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Hıyar (*Cucumis sativus* L.) Hibrit Tohum Üretiminde Meyve Sayısı ile Tohum Miktarı ve Kalitesi Arasındaki İlişkiler

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Özet

Hıyar (*Cucumis sativus* L.) Dünya üzerinde en çok üretilen sebzelerden biridir. Açık tarla ve sera koşullarında üretimi yapılmaktadır. Seralarda üretimi yapılan çeşitlerin büyük bir çoğunluğunu hibrit çeşitler oluşturmaktadır. Yerli hibrit çeşitlerde tohum kalitesi ile ilgili sorunlar yaşanmaktadır. Kaliteli tohum kullanımının verimde %15 ile 20 arasında artışlara neden olduğu bilinmektedir. Bu çalışma, Antalya koşullarında özel bir firmaya ait hibrit hıyar çeşidinin tohum üretimi sırasında ana bitki üzerinde bırakılan meyve sayısı (1-13 arası) ile elde edilen tohumun kalitesi ve miktarı arasındaki ilişkileri belirlemek amacıyla yapılmıştır. Deneme tesadüf blokları deneme desenine göre 4 tekerrürlü olarak tertiplenmiş olup her tekerrürde 5 bitkiye yer verilmiştir. Araştırmada en yüksek tohum verimi (79.08 g) üzerinde 11 meyve tutturulan uygulamadan elde edilirken, bitki üzerinde tutturulan meyve sayısı arttıkça, meyvenin çapı, boyu ve ağırlığı gibi değerlerle, çimlenme hızı ve gücü ile sürme hızının azaldığı ve farklı sayıdaki meyve uygulamalarının sürme gücüne etkisinin önemsiz olduğu anlaşılmıştır. Araştırma sonucunda, "Yaren" hibrit hıyar çeşidinin tohum üretiminde en yüksek kalitede tohum veriminin ana bitki üzerinde 6-8 arası tohumluk meyve bırakılan uygulamalardan elde edildiği belirtilmiştir.

Anahtar Kelimeler: Hibrit, hıyar, meyve sayısı, tohum verimi, tohum kalitesi.

Relationship Between Fruit Number and Seed Quality and Quantity in F_1 Cucumber (*Cucumis sativus* L.) Seed Production

Abstract

Cucumber (*Cucumis sativus* L.), is one of the most produced vegetables in the World. It can be produced both in open field conditions or in greenhouses. In greenhouses mostly hybrid varieties are grown. Seed quality is the main problem of the local hybrid varieties Viable and vigorous seed contributes greatly to yield between 15-20%. The objective of the research is to determine the ideal fruit number to be left on the female parent in order to produce high quality hybrid seeds and to provide some practical solutions for germination and seedling growth problems. This study was established in a greenhouse in Antalya ecological conditions and plant material of the research was "Yaren" hybrid variety also study was conducted with complete randomized blocks with four replications and five plants in each replicate. The results revealed that, highest seed yield (79.08 g) per plant was from a group of plants with 11 fruits. While as the number of fruits on a plant increased, fruit diameter (cm), fruit length (cm), fruit weight (g), germination rate, vigor and seedling growth rate were decreased. For Yaren F_1 seed production, the most suitable fruit number per plant was obtain as 6 to 8 fruits per plant which yielded higher seed yield with least losses on seed quality.

Key Words: Hybrid, cucumber, fruit number, seed quantity, seed quality.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most popular greenhouse vegetable, produced worldwide. It is a warm-season plant and grows rapidly at 24–29 ^{0}C temperatures. [1]. In Turkey, cucumber production is second after tomato production under greenhouse conditions [2]. While it is cultivated 1.741.878 tonnes on 63.000 ha area in Turkey, it is cultivated 65 million tonnes on 2.109.650 ha area in the World [3].

Most of the varieties grown in greenhouses are F_1 hybrids, produced by big seed companies. They vary somewhat in vigor, disease resistance, fruit size, and other fruit characteristics, such as color, ribbiness, neck length, and spininess [4]. Hybrid plants, resulted from crosses between two different varieties or inbreds. Hybrids are often superior over non-hybrid varieties in vigor, yield, uniformity, as well as in other characters. And this is the main reason for their agricultural value [5].

Poor establishment of hybrid seeds in the field was due to low seed quality is found in various crops. Viable and vigorous seed contributes greatly to yield between 15-20 percent [6]. Many researchers have been extensively worked on seed quality parameters [7, 8, 9]. Mixed seed quality leads to seedling growth that is not uniformly vigorous. Also, poor seedlings are susceptible to pathogens [10]. Seed quality depends on many factors such as mother plant nutrition, climate of seed production area, number of fruits per plant and number of seeds per fruit. It is required to know relationships between fruit number on seed quality and quantity in F_1 cucumber seed production for production of high quality seeds with better seed yield.

The objective of the current research was to determine the ideal fruit number to be left on the female parent in order to produce high quality hybrid seeds and provide some practical solutions for germination and seedling growth problems.

MATERIAL AND METHOD

Material

Cucumber plants were grown in greenhouses at the Bircan Seed Company operating in Antalya in south-western of Turkey, and laboratory tests were performed at Süleyman Demirel University, Faculty of Agriculture and Department of Horticulture, located in Isparta, Turkey. "Yaren" is a cucumber variety of the Bircan Co., and its parents' lines were used for experimental purposes.

Method

"Yaren" parent lines were crossed and 1 to 13 fruits were left on female parents. Quality and quantity of seeds produced by these fruits were tested in greenhouse trials designed with complete randomized blocks, with four replicates and five plants in each replicate. Standard cultivation practices were applied during the developmental period.

After male and female flowers developed enough, crossings were done early in the mornings. Subsequent to crossings, physiological maturation of the fruits takes 35 to 45 days [11]. Depending on fruit maturation, harvest continued for two weeks. The seeds were removed from the fruit by fermentation procedure, washed in water and dried on cardboard trays in the shade for 2 days.

The plant and fruit characteristics, fruit diameter (cm), fruit length (cm), fruit weight (g), seed yield per plant (g/plant), and the 1.000 seeds weight, were determined. After harvesting, the transversal cross-section and length of all fruits were measured. The weights of all fruits were also measured (with the scale accurate to 0.01 g). The seeds obtained from the fruits of one plant were used to calculate the yield per plant.

Germination rate and vigor tests which have been used to predict field emergence in various crops [12], were performed under laboratory conditions at room temperature using sand as a medium, and with four replicates each of which containing fifteen seeds.

According to ISTA rules [13] the percentage of emerged seedlings on the 4^{th} day gave the germination rate, whereas the total percentage of emerged seedlings on the 8^{th} day gave the vigor [14]. Seedling growth rate and vigor tests were also performed under laboratory conditions and using an incubator, at a stable temperature of 25 ± 0.5 ºC. As in the germination tests, the trial was designed with 4 replicates and with 15 seeds per replicate.

The seeds were sown between moist paper medium placed in petri dishes. According to ISTA rules [13] the number of seedlings on the 4^{th} day gave the seedling growth rate, while the number of seedlings on the 8^{th} day was the criterion for vigor [14]. The data obtained were subjected to Duncan's multiple comparison tests in the SPSS statistics program.

RESULTS

In the present research, the differences among fruit diameters obtained from the different treatments were significant at the 5% level. The maximum fruit diameter (3.65 cm) was obtained with 1 fruit per plant, whereas minimum fruit diameter (2.30 cm) was obtained from 12 fruits. Fruit length (31.3 cm) fruit weight (731.0 g) were maximum with 1 fruit per plant, while minimum length (18.63 cm) was noticed with 13 fruits and the minimum weight value (300.33 g) was with 10 fruits (Table 1). As fruit number increased, fruit diameter, fruit length and fruit weight decreased and found negative correlation. In addition, the differences between treatments for fruit weight and fruit length were significant at 5%.

Table 1. Effects of different numbers on fruit diameter, length and weight

Treatment	Fruit Diameter (cm)	Fruit Length (cm)	Fruit Weight (g)
With 1 fruit	3.65a*	31.33a*	731.00a*
With 2 fruits	3.40ab	29.30ab	682.00a
With 3 fruits	3.17bc	28.07bc	578.66b
With 4 fruits	3.14bc	27.56bc	549.66bc
With 5 fruits	3.07c	26.21cd	487.66c
With 6 fruits	2.80d	24.26de	403.33d
With 7 fruits	2.81d	23.82de	384.66de
With 8 fruits	2.81d	23.62de	349.66def
With 9 fruits	2.73d	22.68ef	365.33def
With 10 fruits	2.43ef	20.40fg	300.33f
With 11 fruits	2.61de	19.98fg	303.33f
With 12 fruits	2.30f	18.82g	354.00def
With 13 fruits	2.31f	18.63g	318.33ef
Average	2.86	24.21	446.77

*Means within a column that have a different small letter are significantly different from each other ($P < 0.05$).

The highest and lowest seed yields obtained from plants with 11 fruits and 1 fruit, respectively and were significantly different to each other. The weight of 1,000 seeds ranged from 31.83 g (10 fruits per plant) to 38.80 g, (3 fruits per plant) (Table 2.).

Table 2. Effects of different fruit numbers on yield per plant and weight of 1.000 seeds

Treatment	Seed Yield Per Plant (g)	Weight of 1000 Seeds (g)
With 1 fruit	5.29g	36.01abc
With 2 fruits	8.62g	38.31bc
With 3 fruits	16.48fg	38.80a*
With 4 fruits	25.25f	38.18bc
With 5 fruits	42.62e	34.10bc
With 6 fruits	50.71de	32.86c
With 7 fruits	57.70cd	32.90c
With 8 fruits	58.51bcd	32.18c
With 9 fruits	70.11abc	32.97c
With 10 fruits	72.90a*	31.83c
With 11 fruits	79.08a	32.92c
With 12 fruits	75.30a	32.10c
With 13 fruits	71.81ab	32.16c
Average	48.80	34.25

*Means within a column that have a different small letter are significantly different from each other ($P < 0.05$).

In this experiment, no abnormal seedling growth was observed and the highest germination and seedling growth rates were obtained from 2 fruits per plant, whereas the lowest value for seedling vigor was obtained from 13 fruits per plant. Plants with 1, 2, 3, 4 and 5 fruits showed the highest germination rate (100%) in this experiment. According to the current research, the effects of applications/treatments on germination, seedling growth and seedling vigor were significant ($p<0.05$); however, the effect on germination vigor was not significant ($p< 0.05$) (Table 3.).

The Pearson correlation coefficients between the parameters were also determined, and the correlations between fruit diameter × fruit length, and fruit diameter × fruit weight, were significant at the 1% level (Table 4). In contrast, there was a negative correlation between fruit diameter and seed yield.

There was a positive correlation between fruit diameter and the weight of 1.000 seeds. Thus, as fruit diameter increased, the weight of 1.000 seeds increased. However, the correlation between seed yield per plant and the weight of 1.000 seeds was negative (Table 4). Fruit diameter, length, weight and the weight of 1.000 seeds were positively correlated with germination rate, seedling growth rate and seedling vigor; conversely, germination rate, seedling growth rate and seedling vigor were negatively correlated with seed yield per plant (Table 5).

Table 3. Effects of different fruit numbers on germination and seedling parameters.

Treatment	Seedling growth rate (%)	Seedling vigor (%)	Germination Rate (%)	Germination Vigor (%)
With 1 fruit	68.33b	100	56.67abcd	100a*
With 2 fruits	88.3a*	100	65.00a	100a
With 3 fruits	80.0ab	100	63.33ab	100a
With 4 fruits	76.70ab	100	58.33abc	100a
With 5 fruits	76.70ab	100	55.00abcde	100a
With 6 fruits	76.70ab	100	55.00abcde	98.33a
With 7 fruits	66.70bc	98.33	53.33abcde	96.67ab
With 8 fruits	63.33bcd	98.33	48.33bcdef	95.00ab
With 9 fruits	50.00cd	96.66	45.00cdef	93.33ab
With 10 fruits	50.00cd	96.66	41.67def	93.33ab
With 11 fruits	48.33d	96.66	40.00ef	88.33bc
With 12 fruits	46.70d	96.66	40.00ef	83.33cd
With 13 fruits	45.00d	93.33	36.67f	78.33d
Average	64.13	98.2	50.67	94.33

*Means within a column that have a different small letter are significantly different from each other ($P < 0.05$).

Table 4. Pearson correlation coefficients

	Fruit Diameter	Fruit Length	Fruit Weight	Seed Yield Per Plant	Weight of 1000 Seeds
Fruit Diameter	-				
Fruit Length	0.932**	-			
Fruit Weight	0.905**	0.908**	-		
Seed Yield Per Plant	-0.898**	-0.897**	-0.918**	-	
Weight of 1000 Seeds	0.610**	0.668**	0.669**	-0.716**	-

**Means correlation is significantly important at 0.01 levels

Table 5. Pearson correlation coefficients between parameters.

	Seedling growth rate								
Seedling growth rate	-	Seedling vigor							
Seedling vigor	0.548**	-	Germination rate						
Germination rate	0.586**	0.413**	-	Germination vigor					
Germination vigor	0.610**	0.423**	0.718**	-	Fruit diameter				
Fruit diameter	0.635**	0.300	0.544**	0.605**	-	Fruit length			
Fruit length	0.649**	0.389*	0.529**	0.639**	0.932**	-	Fruit weight		
Fruit weight	0.639**	0.359*	0.490**	0.504**	0.905**	0.908**	-	Sd.yld.per Plt.	
Seed yield per plant	-0.681**	-0.363*	-0.549**	-0.506**	-0.898**	-0.897**	-0.918**	-	Weight of 1000 seeds
Weight of 1000 seeds	0.579**	0.301	0.365*	0.327*	0.610**	0.668**	0.669**	-0.716**	-

**Means correlation is significantly important at 0.01 levels
*Means correlation is significantly important at 0.05 levels

DISCUSSIONS

In the current study, fruit diameter and plant seed yield were negatively correlated (Table 4.). Therefore, as the diameter of fruit increased, seed yield decreased. Nevertheless, the weight of 1.000 seeds was higher in fruits with lower seed yield. Under normal nutritional conditions, as diameter increases, seed weight increases, too.

It was observed that, as seed size increased, seedling characters also improved. In other words, big seeds generally developed into good seedlings, and good seedlings produced high quality plants and high yield. Different *Leguminosae* and wheat plant seedling characters were observed and large seeds germinated faster than small seeds [15]. It has been stated that proper seed maturation is the most important factor in seed quality, germination and growth [16]. In addition, seed quality is affected by ecological and genetic factors [17]. Moreover, mother plants and their growth conditions also affect seed quality [18]. Bigger seeds have higher germination rates and seedling growth rates than smaller seeds [19]. Results obtained this experiment are consistent the cited results.

Fruit length × yield per plant were negatively correlated (Table 4.). Plants with 1, 2, 3, 4 and 5 fruits had high fruit lengths and their seed yield varied between 5.2 and 42.6 g; in contrast, plants with 11 fruits had a seed yield of 79.07 g. Seed number per fruit was similar across treatments (100 to 125 seeds/fruit), but seed size was the factor that changed. Fruit weight and yield per plant were negatively correlated. In a capsicum study, different numbers of fruits (control, 6, 8, 10 and 12 fruits) per plant were tested. The highest seed yield was obtained from the control group where the fruit number was unlimited [20]. In the current study, as fruit diameter increased, germination rate, and seedling growth rate and vigor values, also increased. Plants with 1, 2, 3 and 4 fruits had the highest fruit diameters and their seed germination rate and seedling growth rate values were found to be high.

In the present experiment, the first fruits on the mother plants had high quality seeds with respect to germination rate and vigor tests; however, fruits taken from the upper parts of the mother plant were of lower quality. In an eggplant study, researchers found that fruits taken from the 1st and 2nd nodes had higher seed dry matter, germination rate, vigor and weight of 1,000 seeds [21] Those results concur with the findings of the current study. Moreover, research with other plants such as carrot [22], pepper [23] and melon [24] has determined that seed quality depends on selection of the correct harvesting time.

CONCLUSIONS

Maximum seed yield will be achieved under practices that will promote the best comprise between a maximum fruit number with a minimum decrease in seed yield per fruit [25]. As a rule, if less fruits are left on plants, seed quality increases but seed quantity decreases. This would be disadvantageous for seed producers, so the correct balance has to be struck between seed quality and quantity by correctly manipulating the number of fruits on the plant. In the current research, as the number of fruits on the plant increased, fruit diameter (cm), fruit length (cm), fruit weight (g), germination rate, vigor and seedling growth decreased. However, for "Yaren" F_1 seed production, the most suitable fruit number was determined 6-8 fruits per plant which yielded higher seed yield with least losses on seed quality.

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