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The Effect of Growing Bag Culture on Yield, Earliness and Quality Characteristics in Snap Bean Growing Under Unheated Glasshouse During Late Autumn Season

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Abstract: This research was carried out to determine the effect of the growing bag culture and soil culture practices on yield, earliness and quality characteristics in snap bean growing under unheated glasshouse during late autumn season between 2001-2002 years. In the soil culture practice, directly seed sowing and seedling planting methods tried. Five snap bean cultivars (ÖzAyse 16, Alman Ayse, 4F-89, Gitan and Sirik 97) used. In the growing bag culture, the harvesting time of all cultivars were lately than the others. The harvesting time of the cultivars in the seedling method delayed about a week to directly seed sowing method in the soil culture practice. It was determined significant differences in terms of pod number/plant and pod yield characteristics between growing practices. According to the results, it was not obtained desirable values about yield, earliness and pod quality characteristics in the growing bag culture practice. However, the growing bag culture will be more important in future and, this practice will provide highly useful practise when we determined suitable medium and used drip irrigation systems together especially in developing countries for greenhouse growing.

Key words: Snap bean, growing bag culture, soil culture, greenhouse

Introduction

In Turkey, greenhouse activities are quite recent. The first constructions were built in the 1940's in Antalya region by public enterprises (Sevgican, 1989). During the last twenty years, greenhouse crop production and cultivation areas have expanded rapidly in Turkey, particularly in those regions favoured by Mediterranen climatic conditions (Aegean and Mediterranen coastal regions). In Turkey, total greenhouse crop production rates are 95.6, 1.2 and 2.2% for vegetable crops, fruit crops and cut flowers respectively (Aybak, 2002). The most popular crops are tomatoes, cucumbers, peppers, eggplant, melon, watermelon, lettuce and squash in greenhouses. Crops diversification occurs as a result of farmers and producers looking for increased benefit by trying to single out those commodities which are not yet widely produced but have market potential (Baudion, 1992). During the recent years, producers are interested with new alternative vegetable crops in greenhouse cultivation. As a result of this situation, snap bean production rates started to increase in the rate of total greenhouse production. Otherwise snap bean is being sold with high prices during winter months. In addition, the rate of green

bean production in greenhouse vegetable export values has been increased in Turkey during the last years (Ercan ***et al.***, 1994; Balkaya and Gülümser, 1999). The Black Sea Region is one of the most popular snap bean producing area in Turkey. Samsun is the first with regard to greenhouse cultivation area in Black Sea Region. Recently, new cultivars accepted as a result of introducing different cultivars which are suitable to consume fresh (Balkaya ***et al.***, 1999). In a research on yield profitable analysis of some vegetables in unheated plastic greenhouse in Black Sea Region, it was determined that green bean in early spring season and green bean with tomato and cucumber were found to be profitable crops in late autumn season (Apaydin ***et al.***, 2000). In another research done in this region, it was suggested that seed sowing must be between the middle of February and the beginning of March to obtain high quality and yield during the early spring season. It must be between the middle of July and the beginning of August during the late autumn season (Apaydin ***et al.***, 2002).A research has been carried out in Eagean Region in order to determine the effect of different sowing time on yield and quality of green bean in late autumn season. It was determined that the best suitable sowing time was 31 August (Tüzel ***et al.***, 1990).

Growing bag culture, a kind of soilless culture, is a practice with the highest possibility of realization in our country (Sevgican, 1999). Growing bags can be prepared by producers or bought from traders in prepared form. Horizontal growing bag culture, a kind of growing bag culture, is generally used in tomato and pepper growing (Jensen and Collins, 1985).

In growing bag culture, determining the suitable aggregate type and agregat amount per plant is the most important topic (Sevgican, 1999). For this reason, organic wastes used in growing bag culture must supply sufficient amounts of nutrient elements to the plants. The covering the soil surface with plastic material decreases relative humidity and therefore the incidence of fungal diseases. Furthermore, this system supply fast heating environment for the plants (Uzun ***et al.***, 2000). Growing bags can be used at least two years and also in case of growing bags sterilization is easier and cheaper compared with the soil culture (Uzun ***et al.***, 1999). In the growing bag culture, organic and inorganic agregats such as peat, vermiculit and perlit are used as growing medium (Gül, 1990; Magein, 1992). Peat is the most commonly used organic material in regulating to physical and chemical characteristics of growing media (Sevgican, 2000).

Seed sowing or seedling planting, watering the plants with suitable nutrient solution, suspending, pruning, disease and insect management and control are the cultural practices applied after moving the growing bags to the greenhouse (Sevgican, 1999). In green bean growing in greenhouse, plants are grown by directly seed sowing method or seedling planting method (at 4-5 leaves period). Saglam and Yazgan (1998) reported that directly seed sowing practice gave better results in terms of earliness and yield compared with seedling planting practice in early spring season. In directly seed sowing practice, sliming is more common in case of heavy soils. In case of sliming seed emergence is very difficult. Directly seed sowing practice avoids this drawback (Günay, 1992). Furthermore, seedling planting practice allows growing plants with uniform quality. Legume vegetable crops are very sensitive to transplanting (Agaoglu ***et al.***, 1995). For this reason, seedlings must be planted directly to the soil.

In recent years green bean was started to grow as an alternative source in greenhouse. Beside this, using growing bags in greenhouses will be more important in future. In this study, relations between soil culture and the growing bag culture practices in late autumn season green bean growing were examined in the light of earliness, yield and pod quality.

Materials and Methods

This research was carried in unheated plastic greenhouse at the Department of Horticulture, Faculty of Agriculture, Ondokuz Mayis University in 2001-2002 years.

In the research, five cultivars consisting climbing forms were used Öz Ayse 16 (V1), Alman Ayse (V2), 4F-89 (V3), Gitan (V4) and Sirik 97 (V5). The snap bean varieties were sown on the 17th July in 2001-2002 years. In this study, soil culture and the growing bag culture practices were tried. In soil culture practice, growing places (15 m length and 1 m width) were prepared. The seeds were sown into plug trays (5.5 cm width and 6 cm depth). A seed was sown to each septum. Peat, organic manure and sand 2:1: 0.5 rates were used respectively as growing medium. The seedlings were planted to the growing places or the growing bags at 4-5 leaves period in greenhouse.

The plants were planted at the distances 70X30 cm as two rows. In the second year, directly seed sowing practice were also tried to compare with seedling planting together in the soil culture. The directly seed sowing application were not compared with the other practices For this reason, the results was evaluated in the light of earliness and yield characteristics

The black plastic bags (0.32 mm thickness, 100X40 cm dimensions) were used the growing bag culture. In this practice, a mix of peat, organic manure and sand (2:1:1 rates) was used as growing medium. Examples were taken for analyses from all growing places and growing bags for each practise. According to the results of analyses, it was found that the medium examples of all practices which organic matter contents were being the high, pH values were not and total salt contents were being the low (Anonymous, 2003). Snap bean is one of the highly sensitive vegetable crops to salt (Sepetoglu, 1994). For this reason, growing media with low salt contents are very important. In this research, 30 l medium was used in each of the growing bags. Tree seedling were planted to each growing bags at similar distances. After the seedling were planted, water was given to the plants to decrease seedling losses. Furthermore irrigation was done regularly and solution fertilization were done at 15 days intervals.

Phenological observations

a. First flowering dates

The first flower appearing time after seed sowing dated as first flowering time. According to opening time of the flowers a classification was done. In this classification, 36-43 days period between first flower times and dating from seed sowing time is early; 44-51 days period between first flower times and dating from seed sowing time is medium and 52-60 days period between first flower times and dating from seed sowing time is lately (Ekinci, 1976; Balkaya, 1999).

Table 1: Traits using to evaluate which snap bean cultivars and their evaluation method

Traits	Evaluation
a. Pod length (cm)	The pod length was measured with digital compass.
b. Pod width (mm)	The distance from middle of pod was measured with digital compass.
c. Pod shell thickness (mm)	The pod shell thickness was measured with digital compass.
d. Stringless forming	1.present 2.medium 3.absent
e. The pod colour	In the pods harvested the brightness of ground colour was measured with a colorimeter Minolta Choromometre brand. The pod colour measurement was evaluated as to this scale; L: the rate of brightness, +a: red, -a: green and +b: yellow and -b: blue. Besides, pod colours in all cultivars used in this research were determined.
f. The twisted pod rates	1. absent 2.little 3.medium 4.excess

b. Earliness

The first harvesting time of fresh pod when they reached to 2/3 largeness dated as the beginning of harvest.

c. Harvesting period (days)

period (days) between first and last harvesting.

Morphological observations

These practices evaluated according to traits showed in the Table 2.

Yield characteristics

a. Pod number/plant

Fresh red podded beans were harvested every week regularly.

b. Pod yield (g/plant)

The yield values (g) per plant were found by weighing the pods harvested from each plant

c. Average pod weight (g)

For each practice, 20 pods taken from each cultivar were weighed and the values of average pod weight were determined.

The experiment was planned in accordance with the completely Randomized Block Design with three replications. The data were evaluated by Excel 7.0 and MSTAT programme.

Results and Discussion

First flowering dates of snap bean cultivars were different according to the growing practices (Table 2). While flowering of cultivars were being as early and medium in the soil culture practice, it was occurred mostly as lately in the growing bag culture. The yield of snap bean cultivars depends on first flowering date and temperatures in this period (Wallace and Enriques, 1980). Because, pod set rates of first opening flowers are higher then the later opening flowers.

Table 2: The first flowering dates and flowering periods of cultivars in growing culture practices

		First flowering Dates (days)		Flowering Period	
Years	Cultivars	Soil culture	Growing bag culture	Soil culture	Growing bag culture
2001	Özayse 16	42	52	Early	Lately
	A. Ayse	43	52	Early	Lately
	4 F-89	44	45	Medium	Medium
	Gitan	44	50	Medium	Medium
	Sirik 97	45	50	Medium	Medium
	Özayse 16	43	54	Early	Lately
2002	A. Ayse	43	53	Early	Lately
	4 F-89	43	40	Early	Early
	Gitan	47	54	Medium	Lately
	Sirik 97	47	54	Medium	Lately

Table 3: First harvesting dates and harvesting period of cultivars in growing culture practices

		First flowering Dates (days)		Flowering Period	
Years	Cultivars	Soil culture	Growing bag culture	Soil culture	Growing bag culture
2001	Özayse 16	56	68	60	55
	A. Ayse	60	70	55	50
	4 F-89	63	70	60	45
	Gitan	63	74	60	50
	Sirik 97	63	68	60	55
	Özayse 16	56	70	54	54
2002	A. Ayse	56	70	54	54
	4 F-89	61	61	54	49
	Gitan	57	63	67	55
	Sirik 97	57	70	67	55

Data of first harvesting dates of snap bean cultivars were similar to the results of flowering period in the growing practices (Table 3). All cultivars were harvested later at each of the year in the growing bag culture practise. Cultivars were harvested between 49-54 days in second year of this research for directly seed sowing practise. According to growing practices, harvesting times were delayed about one week in seedling planting practice to directly seed sowing practice. This results were similar to the findings of Saglam and Yazgan (1998). After the seedlings were planted in August month, high temperatures had a negative effect in the greenhouse so that the increase in their growing were not similar as a result of transplanting stress in growing culture practices.

It was determined that the harvesting period of cultivars were 55-60 days (2001) and 54-67 days (2002) in the soil culture (seedling planting practice). This period were 45-55 days and 40-55 days for years of 2001 and 2002 in the growing bag culture respectively (Table 3). Otherwise, in the directly seed sowing practice harvesting period was determined as 50-55 days. To obtain high income in greenhouse growing, the cultivars must have a longer harvesting period. For this reason, it was seen the harvesting periods of cultivars in the soil culture were longer than (10

Table 4: Pod length and pod width values of snap bean cultivars in growing culture practices

		Pod length (cm)				Pod Width (mm)	
Years	Cultivars	Soil culture	Grow.bag culture	Years	Cultivars	Soil culture	Growing bag culture
2001	Özayse 16	12.53	11.23	2001	Özayse 16	14.0	12.3
	A. Ayse	12.50	11.94		A. Ayse	16.8	15.2
(15.89**)	4 F-89	18.73	16.33	(14.44**)	4 F-89	14.0	13.7
b	Gitan	21.88	18.26	b	Gitan	15.3	12.8
	Sirik 97	18.27	17.16		Sirik 97	16.0	14.3
	Özayse 16	16.84	15.40		Özayse 16	16.9	14.2
2002	A. Ayse	18.43	14.30	2002	A. Ayse	15.3	14.7
	4 F-89	19.07	15.50		4 F-89	16.6	16.0
(17.28**)	Gitan	21.03	16.57	(15.76**)	Gitan	16.3	13.7
A	Sirik 97	20.37	15.26	a	Sirik 97	18.3	15.9
LSD	Ort.	17.97** a	15.20** b	LSD	Ort.	15.8** a	14.38** b
0.5870	LSD	0.5870		0.91	LSD	0.91	

**: significant at 1% level

Table 5: Pod shell thickness values and stringless forming of cultivars in growing culture practices

		Pod Thickness	Shell (mm)			Stringless	forming
Years	Cultivars	soil culture	grow.bag culture	Years	Cultivars	soil culture	growing bag culture
2001	Özayse 16	7.0	5.7	2001	Özayse 16	Absent	Absent
	A. Ayse	9.0	8.1		A. Ayse	Absent	Absent
(6.95*)	4 F-89	6.8	5.9		4 F-89	Absent	Absent
a	Gitan	7.3	7.1		Gitan	Absent	Medium
	Sirik 97	6.5	6.2		Sirik 97	Absent	Present
	Özayse 16	7.5	6.6		Özayse 16	Absent	Absent
2002	A. Ayse	8.6	7.8	2002	A. Ayse	Absent	Absent
	4 F-89	6.3	4.9		4 F-89	Absent	Absent
(6.64*)	Gitan	5.8	4.5		Gitan	Medium	Present
b	Sirik 97	7.6	6.8		Sirik 97	Medium	Present
LSD	Ort.	7.24** a	6.35** b				
0.30	LSD	0.4052					

**:significant at 5% level

days) than those in the growing bag culture practise (Table 3). Therefore, harvesting period is more important to obtain high yield and income.

The pod length and pod width of snap bean cultivars were given in Table 4. It was determined that there were significant differences in terms of pod dimensions between years and practices. Pod length and pod width of all cultivar values were found higher in 2002 than 2001. In the soil culture, pods of cultivars were longer then those in growing bag culture. The cultivars grown in the growing bag culture couldn't attain the desirable pod sizes. Pod sizes special to cultivar are very important in the marketing. For this reason, cultivars must be grown in suitable growing systems.

Table 6: Twisted pod levels and pod colour measurement values of snap bean cultivars

Years	Cultivars	Twisted soil culture	Pod levels grow.Bag culture	Soil culture	Pod L	Colour a	Intensity b
2001	Özayse 16	Absent	Absent	Özayse 16	62.15	-16.96	30.53
	A. Ayse	Absent	Absent	A. Ayse	54.33	-15.69	27.20
	4 F-89	Medium	Medium	4 F-89	64.16	-13.53	28.69
	Gitan	Absent	Medium	Gitan	59.23	-13.53	28.75
	Sirik 97	Absent	Medium	Sirik 97	51.40	-5.74	22.80
				Grow.bag cult.			
	Özayse 16	Absent	Absent	Özayse 16	58.77	-17.5	32.23
2002	A. Ayse	Absent	Absent	A. Ayse	54.99	-15.73	27.44
	4 F-89	Medium	Excess	4 F-89	62.37	-16.4	29.88
	Gitan	Absent	Little	Gitan	54.02	-7.34	23.33
	Sirik 97	Absent	Little	Sirik 97	47.03	-3.12	18.55

It was determined that there were significant differences in terms of pod shell thicknesses between years and growing practices (Table 5). On the contrary pod length and pod width values, it was determined that pod shell thickness values of all cultivars were higher in 2001 years. However it was also found that pod shell thickness values of cultivars in the soil culture were higher than the growing bag culture. While the highest pod shell thickness values were determined for Alman Ayse cultivar and the lowest values were determined for 4F-89 cultivar in both of the years. It was determined that growing practices could be affective on this trait without changeable consist of genetical structure of cultivars.

When we evaluated about pod length, pod width and pod shell thickness values together, it was determined that the pod dimensions of all cultivars were not reached desirable values as a result of the root volumes of plants were limited at growing bags for fresh consumption in the growing bag culture.

Stringless pod forming is one of the effective factors on the pod quality, for fresh consume. Stringless forming was determined on the pods of Gitan and Sirik 97 cultivars (Table 5). Stringless rates were higher for cultivars raised in soil culture than those raised in growing bag culture. This can be attributed to the genotype of cultivar or Ca deficiency in the growing medium.

The consumers prefer pods with uniform and untwisted shapes. One of the criteria marketing of green bean was the pod structure. Twisted pod numbers of Gitan and Sirik 97 cv. were increased in the growing bag culture (Table 6). Further it was determined that the twisted pod numbers of 4F-89 cultivar were higher then the others. This can be attributed to genotype of the cultivars.

The pod colours were green with different tones in all cultivars (Table 6). In Black sea region, the consumers prefer cultivars with colour of green and dark green (Balkaya, 1999). There were no differences between growing practices in terms of pod colour in 2002. L values shown in the rate of pod brightness. Pod brightnesses of all cultivars in the growing bag culture were lower than those in the soil culture with there was no very big differences together. As a negative the increase in a values shown the increase of green colour density and as a positive

Table 7: Pod number/plant and pod yield/plant (g) values of snap bean cultivars in growing culture practices

Years	Cultivars	Pod Number/plant Soil culture	Grow.Bag culture	Years	Cultivars	Pod (g) Yield/plant Soil culture	Grow.Bag culture
2001	Özayse 16	141.4	33.0	2001	Özayse 16	1083.2	182.7
	A. Ayse	91.8	22.3		A. Ayse	911.5	111.1
(63.62**)	4 F-89	50.8	23.2	(524.3**)	4 F-89	369.2	151.3
a	Gitan	74.1	21.9	a	Gitan	866.6	197.7
	Sirik 97	142.0	35.6		Sirik 97	1179.0	189.3
	Özayse 16	57.5	16.7		Özayse 16	439.8	61.8
2002	A. Ayse	117.0	27.8	2002	A. Ayse	777.0	145.9
	4 F-89	38.8	11.5		4 F-89	399.1	79.2
(43.57**)	Gitan	78.2	15.7	(336.5**)	Gitan	688.6	145.7
b	Sirik 97	61.2	11.2	b	Sirik 97	533.6	94.4
LSD:13.75	Ort.	85.3** a	21.9 ** b	LSD	Ort.	724.9** a	135.9** b
	LSD	13.75		133.9	LSD	133.9	

**:significant at 1% level

the increase in a values shown the increase of red colour density. The increase in the b values indicates that the maturity period is over. There were not significant colour differences between applications but snap bean cultivars (Table 6).

Most of the studies showed that the numbers of pod in beans are the most important components affecting yield (Silbernagel, 1986; Balkaya, 1999). In this research, it was determined that there were significant differences between pod numbers per plant (Table 7).

The pod numbers per plant of all cultivar were lower in the growing bag culture. In the soil culture, the performance of the cultivars were different according to years. For example, although the largest pod numbers were obtained from Özayse 16 and Sirik 97 cultivars in 2001, it was obtained from Alman Ayse cultivar in 2002. When we made an evaluation to determine the reasons of difference between cultivar yields according to years, it was seen which the temperature values of second years lower in flowering and pod set periods than the first years. The temperature values during fruit set period is also effective on optimum pod yield and seed development. The temperature recommended in this period is 18-25°C (Vural ***et al.***, 2000). The flowering periods of the cultivars used in the research have taken place between the temperature levels as pointed out in the literature in 2001 year and no problem has been detected in the cultivars regarding the pod development but some cultivars were not show similar performance in 2002. Heat decreases in greenhouse during late autumn season caused decreases in yield (Iglesias ***et al.***, 1984; Tüzel ***et al.***, 1990).

There were significant relations in terms of pod yield per plant between growing cultures and years (Table 7). In the growing bag culture, the yield of cultivars were found lower than the others. Yield values of cultivars in the growing bag culture were five times lower than those in soil culture (Table 7). This can be stemmed from insufficient root volumes in growing bags. The researchers stated that yield values of green bean cultivars were 2000-4000 kg da^{-1} in greenhouse growing (Saglam and Yazgan, 1998; Apaydin ***et al.***, 2002). Yield values of cultivars were 1230.7-3929.9 kg da^{-1} in the soil culture. When we compare to the effect on yield of directly seed

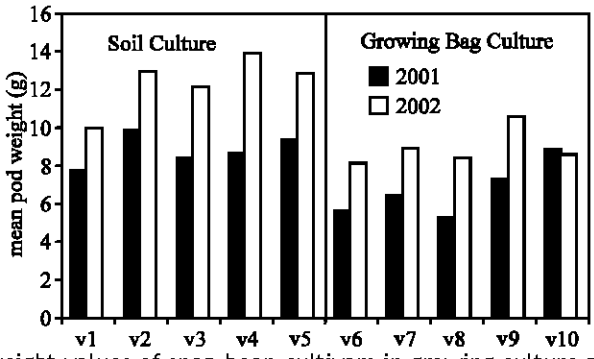

Fig.1 Average pod weight values of snap bean cultivars in growing culture practices

sowing method and seedling planting method in the soil culture practise, the cultivars were not show similar performance. The highest yield values for Alman Ayse and Gitan cv. obtained in the directly seed sowing method. However, in seedling planting method, the highest values were obtained for Özayse 16 and 4F-89 cv. In the studies carried out by many researchers, it was pointed out that the number of leaves and pod in beans are the most important components affecting yield (Duerte and Adams, 1972; Ayanoglu and Engin, 1995). In this research the number of leaves were being different in all practices. Depending on the number of leaves decreasing as the growing practise were being the accumulation of dried materials obtained as a result of photosynthesis was less and therefore less yield of growing bag culture was gained compared to the soil culture practice.

The average weights of pods (g) in the snap bean cultivars in growing practices is given in Fig. 1. The highest average pod weight were obtained from the soil culture for each 2 years. It was also determined that average pod weights were lower in the growing bag culture from the others. Further it was seen the significant differences between years (Fig. 1).

Average pod weight of cultivars in 2002 were found heavier for each two growing practise in 2001. For this reason is that temperature decreasing during the growing periods affects the pollinating, fertilization and pod set of snap bean cultivars flowers negatively, as a result in comparison with 2001 years for each growing practise pod production is lower but average pod weights are higher in 2002 years. In order to clarify for sure entirely that the weight of pod increase in accordance with the years and growing practise, it will be useful to carry out experiments.

According to results of this research it can be said that seedling planting method used in the glasshouse growing during late autumn season, will be very useful for the producers in terms of pod quality and pod yield traits except for earliness. In directly seed sowing method, it was obtained earliness about one week but it was showed that yield performance of cultivars were changed to cultivar in this method. In the growing bag culture practise, it was not reached desirable values about earliness, yield and pod quality characteristics according to using methods in the soil culture. The reason of root volume of the plants is limited in the growing bags, it is essential thinking with suitable agregat types choose and using drip irrigation systems together

so it can be apply practically in greenhouse growing. Further it will be also useful determining the best suitable medium for the growing bag culture in the snap bean growing.

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