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Determination of yield and yield components of gooseberry (*Physalis peruviana*) grown in dry conditions

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Abstract

This study was conducted in 2010 – 2011 in Konya Cumra Vocational High School trial area. Cumra is located in southern Konya which is at central Anatolia. Two kinds of fruit were obtained from gooseberry in the study (big and small). Big sized fruit weights with calyx were found 6,55 gr and fruit weights without calyx were found 6.32 gr in both trial years. The average yield per decare was 317 kg. In both trial years, first flowering was observed 30 days after plantation. Flowering proceeded until the end of harvest. Mature fruits were observed 60 days after flowering.

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Introduction

Turkey which has a very high agricultural potential, has different ecological regions where products of different geographies can be grown. This variety is one of the most important features of our country. Cape gooseberry which is also known as winter cherry or Gooseberry (*Physalis peruviana* L.) is widely talked about in Turkey recently. The origin of this plant is not Anatolia.

It is a plant type which is naturally grown in (*Physalis peruviana* L.) Amazon and And mountains as well as tropical parts of South America (Colombia, Peru, Chile and Bolivia) and it belongs to the *Solanaceae* family. Today it is mostly produced commercially in tropical and subtropical regions such as Colombia and Caribbean (Novoa *et al*., 2006). Although being perennially developed in its own ecology, single year production type is rather suggested in commercial productions. Although the plant shows an herbaceous development the main branches become ligneous towards the end of growing period (Celik 2011). The structure of the plant flowers are hermaphrodite and found in leave axils. During growing period, continuous flowering and fruit set occur depending on plant development. After 55-60 days from flowering, fruits become ready for harvest (Besirli et al. 2011). The calyx part of the flower develops after fruit set and close so as to cover the fruit within. *Physalis alkekengi* L. which is a *Physalis* type which can naturally grow in Turkey is named as winter cherry as the fruits look like lantern (Baytop, 1999; Besirli and Surmeli, 1998).

Due to bioactive components in its fruit, *Physalis peruviana* L. plant is accepted as functional food. High amounts of phytosterols (kampesterol, ß-sitosterol and stigmasterol) were detected in the oil extracts obtained from fruit and it was understood that these components are antioxidant and also decrease blood cholesterol levels. (Besirli *et al*., 2011). Gooseberry which is known as highest fiber including fruit (4,9 – 7,0 g/100g) is also rich by carbohydrate (1,3g/100g) and proteins and 77 calories are obtained from its 100 grams (Celik 2011). In its mineral composition, there are elements such as K, Mg, Ca and Fe. Its Fe content is even higher than many vegetable sources including beans which are known to be very rich by Fe. (Rodrigues *et al*., 2009). The mineral and vitamin content is also high. Its 100 gr includes 8 mg Ca, 5,53 mg P, 1,2 mg Fe, 2,08 mg B vitamin complex, 0,2 g fat and 73% water. Besides high amounts of poly-phenol is related with high antioxidant activity as it includes A and C vitamins. The fruits of the plant can be used fresh as well as in jam and marmalade. The fruits are dried before usage, they are used chocolate cakes and suggested as garniture in salads. It is especially suggested to old people as a fruit to be consumed in the beginning of the day (Celik 2011; Puente 2010; Sarkar and Chattopadhyay, 1993). Gooseberry includes little amount of water mechanically in its calyx so it can be preserved for long time. The fruits harvested in Germany can be preserved for 1-2 weeks which is a very widespread application. (Berger *et al*., 1989)

The multiplication of this species (*Physalis peruviana* L.) can be made by seed and also by strawberries from branches having ligneous structure. However in commercial productions multiplication with seed is preferred. The seeds of the plant are similar to eggplant (among tomato and pepper which are from the same family) but are smaller. The seed size is similar to tomato seeds. The storing feature of the plant is different from all other plants which allow long time preservation. Parallel to the developments in agriculture, it can be a good alternative fruit for dry climate regions (Celik, 2011).

Some of producers started to grow this foreign origin plant in some regions of Turkey. These producers need agronomic properties of gooseberry. In this study, the aim is to evaluate some agricultural properties such as germination ratio and period, Kernel thousand weights, seed amount in one gram, vegetation period, fruit size, fruit

weight and yield in order to contribute to the local producers who have intention to grow Gooseberry.

Material and method

Gooseberry trial was held in Selcuk University Cumra Vocational High School in 2010 and 2011 spring and summer periods. The climate data of these years are given in Table 1. Before the trial, soil sample from 20 cm depth was analyzed. The analysis results are given in Table 2. The seeds used in the trial were provided from Market in Germany. The Kernel thousand weights of the Gooseberry seeds were determined and germination test was conducted according to international rules. (Anonymous, 1985)

The Gooseberry seeds were planted in viols to obtain seedlings in green house conditions in first week of April. The seedlings kept growing until reaching 10-15 cm length. In both 2 years of the trial, in 3rd week of May – after the frost danger passed Gooseberry seedlings were transplanted in the trial field (100 plants, 75 x 75 cm Row spacing, in-row spacing distance and triple recurrence). Except the side rows in the trial field, 10 plants were selected in order to detect plant length, fruit quantity per plant, fruit weight with calyx and without calyx, fruit size with calyx and without calyx, seed quantity in single fruit, vegetation period and yield per decare. The results are given in Table 3.

After water requirement of the transplanted Gooseberry seedlings was fulfilled from first growing period until pre-flowering period, no more water was given until harvest. At the 3rd and 4th weeks of June, pruning was made in the lower branches so as to make them grow upwards.

Organic fertilizer (Farm manure, 2 ton/decare) was used in the trial field before planting. The weed control was manually made with hoe and no chemical drugs were used. The fruits that became mature for harvesting were collected once in every week starting from last week of August to beginning of October (first frost date, 2010 8th of October, 2011 9th of October).

Results and discussion

The results of this study conducted in Konya Cumra between 2010 and 2011 in order to determine the yield and yield components of Gooseberry are given in Table 3.

In this study, the yield and yield components of Gooseberry (*Physalis peruviana*) in the ecological conditions of Cumra. Before planting the seedlings to be used in the research, kernel thousand weight was determined by counting 100 pieces 4 times. The weight of 1000 seeds was found as 1,7gr and seed quantity in 1 gr was found as 588. Afterwards, germination test was made (Anonymous 1985). At the end of this test it was found out that germination rate is 23 days and germination power is 90%. The seed plantation for planting the seedlings to be used in this research was made in viols under green house conditions in the first week of April. The seeds in viols germinated in the last week of April and first week of May. When the seedling lengths became 10-15 cm after 3 weeks, the seedlings were transplanted in the trial field. It was observed that the fruit shapes produced by seedlings obtained from Gooseberry seeds were not uniform. Some of the fruits were spherical while the others were conical. Besides, the size of the fruits was also very different. The big fruit giving plants and small fruit giving plants were determined and the study was conducted on these two types.

When the rainfall distribution in the trial years was examined it was observed that the rainfall of first 10 months of 2011 was 70 mm more than 2010. In the seconds year of the trial the rainfall detected in the Gooseberry growing period (May – September) the rainfall was approximately two times of the 2010 trial year. In both trial years, too high and too low temperatures were not observed during summer. The vegetation period in both trial years between Gooseberry seedling plantation and plant collection was 140 days. In both trial years, first flowering was

observed 30 days after plantation. Flowering proceeded until the end of harvest. Mature fruits were observed 60 days after flowering in the 3rd week of August. In a study conducted in India conditions, it was stated that these periods may change according to plant row and distance (Girapu and Kumar 2006). The mature fruits were collected regularly in the beginning of every week starting from last week of August until the end of harvest. In the first week of October, harvest was finished as night frost harms the leaves and flowers. The plants were completely collected although frost did not harm main branches and stems.

The average fruit weights with calyx were found 1.96 gr and fruit weights without calyx were found 1.87 gr in both trial years. Big sized fruit weights with calyx were found 6,55 gr and fruit weights without calyx were found 6.32 gr in both trial years (3.3 times bigger than small fruits).

Table 1 Precipitation, maximum and minimum temperature data obtained from meteorology data of 2010-2011 and long year average.

	Precipitation			Max Temp. °C			Min. Temp °C		
	L.Y	2010	2011	L.Y.	2010	2011	L.Y.	2010	2011
January	35.6	43.6	52.9	18.0	18.0	8.0	-22.5	-12.8	-6.3
February	28.1	33.3	40.1	20.8	20.8	15.1	-19.0	-12.7	-9.9
March	31.9	12.1	44.2	28.2	26.9	22.9	-14.6	-6.0	-8.7
April	40.0	67.4	48.0	31.5	24.9	24.0	-9.7	0.4	-2.1
May	32.2	12.4	52.5	33.8	32.1	25.8	0.8	4.8	2.0
June	21.2	47.9	39.5	35.2	33.5	32.2	3.9	9.7	9.5
July	6.0	0.0	0.0	39.9	36.4	36.7	7.6	13.0	11.4
August	4.6	0.0	1.0	39.2	39.2	36.4	8.6	12.5	11.2
September	13.2	1.6	3.8	36.1	36.1	31.1	1.4	9.5	6.3
October	27.3	62.6		31.8	30.5		5.0	-1.0	
November	33.8	4.2		24.0	24.0		-18.2	-1.3	
December	46.1	106.8		22.9	22.9		-21.8	-4.6	
TOTAL	320	391,9	282,0						

Table 2 Some soil features of the trial field.

Properties	Data of Analyses	Clasification
Tekstur	%37.23 Clay, %31.67 Sand, 31.10 % Silt	Clay Loam
pH (1/2.5 Saturation)	7.46	Slightly Alkaline
$CaCO_3$ (%)	14.61	Normal
Organic Matter (%)	1.01	Poor
P_2O_5 (kg da^{-1})	6.83	Sufficient
K_2O (kg da^{-1})	459.8	Sufficient
Ca (mg kg^{-1})	13040	Very High
Mg (mg kg^{-1})	720	High
DTPA ext. Fe (mg kg^{-1})	5.60	Sufficient
DTPA ext. Zn (mg kg^{-1})	2.60	Very High
DTPA ext. Mn (mg kg^{-1})	46.40	Sufficient
DTPA ext. Cu (mg kg^{-1})	1.06	Sufficient

Table 3. The Yield Data Values Of Gooseberry (*Physalis Peruviana*) In The Ecological Conditions Of Cumra.

Altın Cilek	Fruit Weight Calyx (gr)	Fruit Weight (gr)	Fruit Diameter Calyx (mm)	Fruit Length Calyx (mm)	Fruit Diameter (mm)	Fruit Length (mm)
Big Fruit(2010)	6.33	6.16	32.00	34.10	21.95	22.00
Big Fruit (2011)	6.78	6.48	32.36	35.60	22.93	22.96
Average	6.55	6.32	32.18	34.85	22.44	22.48
Small Fruit (2010)	1.80	1.76	18.80	24.40	12.90	14.90
Small Fruit (2011)	2.12	1.98	19.04	25.74	13.88	15.52
Average	1.96	1.87	18.92	25.07	13.39	15.21
Gooseberry	Plant Length (cm)	Fruit Quantity	Total Fruit	Yield Per Plant (gr)	Yield (kg/da)	Seed Quantity
Big Fruit (2010)	42	21	28	177	326	179
Big Fruit (2011)	54	25	32	217	400	173
Average	48	23	30	197	363	176
Small Fruit (2010)	70	56	70	126	232	106
Small Fruit (2011)	82	60	80	169	311	116
Average	76	58	75	147	271	111

There is a periphery called calyx surrounding Gooseberry (*Physalis peruviana*) fruits which protects fruits from external effects. The average fruit diameter and lengths with calyx were found 32.18 mm and 34.85 mm for big fruits and fruit diameter and lengths with calyx were found 18.92 mm and 25.07 mm for small fruits. Results show that big fruit lengths and widths are close to each other and almost spherical. The difference is more in small fruits and shape is rather conical. The average fruit diameter and lengths without calyx were found 22.44 mm and 22.48 mm for big fruits and fruit diameter and lengths without calyx were found 13.39 mm and 15.21 mm for small fruits. In a research, single fruit average weight was found 9.34 g, fruit length was 2.54 cm and fruit width was 2.37 cm and in another study where 6 different winter berry rows were used, the fruit properties were compared and fruit weight was found 9.80– 12.20 g, fruit length was found 2.30– 2.90 cm and fruit width was found 2.70– 2.90 cm (Besir et al. 2011, Kour and Bakshi 2006). The seeds within single fruit were counted and it was observed that big fruits include more seeds (average 176) while small fruits include less seeds (average 111).

When Gooseberry was examined in means of plant length, it was observed that plants with small fruits (76 cm) were longer than plants with big fruits (48cm). When first fruits became mature enough to be collected, all fruits were counted. It was observed that mature fruits in plants with small fruits are more compared with plants with big fruits. It was also observed that the period from first maturation until harvest is longer. In fall, it was observed that some fruits fell to the ground before collection. Plants with small fruits had more fruits (58) compared with plants with big fruits (23). Harvest was completed when the leaves of the plants chilled and all fruits were counted again. The fruit quantity increased 30% and 30-75 fruits were counted. During this period, Gooseberry plant continued forming new fruits. Quantity of small fruits increased 17 in average and big fruits increased 7 in average. The average weight was found 147 gr in small fruit plants and 197 gr in big fruit plants.

From this data, average yield was calculated as kg/da. The yield was fond as 363 kg/decare in big fruit plants and 271 kg/da in small fruit plants. The average yield was found 317 kg/da. The yield in similar studies made in Turkey varied between 245.8 – 449 kg/da (Abak *et al*., 1993; Besirli *et al*., 2011). In all plants, yield varies according to climate, soil properties and cultural operations of growing region. In order to increase the yield, it is very important to select plant type and species that are suitable to the particular region.

Conclusion

Gooseberry from *Solanaceae* family which is discussed recently in community is growth naturally in tropical region of South America (Colombia, Peru, Bolivia, Chile). In our trial conducted in Cumra conditions where we aimed to determine yield and yield components of Gooseberry plant which was not irrigated after maturation period, it was observed that the plant was easily grown in our country just like tomato and eggplant from the same family.

Gooseberry shows a perennial development in its own ecology and under green house conditions. Due to this property, it can be grown perennially as well in regions with mild climate.

In our trial conducted in Cumra conditions where we aimed to determine yield and yield components of Gooseberry plant it was observed that the number of fruits in plants with big fruits are less than plant with small fruits but single plant yield and yield per decare of plants with big fruits are more, they maturate later, their fruits fell to the ground less in fall and they include more seeds. During the trial, supporting sticks were placed next to some plants in order to prevent branch breaking. Considering that the plant maturation will be lush in moist regions with high amount of rainfall, supporting the plants regularly will give a good result.

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