERRIES AND APPLES IN TURKEY

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Abstract
Turkey is one of the largest producers of cherry and apple in the World. Flower fertilization problems can decrease cherry and apple yields significantly. Genetic, environmental, and management factors influence fertilization and fruit set. Self-incompatibility problem is the most important genetic cause and is widely occur in both fruit species. Within the scope of environmental causes, temperature, raining, air humidity, wind and light are prominent factors. Also, mistakes made by fruit growers can produce very unfavorable results in fruit set. In this article, apple and cherry cultivation in Turkey has been evaluated in terms of basic fertilization biology problems.

INTRODUCTION

In order to produce seeds and fruits, large quantities of healthy flowers are required. This includes flowers that contain normal developed pistils, high quantity and qualified pollens. Pollen quality is explained with high viability and germination abilities.
Sexual incompatibility commonly occurs both in cherries and apples and it is the top fertilization problem. Also, different chilling requirements between the main cultivar and the pollenizer may result flowers to open at different times, causing lack of fertilization and a low fruit set.
The environmental conditions during flowering period play an important role in pollination and fertilization. At the same time, being careless in both orchard establishment and later treatments can also decrease fruit yield and quality.
In the following sections, the factors affecting fertilization in cherries and apples will be mentioned with some research results in Turkey and the World.

1. Healthy Flower Formation and Pollination Success

Temperature is the most important environmental factor for healthy flower formation. When chilling requirement cannot be satisfied, flower formation decreases and therefore, providing sufficient amount of healthy flowers are

not possible (Engin and Ünal, 2006). In addition, frost events in spring and winter may damage flowers (Cittadini et all., 2006). Flowering periods typically extend when temperatures are low and it shortens when temperatures are high (Engin and Ünal, 2002). Besides this, unsuitable plant nutrition, irrigation, pruning, and pest control applications can cause problems in morphological development of flowers in sweet cherries can occur (Engin and Ünal, 2003). At the same time, if trees are not well maintained, pollen quality and production become insufficient.

Many ecological factors negatively affect pollination success. In high relative humidity, anthers cannot dry and split, hence pollen shed reduced. Also, heavy rains cause pollen loss (Yates and Sparks, 1993). Extreme high or low temperatures during bloom can reduce pollinator insect activity. Honey bee activities decrease in low temperature. At low temperatures wild bees like bumble bees can work as pollinator. Also, pollinator insect activity affected from long standing rains, strict winds, high relative humidity and fog during flowering period (Tüzün and Bilgili, 2013).

For a successful pollination, there have to be sufficient pollenizer plants that flowers at the same time with the main cultivar. The pollenizer plants also have to produce copious amount of good quality pollen. In addition, the pollenizer must be compatible with the main cultivar, flower consistently every year (i.e. low biennial bearing), and produce fruits that have commercial value (Paydaş et all., 1996; Sütyemez and Eti, 1996).

2. Pollen Germination, Tube Growth and Fertilization

The main factor affecting the rate of pollen viability and germination is again temperature. Also, it affects pollen tube growth. Low temperatures extend stigmatic receptivity, but decrease pollen germination capability and pollen tube growth. Conversely, high temperatures shorten stigmatic receptivity, decrease pollen viability but accelerate pollen tube growth (Stösser and Anvari, 1990; Hedhly et all., 2003). Temperatures between 12-25^{o}C is optimal for pollen germination and tube growth. High temperatures with low relative humidity dry the stigma surface and inhibit pollen germination (Vasiliakis and Porlingis, 1985). Another important factor affecting pollen tube growth is the sexual incompatibility problem. Pollen that is incompatible with the pistil, will not grow down the style to fertilize the ovule (Sarısu, 2012). Also, early ovule senescence occurs as a strong fertilization obstacle (Stösser and Anvari, 1982; 1983) and it accelerates with high temperature (Stösser and Anvari, 1990). At this point, effective pollination period (EPP) concept comes into prominence. The EPP is defined as the longevity of the ovules minus the time lag between pollination and fertilization (Williams,

1966). Stigmatic receptivity is also closely related with this concept (Sanzol and Herrero, 2001). For successful fertilization to occur, pollen must be germinated during EPP even if the stigmatic receptivity is longer. This means, the pollen must be germinated, grow down the style and fertilize the ovule before the ovule dies. In a study conducted in Isparta conditions with 0900 Ziraat and Sweet Heart cherry cultivars about EPP, the pollen tube growth was calculated to take 3 or 4 days to reach the ovule and the ovule longevity was 7-8 days. In this case, EPP was determined as 4 days (Emre, 2011).

3. Cultivars Grown in Turkey and Their Pollinators

In both apples and cherries, because of self-incompatibility there have to be adequate pollenizer with the main cultivar in the orchard. Cherries may also show cross-incompatibility and for that reason, choosing a pollenizer has a great role in productivity (Sütyemez and Eti, 1999).

"0900 Ziraat" is a native cherry cultivar in Turkey and it is very important among the cultivars grown in Turkey. Because of its late ripening, rather high fruit quality and high shelf life, 0900 Ziraat has a high export value. However, there is a cultivar confusion concerning 0900 Ziraat. In different regions some cultivars or types, which are named 'Akşehir Napolyonu', 'Malatya Dalbastı', 'Uluborlu', 'Allahdiyen' and 'Ömerli', show great similarity with 0900 Ziraat. These cultivars or types are suspected as clones of the same cultivar. In a molecular study, 'Akşehir Napolyonu', 'Malatya Dalbasti', 'Uluborlu' and 'Allahdiyen' cultivars showed similar SSR patterns amongst themselves, but they differed from 0900 Ziraat and Omerli cvs. However, all cultivars carried either one common allele at every locus (Aka Kaçar et all., 2005). There are a lot of studies aimed at pollenizer determination for related cultivars and types (Eti et all., 1995; Paydaş et all., 1998; Sütyemez and Eti, 1999; Dilmaçünal et all., 2003; Tosun and Koyuncu, 2007). In these studies, Bigarreau Gaucher, Durano di Cesena, Merton Marvel, Merton Bigarreau, Merton Late, Noble, Vista, Larian and Starks Gold came into prominence as adequate pollenizer for 0900 Ziraat and similar cultivars (Table 1). Between these pollenizer Larian, Merton Late and Starks Gold are the most common cultivars today, because of their higher fruit quality.

Table 1. Suitable pollenizer for 0900 Ziraat and similar cherry cultivars.

Cultivars	Pollenizer							
	Big. Gaucher	Durano Di Cesena	Merton Marvel	Merton Bigarreau	Noble	Vista	Larian	Starks Gold
0900 Ziraat	X[4]		X[1,2]	X[2,3]	X[1,2]	X[3,4]	X[1,3]	X[2,4]
Akşehir	X[1]	X[1]	X[2]		X[2]		X[1,3]	X[2]

Napolyonu								
Ömerli	X[1]	X[1]	X[1]	X[2]	X[2]			X[2]
Malatya Dalbastı		X[1]		X[3]			X[1]	
Uluborlu					X[3]			
Allahdiyen						X[3]		

(Eti et all, 1995[1]; Sütyemez and Eti, 1999[2]; Dilmaçünal et all., 2003[3]; Tosun and Koyuncu, 2007[4])

The most important sour cherry cultivar in Turkey is “Kutahya” which doesn’t have any problem in terms of fertilization. This cultivar is also a good pollenizer for 0900 Ziraat and similar cherry cultivars (Paydaş et all., 1998).
Today, the most important apple cultivars in Turkey are Golden Delicious, Starkrimson, Fuji and Granny Smith. Recently, new cultivars like Breaburn, Early Redone, Redchief, Yellow Spur, Lutz Golden Royal Gala are being tested for their adaptation in Turkey. Especially, Golden Delicious, Fuji, and Granny Smith apple cultivars are determined as rather good pollenizers for both each other and these new cultivars (Gök, 2001; Aşkın et all., 2006). Summerred, Raritan and Jerseymac apple cultivars that ripen in summer are also adequate pollenizers for important cultivars in Turkey (Eti et all., 1998).

4. Mistakes Related to Fertilization Biology and Suggestions

Picking a cultivar that is not suitable for the region’s environmental conditions in terms of chilling requirement causes to large yield losses (Engin and Ünal, 2006). In addition, growers can also make important mistakes in pollenizer preference. If there is low number or poor pollenizers in the orchard, grafting or planting suitable pollenizer can solve this problem. In new plantations, growers must plant sufficient amount of pollenizer inside the orchard and they distribute homogenously. Because of changeable flowering dates year by year, it is useful to keep two different pollenizer in the same orchard.
Furthermore, in order to provide an effective pollination, there must be adequate number and regularly placed honey bee hives inside the orchard (Çırtlık, 2006). Generally, it is sufficient to keep 2-5 honey bee hives/ha for apples and 4-8 hives/ha for cherries (Kellerhals et all., 2005). However, this number can be increased in cold and rainy weather conditions occurred during flowering period. Also, growers can constitute “insect hotels” for wild bees like bumble bees and other insects (Barren, 2013). Besides this, destroying the weeds that attract pollinator insects is important. Avoiding chemical treatments during flowering period is necessary for both successful pollination and pollinator insect health (Kellerhals et all., 2005).

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POTENTIAL PLANT PROTECTION PROBLEMS ON STONE FRUITS IN TURKEY

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Abstract
Turkey known as cradle of fruit growing culture, is native country of many fruit varieties. Many stone and pome fruit varieties, are grown economically, are arised in Anatolia. Through early riser and low vernalisation varieties, fruit growing has been expanded to new areas (Anonymous, 2000). Species and varieties, which are needed more propagation material at unit area, are both genetically spur and semi-spur and having different pruning and training systems, have been stand out. Due to needed more propagation materials and control problems on sapling transport can cause admitting of biotic factors, expressive on sapling and trees, in to the county and transmission to pests free zone within country. There are pests effective on quantity and quality like Apple Scab, Gymnosporangium, Powdery Mildew, Monilia, Stigmina, Destructive Bacterial Cancer and wilt diseases, Capnodis, Anthonomus, Scales Acarinas, Fruit Flies, are hard for management and cause economically loss in country (Fidan et.al.,2013), Among them, Virus and virus-like diseases like Sharka (PPV, First report for almond in Turkey; Koç, 2010), have easy transmission and distribution by pollen, insect vectors, graft and infected material, are present, Having no chemical protection facilities against to viruses are become them more important according to others (Baloğlu et.al. 2001). Diseases and pests can spread throughout the country via production of infected saplings. Supplying of healthy and originally registered production matarial to growers by quick production models could obtain diseases and pests free sapling production, should be main aim (Koç, 2010). However, Eradication is not temporize due to progressivity of sanitary statues.

Key Words: Stone and Pome Fruits, Plant Protection Problems, Viruses

INTRODUCTION

Many stone and pome fruit varieties, are grown economically in Turkey. These fruit groups are members of *Rosales* order, *Rosacea* family. In our country, Orchards are 1.693.000 hek in totally of 24.479.000 hek. Agriculture field (TUİK, 2009). This is percentage 6,91 % of totally agricultural and forestry. Fruits and olive growing areas are raised in last decades. While cereals, vegetables and vineyards fields are decreased.

Different production systems are presented to growers as modern horticultural aspect due to aim of higher quantity and quality at average. Due to needed more propagation materials. Control problems on sapling transport can cause admitting of biotic (Disease and other pests) factors, expressive on sapling and trees, in to the county and transmission to pests free zone within country. Biotics are one of the most limiting factors for growing. Insects and fungi have stand in front line as quantitively Specially, When relative humidity is higher, The production, had been become impossible, without protection against to Monilia, Wilsonomyces and Scab. Soil borne diseases like bacteria and fungi are responsible for cancer, infect the plant during the harvest, are difficult for the management.

Virus and virus-like diseases (Table 1). like Sharka (PPV, First report for almond in Turkey; Koç, 2010), have easy transmission and distribution by pollen, insect vectors, graft and infected material, are present, Having no chemical protection facilities against to viruses are become them more important according to others (Baloğlu ve ark. 2001).

Saplings are infested by bacteria, fungi and nematodes. Also sap feding vectors of virus, phytoplasmas have similar mechanism. (Fidan et.al.,2013). Apple Mosaic Ilarvirus, Apple Chlorotic Leafspot Virus, Prunus Necrotic Ringspot Ilarvirus, Prune Dwarf Ilarvirus and Plum Pox Potyvirus are main viruses in Turkey. (Sıpahıoğlu,, 2000; Koç and Baloğlu, 2003; Koç and Baloğlu 2006; Koç, And Baloğlu, 2007; Koç et al.2011; Fidan et.al.,2013),. The most important one is named in Slavic as Sharka. The causal agent, is Plum Pox Potyvirus, has a dominant effect on all stone fruits for Turkey and worldwide. Main strains of Sarka disease, have been reported by many researchers from different countries and continents, are Marcus (PPV-M), Dideron (PPV-D), El Amar (PPV-EA), Cherry (PPV-C) (Wetzel et al., 1991b, Cambra et al., 1994, Nemchinov et al., 1996), Recombinant isolate (Slovakia) (Glasa et al., 2004). Finally New and atypical isolate (Canada) James and Varga, 2005).

Main vectors of the Sharka ordered as man(to use of infected plant propagating material and Intensive Pruning) and aphids (tree to tree

transmission in orchards). PPV can transmitted about 30 aphid species ‘’*Aphis arbuti, A. cytosorum, A. craccivora, A. fabae, A. gossypii, A. hederae, A. sambuci, A. spiraecola, Brachycaudus cardui, B. helichrysi, B. persicae, Callaphis juglandis, Chaetophorella aceris, Dysaphis plantaginea, D. Pyri, Eucalypterus tiliae, Hyalopterus pruni, M. rosae, Megoura rosae, Myzus cerasi, M. persicae, M. varians, Metopolophium dirhodum, Phorodon humuli, Rhapalosiphum padi, Sitobion fragariae, Taxoptera citricida, Ureleucon sonchi* ‘’ (Nemeth ve Kolber, 1983; Nemeth, 1994; Labonne ve ark, 1995; Gaborjanyi ve Basky, 1995; Gildow ve ark., 2000 ; Gildow ve ark, 2004). Sharka, had not been restricted in the area, were first recorded in Bulgaria. It has, distributed Worldwide anymore, has many cultured and wild hosts from different species. In our country, It is distributed from Edirne to Eastern Anatolia and Mediterranean (Akbaş et al.2011). Ringspot on leaves and kernels, Flower colour breaking, Irregular fruit shapening and Leaf wein clearing, Early fruit dropping at harvest time symptoms are caused by PPV on stone fruits (Koç, 2010).

If The Sharka is a problem in A country, The solutions are creations of quarantine, eradication, certification, management with insecticides for natural vectors, researchers for biotechnology and resistance breeding by using potential genitors against to PPV. The Success Of PPV control related to progressivity of all solutions as ıntegrated. Not only Sharka but also PNRSV, PDV, ApMV, ACLSV and other Virus-Virus like diseases.

Table 1. Virus and virus-like diseases on Stone Fruits (OEPP/EPPO, 2011)

Viruses	**Akronyms**
Apple chlorotic leaf spot trichovirus	ACLSV
Apple mosaic ilarvirus	ApMV
Arabis mosaic nepovirus	ArMV
Apple stem-grooving capillovirus	ASGV
Apple stem-pitting foveavirus	ASPV
Petunia asteroid mosaic tombusvirus and *Carnation Italian ringspot tombusvirus*, causing cherry detrimental canker	PAMV, CIRV
Cherry green ring mottle foveavirus	CGRMV
Cherry leaf roll nepovirus	CLRV
Little cherry closteroviruses 1 and *2*	LChV-1, LChV-2
Cherry mottle leaf trichovirus	ChMLV
Plum Pox Potyvirus	***PPV***
Prune dwarf ilarvirus	PDV
Prunus necrotic ringspot ilarvirus	PNRSV
Raspberry ringspot nepovirus	RpRSV
Strawberry latent ringspot nepovirus	SLRSV
Tomato black ring nepovirus	TBRV

Phytoplasma	
European stone fruit yellows phytoplasma	ESYP
Viroids	
Hop stunt Viroid	HSVd
Peach latent mosaic pelamoviroid	PLMVd
Pear blister canker viroid	PBCVd

Diseases and pests can spread throughout the country via production of infected saplings. Supplying of healthy and originally registered production material to growers by quick production models could obtain diseases and pests free sapling production, should be main aim (Koç, 2010). However Eradication, is not temporize due to progressivity of sanitary statues. In last years, Optimistic steps by state are become in act as approach for certification in our country.

There is no cure or treatment for the disease once a tree becomes infected

Direct Management of Virus and virus-like diseases***;***

- Infected tree and weeds must be destroyed in nurseries and orchards
- control of vectors
- Application of sanitation

Indirect Management;

- Using pathogen and pests free production material (sapling, graft etc.)
- Sources of resistance germplasm for future breeding programs
- Applying quarantine rules
- Use of certified nursery materials
- Monitoring; surveys, eradication of PPV and education about pests

Pests were detected on S. Fruits In Turkey

Generally common pest problems on fruit orchards, which were determined, are detected in our country as well. (Table 2). But some ones of them are more important for nursery, because they have been fed young on saplings Günthart (1971), also as vector for virus like disease like *Empoasca* sp. (Table 2).

In Table 2, There are 57 pest species from 23 family at 5 order in Turkey. Nevertheless, Even species number is so high, most of them are occurred rarely in nursery. It should be underlined that as a result of false applications and uncared for snail, grasshopper, red mites and the others reported in high populations as problems. (Aykaç ve Kılıç, 1992; Hantaş, 1992; Önuçar ve Ulu, 1992; Zeki ve ark., 1994; Öztürk ve ark., 2009.). Some pests that cause economic losses in fruit production in our country is subject to

quarantine, and preservation of existing plantations should be clean in terms of these pests (Anonim, 2001).
Maın Pests are ordered as *Rhagoletis Cerasi* (notably for exporting), *Archips sp*. On Cherry; *Anarsia spp* ON APRICOT; *Cydia molesta & Anarsia Lineatella* ON PEACHES. Also secondary pests are *Diaspidiotus pentagona*, San-Jose Scales, *Ceratitis capitata, Myzus percicae, Hyolopterus puruni, Capnodis sp., Scolytus spp.* universal for all stone fruits (Hantaş, 1992; Özturk, ve ark., 2009; Fidan et.al.,2013). Among them *Myzus and Hyolopterus genuses have important role for Plum Pox poty Virus (Koç, 2010; Koç and Baloğlu, 2011)*

Control Strategies

Primary step is place of nursery or orchards and used equipment, which should be sterilized (pruning and grafting equipments).

Also place doesn't affected by drainage, pH like Abiotic stress conditions. Otherwise physiological drought, etiole, nutrient deficiencies can occur. Vector free isolation distant for nursery has to be min. (mean 1000m), Five years rotation for soil borne nematodes and other soil borne pathogens (*Pythium, Rhizoctonia, Phytophthora, Fusarium*) is strict rule. Herbicide management for alternative herbal hosts should be in consideration.
Additionally stress factors could be invite secondary agents.

Agropyron spp. Sorghum halepense, Cyperus sp. Avena spp. Hordeum burposum, Amaranthus sp. Orabanche spp., affects the plant as parasitically and allelopaticaly. Also it acts as alternatively hosts for pests. For this reason Production fields have to free from herbal sexual and asexual units İt that are mulching, mechanical management, and using herbicides are suggested for control.

Table 2**.** Insect pests on Fruit Orchars and nurseries in Turkey

Order	**Family**	**Species**
Acarina	Eriophyidae	**Aceria granati* (C.&M.)
		Eriophyes pyri (Pgst.)
		E. similis Nalepa
		Phyllocoptruta oleivora (Ash.)
	Tetranychidae	**Panonychus citri* (Mc Gregor)
		**Panonychus ulmi* (Koch)
		Tetranychus urticae Koch.
		T. viennensis Zacher
Hemiptera	Aleyrodidae	**Aleurothrixsus floccosus* (Maskell)
		Dialeurodes citri (Ashm.)
		**Parabemisia myricae* (Kuwana)
	Aphididae	*Aphis pomi* Deg.
		Callipterus juglandis Goetze

		Dysaphis plantaginea (Passerini)
		**Eriosoma lanigerum* Haus.
		Hyalopterus pruni Geoff.
		Myzus cerasi F.
		M. persicae Sulzer
		Toxoptera aurantii (Boyer&Fonsc.)
	Cercopidae	*Philaenus spumarius* L.
	Cicadellidae	**Empoasca decipiens* Paoli
		Zygina nivea Muls.&Rey
	Coccidae	*Palaeolecanium bituberculatum* (Targ.&Tozz.)
		Saissetia oleae (Olivier)
	Diaspididae	*Aonidiella aurantii* Maskell
		A. citrina (Coq.)
		Lepidosaphes ulmi (L.)
		Parlatoria olea (Colv.)
		**Pseudaulacaspis pentagona* (Targ.&Tozz.)
		**Quadraspidiotus perniciosus* Comst.
		Sphaerolecanium prunastri (Boy.)
	Issidae	*Agalmatium flavescens* Oliv.
	Membracidae	**Cerasa bubalus* F.
	Psyllidae	**Cacopsylla pyri* (L.).
	Pentatomidae	*Apodiphus amygdali* Germ.
	Tingidae	**Stephanitis pyri* (Fabr.)
Hymenoptera	Tenthredinidae	**Caliroa limacina* Retz.
Lepidoptera	Gelechiidae	**Anarsia lineatella* Zell.
		Recurvaria nanella Hübn.
	Gracillaridae	**Phyllocnistis citrelle* Stainton
		Phyllonorycter gerasimowi (Hg.)
	Lyonetiidae	*Leucoptera scitella* Zell.
		Lyonetia clerkella (L.)
	Plutellidae	*Prays oleae* (Bern.)
	Stigmellidae	*Stigmella malella* (Stt.)
		S. pyri Glitz.
	Tortricidae	*Archips rosanus* L.
		Cydia molesta (Busck)
	Yponomeutidae	*Yponomeuta malinellus* Zell.
Coleoptara	Buprestidae	**Capnodis carbonaria* Klug.
		**C. cariosa* Pall.
		**C. porosa* Klug.
		**C. tenebrionis* L.
	Scarabaeidea	*Anomala* spp.
		Melolontha albida Frivald.
		**M. melolontha* L.
		**Polyphylla fullo* L.

*Important species at fruit orchards and nurseries

Sanitary statue report of plant clones-varieties and mother block stencil have to prepared and checked during establishing the pots and control.

Respectively surveying of general conditions of field, labelling according to origin and sanitary statues should be always in progress.

Periodic controls for funguses, viruses, bacteria (Table 1; Table 3) and plant suckers insects, (Aphides, Cicadides, Whiteflies etc.) have to made for secondary infections.

Pseudomonas, Agrobacterium as the bacteria; *Monilia, Wilsonomyces, Stereum and Podosphaera* genuses from fungies have been stand in front line (Table 3). *Xylella fastidiosa however is related agent with bacteria* in Turkey.

Table 3. The fungi and bacteria are pest on fruit trees (Anonim,2009)

Binomial Latin Name	**Name in Turkish**
Funguses	
Armillaria mellea	Armillaria
Botrytis cinerea	Kursuni Küf
Stereum purpureum	Gümüs Yaprak
Leucostoma cincta	Leucostoma
Monilinia fructigena	Monilya (Mumya)
Phytophthora spp.	Kök Çürüklügü
Podosphaera leucotricha	Külleme Hastaligi
Rosellinia necatrix	Rosellinia
Sclerotinia sclerotiorum	Beyaz Çürüklük
Taphrina deformans	Yaprak Kivircikligi
Tranzschelia discolor	Pas Hastaligi
Wilsonomyces carpophilus	Yaprak Delen
Bacteria	
Xanthomonas campestris	Bakteriyel Leke
Agrobacterium tumefaciens	Bakteriyel Gal
Pseudomonas syringae pvs.	Kabarcik Yaprak
Rhizobium rhizogenes	Sacak Kök Kanseri
Xylella fastidiosa	Phony Hastalığı

Using disease free graft from healthy plants, any growing sensitive plant in the orchards (except monitor plants) and screening shade for migratory pests, deletion of pruning will cleaned shoring and peeled for pests, which are live in shores, chemical disinfections, collecting egg buckets and deletion of the nests are important to success. But, natural balance could be considered.

RESULTS

Polices for Turkish fruit growing have to suited for European Union standards and infrastructure is prepared and hardly applied. Books and brochures published for growers' education for EU standards. Finally Workshop like this has an important role for the future shares and collaboration.

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STUDIES ON SHADING SYSTEM IN SWEET CHERRIES (*PRUNUS AVIUM* L.) TO PREVENT DOUBLE FRUIT FORMATION UNDER SUBTROPICAL CLIMATIC CONDITIONS

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Abstract

In this study, the performances of cherries grown under subtropical conditions and the effects of shading systems on the prevention of double fruit formation were investigated. The experiments were carried out at Pozmer Agricultural Research and Application Center in Adana (50 m a.s.l.) during 2006-2008. Na-1, Early Van Compact, Bing Spur, Lapins and Cristobalina cherry cultivars were fruited earlier and good yielding, however, double fruiting especially in Na-1 cherry cultivar seemed to be a serious problem under warm climatic conditions. The shading system was applied to reducing the high temperature affect to double fruit formation. Shading system with 55% of light transmission reduced the air temperature about 1.9-3.1^{o}C degrees as compared to the fully exposure. As a result of the reduction in temperature, double pistil formation was also reduced to 60.89% and 27.81% while the temperatures over 30°C, affected to the promotion of double fruit formation during the physiological bud differentiation period at the beginning of June while morphological differentiation period of cherries will be initiated on 20th June and continued until the end of July to the beginning of August.

Keywords: Cherries, high temperatures, multiple pistils, shading

INTRODUCTION

Double fruit formation ocurred incherries grown under subtropical conditions (Cukurova). This deformity decreases the fruit quality in cherries and in some other stone fruits. Especially peach and nectarin (İmrak, 2010).

The first results related to double fruit formation was seen in Victoria plum cultivar in 1927. The first double fruit formation in cherry trees was found in Idaho state in USA in a cherry producer orchard, in 1993. Also, abnormal

fruit formation and double pistils are seen in cherries in south regions of California State.
The percentage of double pistil formation in Bing, Napoleon and Lambert cherry cultivars were 44%, 26% and 13%, respectively. Since double fruit formation decrease the market value of the cherries, the fruits are not harvested by the growers (Küden, 1989 and Küden et all, 1997).
In Turkey, global climate change causes rather important amount of double fruit formation also in Kemalpaşa district where it is known with cherry exportation.
This problem was also determined in Napoleon and Early Burlat cherry cultivars mainly grown in Manisa region, for about 42% and 34% respectively (Engin and Ünal, 2003).
The effects of global warming are better understood in warm climatic regions. Generally, single female organ was formed when the temperature was about 25^{o}C during the flower bud differentiation period and the rate of the double pistil formation is increased when the temperature was about 30^{o}C. Eighty percent of double pistil formation was determined at the temperatures over 35^{o}C.
Aim of this study is to decrease the double fruit formation in sweet cherries under warm climatic conditions by using shading system.

MATERIALS AND METHODS

The study was carried out at Cukurova University Pozanti Agricultural Research and Application Center. Na-1, Early Van Compact, Bing Spur, Lapins and Cristobalina cherry cultivars on Prunus mahalep L. rootstock were used plant materials.
The experimented sweet cherry cultivars of five years old trees were planted as 4 x 2 m in the orchard.
To decrease the temperatures, the trees of each cultivar were taken under green plastic netting which has 55% of light transmission and also left as control in open air.
Shading system was applied after 15th of June and removed at the end of August in 2006 and in 2007. In this period, daily maximum and minimum temperatures were recorded hourly by the meteorological station (Davis Vantage Pro2, David Instruments USA).
At full bloom stage of the cultivars, fifty flowers of each four sides of the trees were collected and double/single pistil formations were determined both in 2007 and 2008.

RESULTS AND DISCUSSION

According to data recorded hourly by meteorological station for three months, daily average temperatures under shading system were lower than the outside temperatures in 2006 and 2007. The shading system decreased the outside temperatures approximately 3.1°C.

The highest double fruit formation (85.67%) was obtained from the control trees of NA-1, while shading application decreased the double fruit formation (56.34%) (Table1).

In parallel with the observations in 2007, the highest double fruit formation was determined from the control trees with 46.49% and from the shaded trees with 28.83% in NA-1 cultivar. (Table 1)

In Early Van Compact cultivar, the lowest double fruit formation was determined with 29.32% in control and 11.99% in shaded trees in 2007, it was similarly in 2008 (Table 2).

In addition, shading system decreased double fruit formation depending on the different directions where samples collected from trees.

CONCLUSIONS

In conclusion, double fruit formation in cherries under subtropical climatic conditions is a big problem which is decreasing the fruit quality. In previous studies, water stress, plant nutrition deficiency and changes in plant hormone levels were indicated as the main reasons of double fruit formation (Johnson et. al., 1994; Engin and Ünal, 2008). However, temperatures over 30°C during the flower bud differentiation period were also reported to be increasing the double fruit formation.

In this study, the temperatures were decreased about 1.9-3.1°C and also the multiple pistils were decreased in the shaded trees.

The negative effects of global warming are seen all around the world and it is known that, the temperatures will be higher in coming days than today. Thus, this problem will bring various disadvantages in the future.

For this reason, other applications such as applying reflectances (kaolin) or sprinkler irrigation combined with shading systems will increase the success of preventing double fruit formation in cherries as well as in other stone fruits.

Table 1. The percentage of double pistil formation of the cherry cultivars tested in Adana in 2007

Cultivars 2007	Under Net (%)				Control (%)			
	East	West	North	South	East	West	North	South
Na-1 (LSD 5%: 3.945)	60.67d (51.16)	72.67c (58.48)	46.00e (42.70)	46.00e (42.70)	84.00ab (66.42)	88.67a (70.33)	85.34ab (67.48)	84.67ab (66.95)
Average LSD 5%: 1.970	56.34b (48.64)				85.67a (67.75)			
E. Van Compact LSD 5%: 2.797	12.00d (20.26)	13.33d (21.41)	4.00e (11.53)	18.66c (24.59)	32.66a (34.85)	29.33a (32.79)	32.66a (34.85)	22.66b (28.42)
Average LSD 5%: 1.398	11.99b (20.25)				29.32a (32.78)			
Bing Spur LSD 5%: 4.110	27.33e (31.51)	32.00e (34.45)	54.00d (47.29)	26.66e (31.08)	80.66b (63.91)	68.66c (55.95)	94.66a (76.63)	80.00b (63.43)
Average LSD 5%: 2.055	35.00b (36.27)				81.00a (64.15)			
Lapins LSD 5%: 4.477	62.00cd (51.94)	(34.45)	54.66d (47.67)	46.66e (43.08)	85.00a (67.21)	44.66e (41.81)	70.66b (61.11)	64.66c (53.52)
Average LSD 5%: 2.246	48.83b (44.04)				66.24a (54.47)			
Cristobalina LSD 5%: 3.348	25.33d (30.21)	30.66c (33.62)	22.66d (28.42)	25.33d (30.21)	39.33ab (38.83)	44.00a (41.55)	36.66b (37.26)	39.33ab (38.83)
Average LSD 5%: 1.674	26.00b (30.65)				39.83a (39.13)			

Table 2. The percentage of double pistil formation of the cherry cultivars tested in Adana in 2008

Cultivars 2008	Under Net (%)				Control (%)			
	East	West	North	South	East	West	North	South
Na-1 LSD 5%: 3.670	28.66c (32.36)	30.00c (33.21)	27.33c (31.51)	29.33c (32.79)	43.33b (41.16)	59.33a (50.37)	43.33b (41.16)	40.00b (39.23)
Average LSD 5%: 1.835	28.83b (32.47)				46.49a (42.98)			
E. Van Compact LSD 5%: 2.275	12.66d (20.84)	8.66ef (17.11)	(14.95)	9.33e (17.78)	27.33a (31.51)	26.66a (31.08)	22.66b (28.42)	18.66c (25.59)
Average LSD 5%: 1.137	9.32b (17.77)				23.82a (29.21)			
Bing Spur LSD 5%: 2.625	22.66e (28.42)	26.66d (31.08)	43.33b (41.16)	(25.59)	34.00c (35.66)	32.06c (34.48)	59.33a (50.37)	34.00c (35.66)
Average LSD 5%: 1.311	27.82b (31.73)				39.84a (39.13)			
Lapins LSD 5%: 3.095	32.06bc (34.48)	22.66d (28.42)	28.66c (32.36)	27.33cd (31.51)	48.66a (44.23)	27.33cd (31.51)	43.33a (41.16)	34.00b (35.66)
Average LSD 5%: 1.546	27.67b (31.73)				38.33a (38.25)			
Cristobalina LSD 5%: 4.500	6.66e (14.95)	13.33d (21.41)	9.33de (17.78)	12.66d (20.84)	18.66c (25.59)	43.33a (41.16)	26.66b (31.08)	29.33b (32.79)
Average LSD%5: 2.250	10.49b (18.89)				30.83a (33.72)			

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SWEET CHERRY HARVESTING MOVING FROM MANUAL TO MECHANICAL A REVIEW

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Abstract

The U.S. sweet cherry (*Prunus avium* L.) industry relies on human labor to harvest the crop. Cherry growers and researchers have been looking for alternatives to hand harvesting because of the shortage of harvest labor and increasing labor costs. Mechanical harvest of sweet cherries has been studies for many years but few growers have adopted the practice. This is because of unacceptable levels of fruit bruising, difficulty in removing a large percentage of the fruit, tree damage caused by the mechanical harvester, and the lack of a pedicel (stem) connected to the fruit. Fresh fruit is typically marketed with the pedicel attached to the fruit, but during mechanical harvest the pedicel is removed. Thus, consumer acceptance for stem-free cherries is critical to implement mechanical harvesting. Recent developments in the sweet cherry industry have renewed interest in mechanical harvesting. Developments include: 1) Effective fruit loosening materials, 2) Improved mechanical harvesters 3) Dwarfing rootstocks, 4) improved training systems, and 5) consumer acceptance of stem-free cherries. These developments could reduce the drawbacks of mechanical harvest and has the potential to dramatically reduce harvest costs compared to traditional hand harvest.

Previous problems with mechanically harvesting sweet cherries

The sweet cherry (Prunus avium L.) industry relies on hand harvesting to bring the crop to market which is extremely labor-intensive. Hand harvesting is very expensive accounting for about 60% of the annual costs of production (Seavert et al., 2008) and shortages of harvest labor are common and likely to increase in the future (Taylor et al., 2012). The supply of Mexican labor available to work in the United States, for example, has fallen sharply due to a decrease in Mexico's total fertility rate and employment growth in Mexico (Passel, et al., 2012). What it means to US sweet cherry growers is that farms will have to produce more with fewer workers and embrace labor-saving technologies. The U.S. sweet cherry industry must improve harvest efficiency without compromising consumer appeal of the

fruit. Consequently, considerable research attention has been devoted to the development of mechanized harvesters. Mechanical harvest has proven particularly difficult with cherries because: 1) difficulty in fruit removal – many previous attempts to mechanically harvest trees resulted in large amounts of fruit remaining on the tree, 2) bruising and injury to the fruit – this occurs as the fruit hit branches, twigs, and catch frame before landing in the harvest box, 3) bark damage on the tree trunk – this damage caused by the shaker machine can decrease the economic life of the tree, and 4) acceptance of stem-free cherries by consumers. These factors have limited the acceptance of mechanical harvesters in the sweet cherry industry. New technologies, however, are being developed to address these problems. A successful mechanical harvesting system in sweet cherries needs to include abscission agents, mechanical harvesters, training and pruning systems, and postharvest treatments.

Fruit loosening agents

Abscission agents can be beneficial in mechanically harvested crops because they reduced the fruit detachment force (FDF) need to separate the fruit from the tree and decrease fruit remaining on the tree after harvest. Abscission agents have been proven efficacious in other mechanically harvested crops such as in citrus (Burns et al., 2005; Hartmond et al., 2000) and grape (Fidelibus et al., 2007) and to a limited extent in table olive (Burns et al., 2008). In sweet cherries, ethophen applied at least two weeks before fruit harvest significantly reduced the FDF in the 'Bing' cultivar, but not when applied to 'Chelan' (Smith and Whiting, 2010). When ethophen is applied to sensitive cultivars it may enhance fruit removal percentages and allow for a gentler tree shake by the mechanical harvester resulting in minimal fruit damage. Thus, sensitivity to ethophen likely will become an important consideration when selecting cultivars in mechanically harvested orchards in the future.

Harvest Mechanization

Mechanical harvesting has resulted in unacceptable levels of fruit bruising and pitting in many previous trials (Couey et al., 1974; Kirk and Booster, 1979; Norton et al., 1961; Thiene, 1969). These results have led to the belief that mechanical harvesting of fresh-market sweet cherries is not feasible. Improved technologies, however, can reduce fruit injury and improve fruit quality. New cultural practices and innovative harvesting machines can reduce mechanical damage. A prototype branch shaker machine removed 88% of the fruit from the tree and fruit injury percentages (~13%) were

similar to those of hand-harvested fruit (Peterson et al., 2003). They found that a high density perpendicular V training system (5 m x 1.5 m) was the most efficient system to harvest the fruit with minimal damage. The branches were trained along wires at about a 55° angle which allowed the fruit to fall onto the padded catch frame without hitting other branches and thereby minimizing fruit injury (Peterson et al., 2003). Another prototype machine that detaches fruit using vibrations removed more fruit (90 vs 82%) with less fruit injury compared with a branch shaker (Chen et al., 2012). Finally, over-the-row canopy shakers need to be evaluated in high density sweet cherry orchards. Canopy shakers can deliver both vertical and horizontal energy using tines that 'tease' fruit directly from the canopy. These machines are commercially available and work well in hedge-rowed olive, blueberry, and grape orchards. More research is needed maximize fruits with minimal damage using over-the-row and trunk shakers.

Rootstocks, training, and pruning systems

New rootstocks, training, and pruning systems can reduce mechanical damage caused by the harvester. Dwarfing rootstocks and trainings systems such as the Upright Fruiting Offshoot (UFO) system reduce the distance the cherries must fall before they hit the catch frame. Researchers have found that the ideal tree and orchard configuration for mechanical harvest is a close- spaced hedgerow system which would present a flat narrow fruiting wall to the harvester (Connor et al., 2014). The UFO training system provides this narrow fruiting wall which increases the accessibility to the picking head, improves harvest efficiency with reduced force and, therefore, reduces fruit damage (Du et al., 2013). Moreover, the use of fruit loosening agents can further reduce the force needed to detach the fruit from the tree.

Postharvest treatments.

Cherries are typically marketed with the stem connected to the fruit. Mechanical harvesting detaches the stem from the fruit and studies were conducted to determine consumer acceptance of a stem-free product. Survey results found that consumers showed equal preference to cherries without stems and to cherries with intact stems (Turner et al., 2008). Low temperature, high humidity, and modified atmosphere packaging (MAP) have also proven successful in extending the shelf life of sweet cherries. Studies indicated that CO_2 levels between 10 and 15% and O_2 levels between 3 and 10% prolonged shelf life of sweet cherries (Jiang et al., 2002). In conclusion, the future of mechanically harvesting sweet cherries looks bright. With refinement and further testing in fruit loosening agents,

dwarfing rootstocks and training systems, new harvesting equipment, and postharvest storage technologies all provide the sweet cherry industry with promising alternatives to conventional hand harvesting.

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POSTHARVEST PHYSIOLOGY AND STORAGE OF APPLES

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Abstract
Storage methods aim to manipulate ripening related processes and thus to maintain fruit quality over a longer period. Fruit quality as well as storability depend of a number of pre- and postharvest factors, which generally function in a complex interaction to each other. The genetic potential of a variety, climate and site conditions and the crop management are important factors just as an optimal harvest date and appropriate storage conditions. The optimal harvest date determines the stage of fruit development suitable for long term-storage and high ex-store fruit quality. At this stage fruit must provide a good eating quality on the one hand, but sufficient storability on the other hand. In climacteric fruit, like apple, ethylene plays a crucial role for initiation and continuation of ripening and senescence, as most ripening related processes, like softening, yellowing or the decrease of sugars and acidity, are regulated by this phytohormone. Storage parameters like low temperatures, reduced O_2 and elevated CO_2 partial pressures in the storage atmosphere have the potential to influence ethylene biosynthesis and action and are widely used in many commercial CA (controlled atmosphere) applications. During recent years the development of dynamic controlled atmosphere (DCA) storage or the application of the ethylene inhibitor 1-MCP (1-Methylcyclopropene; SmartFresh™) has contributed to an advancement of storage technologies. In DCA oxygen level is reduced in the storage near to the lowest level tolerated by the fruit (anaerobic compensation point), without inducing excessive anaerobic metabolism. This critical level can be detected by different methods, like real time measurements of chlorophyll fluorescence or ethanol production. A main benefit of this storage technology is its effect in reducing superficial scald symptoms, a physiological disorder which is linked to the oxygen level in the atmosphere. The application of the ethylene inhibitor 1-MCP has also been shown to have a strong ripening inhibiting effect and thus the potential to limit major quality losses during storage and mainly during marketing. Physiological disorders that are promoted by ethylene, like superficial scald, mealiness or core browning can be effectively reduced by 1-MCP application, whereas internal flesh browning symptoms can increase, especially in sensitive varieties like

Braeburn. CA- or ULO- (ultra low oxygen) storage as well as DCA and 1-MCP have a big potential in maintaining fruit quality in apples, providing that they are applied according to good agricultural practice, taking in account the optimal harvest date as well as variety-specific demands to storage conditions.

POSTHARVEST PRACTICES OF APPLES AND CHERRIES IN TURKEY

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Abstract
Turkey, which countries is a major manufacturer in the world, produces 3,128,450 tons of apples (3rd place) and 494,325 tons of cherries (2nd row). In Turkey, in storage after harvest of apples is mostly used for normal atmosphere (NA) storage. The number of controlled atmosphere (CA) storage has been increasing in Turkey in recent years. 1-methylcyclopropene (1-MCP) has been started to use in apples after harvest in the 2005 year and now, 1-MCP use was fairly widespread. Besides, a few calcium applications are being made. Pre-harvest 1-MCP applications in apple has been commenced. During storage plastic boxes and bins (plastic-wooden) instead of wooden boxes began to be used. Due to sweet cherry is very short post-harvest life, pre-cooling application is very important. Manufacturers deliver their products to the nearest packing houses and pre-cooling with water immediately here (hydro-cooling) operation is performed. Moreover, in regions where intensive cherry orchards, establishing a certain point of reception, vehicle cooler is made of pre-cooling immediately after harvest. Sweet cherries in the storage are widely used for the modified atmosphere packaging bag. Apples and sweet cherries in the selection instead of manually, semi-mechanical system has been replaced by modern packaging facilities. The classification of products according to the length or diameter, weight and color in packing houses are made. From the storage to the retailer sweet cherries completely, mostly in apples are transported with cooling vehicle.
Keywords: Turkey, apple, sweet cherry, postharvest applications

1- INTRODUCTION

Turkey is one of the important fruit producing countries. Turkey's fruit production is 18.2 million ton. Turkey ranked fourth in world apple production and second in world sweet cherry production.

Table 1. World and Turkey apple and cherry production (ton)

	Apple Production (ton)	Cherry Production (ton)
World	76.378.738	2.256.519
Turkey	3.128.450	494.325

Figure 1 shows the major production regions in Turkey. Due to the suitability of ecological conditions and be the centers of origin, apples, almost every part of our district since the very earliest cultivated. The major apple varieties grown in Turkey Golden group (Starkspur Golden Delicious and Golden Delicious) and Red Delicious group (Starking Delicious and Starkrimson Delicious) has focused on apples.



*Marked districts are main apple production area.



*Marked districts are main cherries production area.
Figure 1. Apple and sweet cherry production in Turkey and in the World

Apples and cherries generally is kept in normal atmosphere storage. In recent years, the use of controlled atmosphere storage of apples has become widespread. As soon after harvesting the cherries are water cooled (precooling) in the land or in the packaging house with hydrocooling. Generally, after sorting and classification are kept in modified atmosphere bags.

2- POSTHARVEST PRACTICES OF APPLES IN TURKEY

Different applications pre-harvest and post-harvest in order to help maintain the quality of products are used. Some of the important practices are following. Ca and 1-MCP used most widely in Turkey.

- Ca (Calcium)
- 1-MCP (1-Methylcyclopropene)
- AVG (Aminoetoksivinilglisin)
- DPA (diphenylamine)
- Ozone (O_3)
- UV lamb

a. Calcium (Ca) application

i. Calcium

The importance of calcium in apple fruit is its role in contributing to the maintenance of optimum quality during postharvest storage and fruit ripening (Ferguson, 2001). It is known that calcium deficiency can induce a

range of postharvest disorders in many fruits and vegetables. Calcium deficiency can be overcome by calcium salts spraying during fruit development and/or by postharvest dip or drench treatments after harvest (Antunes et al., 2007). Due to transport of calcium in plants is low, increasing the level of this element with the root system is difficult. Calcium sprays applied to fruit during the growing season may reduce the incidence of certain fruit disorders and may improve fruit quality.

Effects of low Ca fruit

- Hasten fruit senescence
- Increased rate of softening of fruit
- Impaired regulation of respiration
- Reduced total acid content
- Hasten rates of colour change,
- Ethylene production inversely related to Ca concentration (Convey and Sam, 1987)

Production of apples characterized by a high Ca content is very important for successful storage and handling. The desirable Ca content may be different for various cultivars. In general, it is reported that a Ca content above 45–60 mg/kg of fresh fruit weight is satisfactory. Not only Ca content, but also N/Ca, K/Ca, (K+Mg)/Ca, Mg/Ca rate are important to physiological disorders and fruit quality (Lanauskas and Kviklienė, 2005).

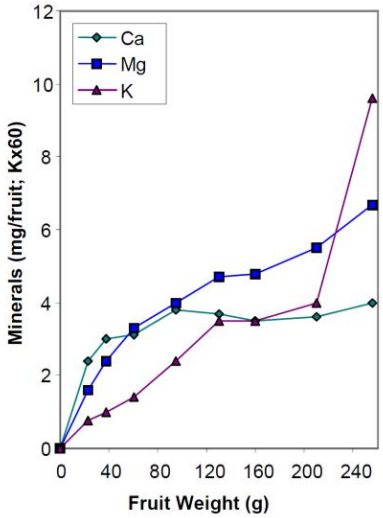
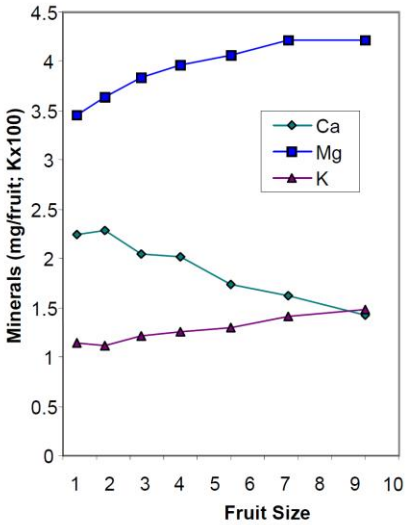


Figure 2: Ca, Mg and K intake during fruit growth in Cox's Orange Pippin apples continues. However, after a certain level of Ca intake slows down (Ferguson, 2001)



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Figure 3: the amount of CA, Mg and K elements in different sizes apples are seen. With fruit size increasing, only Ca concentration decreases (Ferguson, 2001)

Thus, with the increasing size of the fruit is reduced Ca ratio, and are increased K and Mg ratio.

Physiological role of calcium

Lack of calcium in pome fruit as apple, pear is more common. Crop quality also deteriorates with reduced firmness and increased incidence of physiological disorders such as bitter pit, cork spot, lenticel breakdown, senescent, fruit cracking, watercore and sunscald (Figure 4).

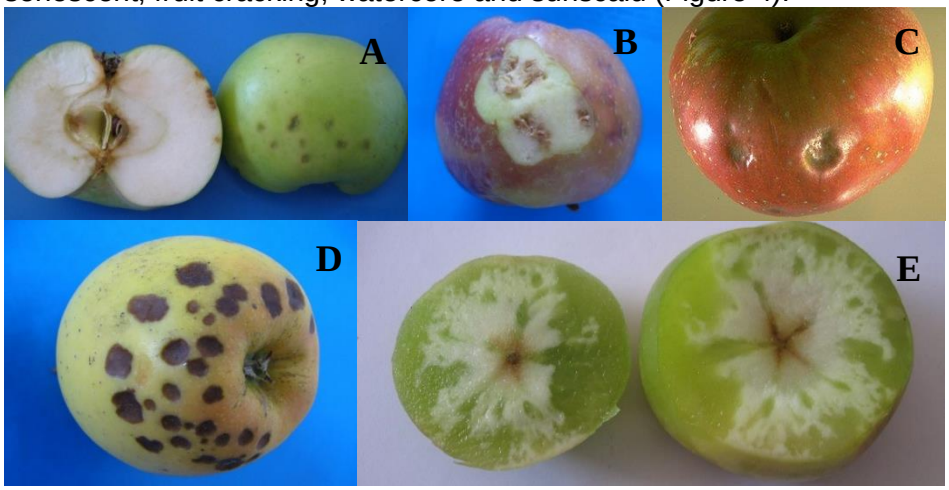


Figure 4. Ca deficent in apple is shown some physiologic disorders A-B: Bitter pit, C: Cork spot, D: Lenticel breakdown, E: Watercore.

In addition, increasing Ca in tissue of apple fruit alone also maintains firmness and reduces decay caused by *Penicillium expansum* Link, *Botrytis cinerea*, and *Glomerella cingulata* (Stoneman) Spauld. & Schrenk (Conway, et al, 1994).

Calcium applications on preharvest and postharvest of apple fruit

1. Orchard application
    a. Soil application
    b. Foliar spray application
2. Postharvest application
    a. Dipping application
    b. Drencher application
    c. İnfiltration or vacuum application

Orchard application - Soil application

Generally, the application calcium from the soil is not recommended. Only in low pH soils it is recommended.

Orchard application - Foliar spray application

Successful augmentation of fruit Ca concentration and diminution of calcium related disorders have been achieved by application of multiple sprays of soluble Ca salts directly to the fruit surface prior to harvest. Apply 5 to 8 applications from early June to late August.

Table 2. Suggested spray calcium application

Time	Calcium g/da	Calcium chloride g/da/t	Calcium nitrate g/ha/t
Mid-July	300	500	750
End July	350	600	900
Mid-Aug	400	700	1.050
End Aug	400	700	1.050
Total	1.450	2.500	7.500

The risk of calcium chloride or calcium nitrate causing fruit russett increases with increasing number of applications, high rates, and when applied at less than 100 liters per da. The hazard is reduced by using low rates and dilute sprays (Peryea and Willemsen, 2000). The effectiveness of Ca sprays is influenced by environmental conditions, particularly relative air humidity. In areas like temperatures are high and relative air humidity is low, even at night, in summer, Ca treatments are not very effective, and give inconsistent results (Val et al., 2008). Avoid spraying calcium chloride or calcium nitrate under slow drying conditions or at temperatures above 27 to 30°C. (Peryea and Willemsen, 2000).

Application of calcium postharvest

Fresh market Ca treated apples had less green color, were firmer, with a high titratable acidity and ascorbic acid content, than untreated apples in standard cold storage (Drake and Spayd, 1983). Ca can be applied postharvest to picked fruit by dipping, drencher, vacuum or pressure infiltration with $CaCl_2$ salts. Postharvest treatments such as dips and drenches to increase calcium levels in the fruit during storage.

Postharvest Calcium Dips

Dipping certain fruit in calcium after harvest has been shown to have beneficial effects. Postharvest dips before storage may reduce bitter pit and other Ca related disorders symptoms. Calcium dips can cause fruit injury, should be carefully (Moller, 1975).



Figure 5. Experimental scale machine used for dip in fruits.

Postharvest Calcium Drencher

Postharvest drencher application before storage may reduce related disorders symptoms. Use 2-3% by weight $CaCl_2$ in the drench water.



Figure 6. The machine used for drencher in fruits.

Pressure infiltration or vacuum application

Vacuum and pressure infiltration of Ca salt solution have been especially effectevie in getting Ca into the apple reduceing physiological problems (Conway and Sams, 1983).

ii. **1-MCP (1-Methlylcyclopropene)**

What is 1-MCP ?

1-MCP is a gas with a molecular formula of C_4H_6. 1-MCP is thought to occupy ethylene receptors such that ethylene cannot bind and thereby preventing ethylene action. The affinity of 1-MCP for the receptor is approximately 10 times greater than that of ethylene. Compared with ethylene, 1-MCP is active at much lower concentrations (Blankenship and Dole, 2003).

1-MCP is available as a commercial preparation, including SmartFresh™ and Ethylbloc™. 1-MCP in Turkey is the most widely used in apple. Commercial use is dose level of 625 pbb. 1-MCP is applied in cold storage rooms which is low gas seal. After harvest 1-MCP must be applied as soon as possible and should be within 7 days (harvest time important).Plant developmental stage must be considered when applying 1-MCP as effects vary with plant maturity. 1-MCP effects decreases with advanced fruit development. 1-MCP in apples are applied before climacteric increase (Figure 7).

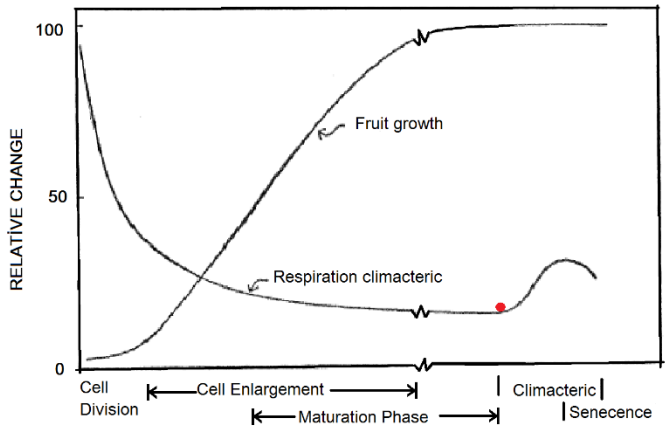


Figure 7. 1-MCP application time in the climacteric fruit.

Since the discovery of the properties of 1-MCP as a postharvest ethylene inhibitor in Turkey such as in the World is widely used. 1-MCP was registered in Turkey with the number 5021 dated 16.02.2005. Amount of 1-MCP treated apples is about 170-180 thousand tons.

1-MCP benefits in fruits

Softening, yellowing, respiration, loss of TA and sometimes a reduction in soluble solid concentration, as well as the development of several physiological disorders, are delayed or inhibited by 1-MCP application (Blankenship and Dole, 2003) (Figure 8).



Figure 8. Effect of 1-MCP upon breakdown of chlorophyll and on superficial scald in Granny Smith apples

1-MCP application temperature, dose and time

In general treatment duration is 24 h, treatment dose is 625 ppb and treatment temperature is 10-12C, which was sufficient to achieve a full.
If 1-MCP application temperatures and dose are decreased, 1-MCP application time is prolonged, application time can be reduced if the temperature and dose are raised.

Sorting and packaging of apples in Turkey

Apples after harvest are usually brought to the warehouse and are cooled. After storage for apples by hand, with semi-mechanized and fully automated packaging systems are sorted.
At the packaging house, submerge the fruit in water dumps, wash, and sort into fresh-market, processing, and cull fruit. In general, small to medium sized apples keep the longest, while the most mature have the shortest shelf life and should be removed from storage first. Cool fruit as rapidly as possible following harvest, using room cooling.

3- POSTHARVEST PRACTICES OF CHERRIES TURKEY

Cherry varieties mostly produced in Turkey is 0900 Ziraat, which is the most common variety for export.

Sweet cherry fruit is non-climacteric (Biale, 1960). Fruit quality cannot be improved after harvest. Therefore, fruits is picked optimum harvest date. Harvest date is usually determined by the skin color. The fruit changes color from green to yellow to red to dark red (mahogany). Fruit firmness, soluble solid content and fruit size are other important harvest date prediction criteria for cherries.

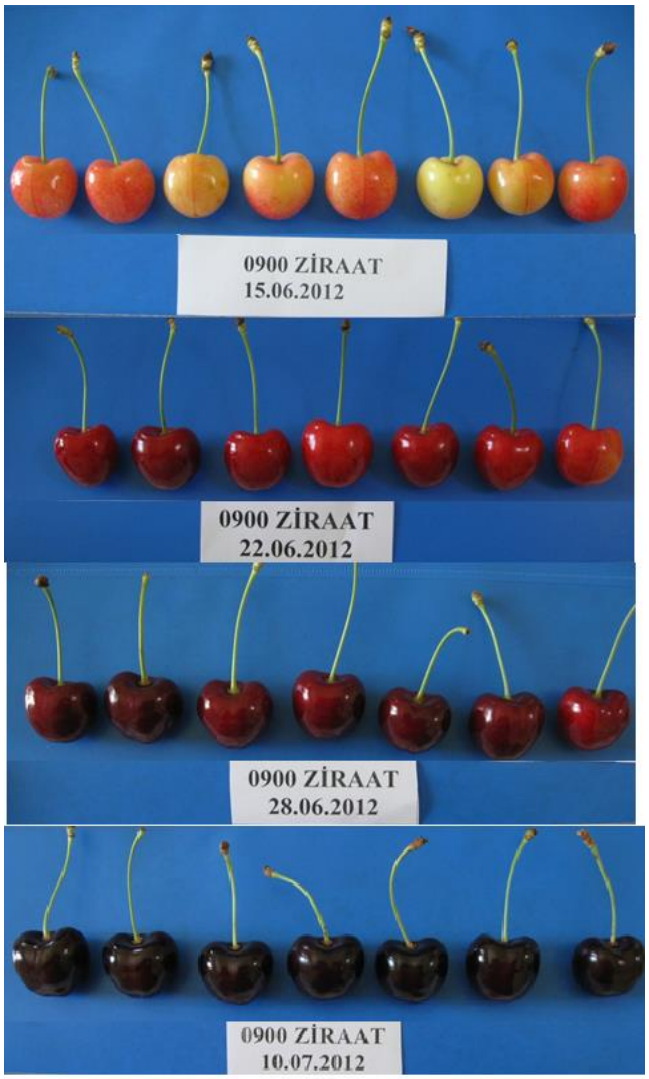


Figure 9. Fruit peel color of the 0900 Ziraat sweet cherry at different dates.The colors cards are used in the determination of the optimal harvest time.

Harvest Maturity

Determination of optimum harvest time in sweet cherry is important a criteria. If harvest at optimum time sweet cherry is not picked, fruits have lost some

quality and crop. Early and late harvest cherry fruits disadvantages are listed below.

1. Harvest too early
    a. Small size
    b. Poor color
    c. Poor flavor
2. Harvest too late
    a. Soft fruit
    b. Increased decay susceptibility
    c. More shrivel, stem browning and pitting

Harvested cherries is brought to collection points or packaging house. Cherries deteriorate from the moment they are picked. It is critical to cool the cherries as rapidly as possible immediately after harvest to remove excessive heat and to reduce the vapor pressure deficit. Therefore, cherry fruits are immediately precooled with hydro cooling. Cherry quality cannot be improved after harvest (Kupferman, 1986). After precooled cherry is sorted by hand (Figure 10) or automated machine. Fruits put in suitable modified atmosphere packaging for cherry and placed in cardboard boxes (Figure 11). Boxed cherry fruits are transported refrigerated truck to retail market.



Figure 10. Sweet cheery is sorted by hand.

Weight loss in cherries can be equated to the amount of water lost as water vapor, resulting in softening. Cherries have weak cuticle barriers to prevent water loss. The stems have even poorer barriers to water loss. The difference between the vapor pressure of the surrounding air and the vapor

pressure of the cherry is a major variable in water loss. Two major factors influencing water loss in sweet cherries are relative humidity and temperature (Kupferman, 1986).
Modified atmosphere packaging has lengthen the postharvest life of cherry fruit by reducing the water loss, the rate of growth of decay organisms, retard softening and retain stem color.



Figure 11. Sweet cherry in the modified atmosphere bag.

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THE PAST, CURRENT AND FUTURE OF APPLE FRUIT STORAGE IN TURKEY

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Abstract

Apple is among the most important pome fruits which has an increasing production in Turkey. There were a limited commercial importance with ‘‘Starking Delicious’’ and ‘‘Golden Delicious’’ as well as local apple varieties before two decade. Between the years 1990 and 2000 new cultivars have been introduced to the market very rapidly. However postharvest applications and export still developing slower comparing the postharvest treatments with developed countries. Apple storage facilities will be discussed with a chronological order in this review.

Key words: apple, storage, quality, postharvest applications.

INTRODUCTION

Apple is one of among the world dominate fruit market with oranges and bananas. Turkey is ranked in fourth apple producer with 2.889.000 tones after China, United States and India (Anonymous, 2014). This production is increasing yearly with new varieties and apple production forecast is about 3.300.000 tones for 2014. Turkey has suitable ecological conditions for apple production especially around Isparta, Denizli, Niğde, Karaman, Antalya and Kayseri ecological regions. So these are main apple production areas.

Between the year 1990 and 2000 Golden and Starking delicious cultivars were dominated cultivars in Turkey. However after 2000 year new varieties were introduced to the market. In the beginning, these new varieties were imported and consumers awareness increased for new apple varieties and especially quality perception changed. This change led the growers to adapt the new cultivars, orchard management and also postharvest practices including some new storage technologies.

The main problems were poor irrigation, fertilization and harvest time and lack of storage facilities during the mentioned years. Thanks to globalization and communication systems since after these years’ varieties and new agricultural application techniques had been started to be

reachable via internet. Also support of Turkish Ministry of Agriculture both as subvention and knowledge was very intensive during these years.

Finally after 2003 the first postharvest applications of 1-methycyclopropene started to come from the Universities (Ozkaya and Dundar 2009). These applications were also done as farmer demonstrations. In our knowledge and opinion the 1-MCP opened a huge bridge between apple growers and researchers in Turkey since application results were very unique and practically effective on postharvest physiology of fruits.

Current situation

In the current status Turkey has ample opportunity for export especially to the Middle East countries with new varieties and with a good quality. Quality criteria have been started to understanding and farmers awareness about the price-quality link increased recently. Good agricultural practices, also all kind of preharvest applications and precautions for biotic and abiotic stresses started to be use widely among the growers. The most important examples are, drip irrigations systems, preharvest cultural farming applications, fertigation systems, as well as some other applications influence the postharvest quality such as Ca, ethylene inhibitors (aminoethoxyvinylglycine etc.).

Beyond the positive progress mentioned above also we have weak points especially for postharvest practices. Turkey still has between 20-25% postharvest losses depending on variety. These losses caused by wrong harvest maturity determination and poor cold chain facilities. In terms of apple production SmartFresh™ technology based on 1-methylcyclopropene change the apple trade in Turkey.

The SmartFresh™ Quality System has been called the produce industry's most important advancement in years because it makes it possible for farmers and packer-shippers to maintain better just-harvested quality of their fruits and vegetables throughout storage, transport and retail display right through to the consumer.

SmartFresh™ application was about 250.000 tons of apples during 2013 and the distributor company target is more than 300.000 tons for 2014. The most application were done to 56% Red varieties, 28 % Granny, 12 % Golden and 4 the others.

Turkey has between 900.000-1.100.000 tons of cold storage capacity yearly. However this capacity is not enough not only for apples but also for other pome fruits. Thus it should be increase gradually depending on cultivar.

Future Prospective of Apple Production

We try to mention the most important problems and current status of Turkey apple production in this review. The most important problem is that Turkey has still over 3.000.000 tons of apple to sell annually. Limited amount of export cause competition for price and farmers negatively affected from that competition. There should be more sophisticated packing houses as well as more controlled atmosphere storage rooms needed.

Cooperatives should take more effort starting from cultivation to marketing. Although we are complaining from old cultivars, Turkey really has a fast dynamic for renewing the orchards (Intensive farming, new cultivars, etc.). University and Agriculture ministry have a big effort not only for the research but also for supporting the new technologies. The small farmers should immediately start to establish cooperation's.

To sum up, we believe that we started to have sophisticated growing technology; intensive farming techniques therefore yield is going up year by year per hectares. We still do not have expensive labor comparing EU (very big advantage). But we still need well organized postharvest management and international marketing strategies. Also we need to have apple based food technologies such as fresh juice, chips etc.

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