

The Characteristic of Different Cultivar of Okra (*Abelmoschus esculentus*) under the Plastic House Condition in Jeju Island

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Abstract. This study was conducted to develop method of producing okra in the plastic house and the 11 cultivar of okra were planted in plastic house for selecting proper cultivar in Korea. As result of observing growth, commercial cultivar germinated better than wild collected. The germination rate in 'No 1', 'No 4' and 'No 5' were better than in 'No 2' and 'No 3'. The plant height of 'No. 4', which is one of wild collected, showed biggest plant height moreover 'Greensode'. The numbers of node, which could indicate to set fruit, showed 4.2~6.5 per plant in most cultivar and 'No 2' and 'No 5' could yield more than others. 'Greensode' was planted in plastic house for finding out suitable planting method. The seeds were soaked could germinate 100% and those were taken 8 days for germinating but control seeds needed 15 days to germinate. The yield of 'Greensode' which was planted in 45 × 75 cm with planted 3 and 4 per hill could best produce in plastic house.

Key wards : *Abelmoschus esculentus*, okra, plastic house

Introduction

Okra is known as bhindi in Pakistan or Lady's finger, gumbo in England (Tindall, 1983). It's science name is *Abelmoschus esculentus* (L.) moench, belong to the family Malvaceae under the order Malavles. The genus *Abelmoschus* has been separated from the genus *Hibiscus*. It is one of the most important summer vegetable in all of the world. Okra is a seed propagated hot weather crop sensitive to frost, low temperature, water-logging as well as drought condition. It is grown in tropical and sub-tropical region and also in warmer parts of temperate region. okra grows well hot humid climate. Best plant growth and fruiting is observed at around 25°C average temperature with high relative humidity. Seed germination is fast at 30~35°C, but temperatures lower than 25°C slow down while above 42°C slow down plant and fruit growth (Dhankhar and Mishra, 2004). The immature fruits are cooked as vegetable. The fruits are fairly good in nutritive value and 100 g consumable portion contains 10.4 g dry matter, 31000 caloric energy, 1.8 g protein,

90 mg calcium, 1.0 mg iron, 0.1 mg carotene, 0.07 mg thiamin, 0.08 mg riboflavin and niacin and 18 mg vitamin C, with almost comparable constituents, barring few, in leaves (Grubben, 1977). Some countries are used as leafy vegetable. Dried fruit shell and stem are used in the manufacture of paper and cardboard. Dried seed kernels of Okra contain 13~22% edible oil and 20~24% edible protein and may be used as a substitute for edible oil. In Korea, Okra was introduced in 1973 that times there were no growers as commercials only for researching about sowing times, nitrogen fertilizer, and planting density. These days the Okra is considered as a very important vegetable because of its nutritive value. Okra is known to the infinite growth type plant if we harvest baby pods it could grow infinitely till it frosts.

In order to make value of pods farmers should reap regularly baby pods which grow 5~13 cm it needs 5~10 days after flowers.

The previous studies on okra in korea addressed only the yield of pods at the open field and did not changes in growth by prolongation of reaping pods in plastic house. This experiment was conducted to set the planting method for stable harvesting pod by prolongation of harvesting season in plastic house.

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Material and Method

The experiments were carried out at the National Institute of Herbal and Horticultural Science, National Agricultural Research for Climate Change, Jeju, Korea. The study was designed to select proper varieties and to investigate the effect of different planting distance for stable production of pods. Firstly, 11 different varieties i.e. Greensode, Veny, Marmirzang, Greenrocket, Betafive, Arifive, and 5 unknown named (which were provided from Agricultural Gene Bank in Korea) were planted and investigated germination rate, growth and fruits (baby pods stage) traits. Secondly, “Greensode” cultivar which was selected for growing in the plastic house which had not heating system was planted 45 × 75, 45 × 50, 45 × 25 cm and retaining 2, 3, 4 plant each hill. And the seeds of “Greensode” were sowed to test germination rate by different soaked time in 9, 18 hours and control. Every treatment plant was grown none of the subsequent branches.

Result and Discussion

The okra germplasm revealed different germination traits. The commercial cultivars like “Greensode”, “Veny”, “Marmirzang”, “Greenrocket”, “Betafive”, “Arifive” which were introduced from Japan could germinate better than others 5 okra which were offered by Agricultural Gene Bank of Korea in 10 days after sowed.

Commercial cultivar seeds germinated perfectly but No. 2 and No 3 varieties of okra germination ratio were 55.2 and 69.8% respectively, and No1, No, 4, No 5 varieties germination ratio showed 86.1, 86.5, 86.8% in 10 day after sowing. Hussain et al. (2006), who reported mean values for sowing dates revealed that maximum days to emergence of okra is 13.7 days, while minimum days to emergence of okra is 10.93 days after sowing. comparison for the mean of cultivars showed that maximum days to emergence of okra is 14.28 days while minimum days to emergence of okra is 10.89 days after sowing. Same result was also reported by Gadakh et al. (1990).

It might be due to the genetic characteristics of the different okra cultivar. In okra, plant height and number of node are very important to yield. Comparison of the vari-

Table 1. Comparison of germination rate in different cultivar of okra in the green house.

Varieties	Germination ratio (%)		
	3 days after sowed	7 days after sowed	10 days after sowed
Greensode	0.9 cd	100.0 a	100.0 a
Veny	5.2 a	80.6 d	99.0 a
Marmirzang	3.1 abcd	97.6 a	100.0 a
Greenrocket	0.7 d	92.0 abc	99.7 a
Betafive	0.0 d	92.4 abc	100.0 a
Arifive	2.4 abcd	94.1 ab	97.9 a
No. 1	0.7 d	69.4 e	86.1 b
No. 2	0.0 d	8.0 g	55.2 f
No. 3	1.7 bcd	38.5 f	69.8 c
No. 4	4.9 ab	88.9 bc	86.5 b
No. 5	4.2 abc	85.4 dc	86.8 b

*Sowing date: 2009. 3. 17.

*DMRT P = 0.05.

eties of okra growth characteristics showed that maximum plant height was 239.2 cm in No. 5 varieties while minimum plant height was 159.6 cm in “Arifive”. Comparison of stem diameter of okra varieties showed that maximum was 24.6 mm in Marmirzang, minimum was 14.1 mm in Arifive. Number of node, it is related with number of pods, showed that maximum was 44.3 in Number 5, minimum is 24.0 in No. 1. Kim et al. (1995) also recorded similar data while Hussain et al. showed plants height were 1.19~1.48 m. Lee et al. (1990) recorded plant height was 133.2~170.8 cm, number of leaf was

Table 2. Comparison of growth characteristics in different cultivar of okra in the plastic house.

Varieties	Plant height (cm)	Stem diameter (mm)	Number of node
Greensode	224.5 a	15.4 d	43.3 a
Veny	196.1 b	16.0 d	39.4 a
Marmirzang	221.8 a	20.9 b	39.3 a
Greenrocket	197.3 b	16.7 d	36.0 b
Betafive	167.3 c	14.2 e	30.7 c
Arifive	159.6 c	14.1 e	30.1 c
No. 1	165.8 c	14.0 e	24.0 d
No. 2	204.5 b	17.1 cd	32.8 c
No. 3	226.6 a	18.9 c	37.8 ab
No. 4	227.3 a	24.6 a	39.0 a
No. 5	239.2 a	20.4 b	44.3 a

*Planting time: 2009. 4. 7. Investigating time: 2009. 11. 10.

*DMRT P = 0.05.

Table 3. Comparison of pods characteristics and yields in different cultivar of okra.

Varieties	Pods weight (g)	Pods width (mm)	Pods length (mm)	Yields (kg/10a)	Goods ratio (%)
Greensode	16.1 a	18.6 bc	125.4 ab	11,451 a	93.0
Veny	11.1 c	16.6 cd	114.7 c	7,792 c	35.5
Marmirzang	12.4 bc	15.5 d	120.5 b	9,203 b	82.2
Greenrocket	9.5 cd	17.4 c	98.7 cd	8,474 bc	68.3
Betafive	11.9 c	17.6 c	107.7 c	7,489 c	73.4
Arifive	11.2 c	18.6 bc	104.8 c	7,024 c	60.0
No. 1	12.9 bc	17.0 c	131.0 a	5,015 d	9.3
No. 2	14.0 b	17.1 c	133.5 a	11,421 a	96.6
No. 3	12.8 bc	18.6 bc	130.3 a	8,961 bc	70.8
No. 4	14.2 b	19.4 b	130.0 a	9,670 b	64.3
No. 5	16.0 a	21.2 a	122.9 b	11,637 a	90.0

*Planting time: 2009. 4. 7. Investigating term: 2009. 06. 10~11. 10.

*DMRT P = 0.05.

13.6~17.0 at the open field. Kim et al. (1994) recorded plant height was 72~213 cm which had very big term between the varieties. The pods weight in okra varieties showed that maximum was 16.1 g in greensode and minimum was 9.5 g in Greenrocket. Pods size showed that pods width maximum was 21.2 mm in No. 5 and minimum was 15.5 mm in Marmirzang while pods length maximum was 133.5 mm in No. 2 and minimum was 98.7 in Greenrocket. The yields maximum was 11.637 kg/10a in No. 5 and minimum was 5,015 kg/10a in No.1 while goods ratio maximum was 93% in Greensode minimum was 9.3 in No. 1.

We wanted to know the condition of germinating okra seed that could increase germination rate for growing it. The result of treating different time of soaking seeds in the water velocity of germinating seeds in 18 hours soaked seeds better than 9 hours and control seeds. 18 hours treatment seeds could germinate 100% in 8 days after sowing that was faster 7 days than 9 hours soaked and control in the greenhouse which had been kept at 17~25°C. The optimal soil temperature for seed germination is about 24~32°C. Germination is poor at 20°C (Yamaguchi, 1983). At 25°C, okra requires 2~4 days for radicle emergence, while at 15°C, 7~9 days are required under controlled condition. Although not much different was observed in seed germination collected from different fruit positions at 25~35°C, a considerable reduction in the germinability was found at 15°C (Bhatt and Srivasa Rao, 1998). Enu and Nwalozie (1986) recorded the presowing soaking of seeds for 24 hours in water fol-

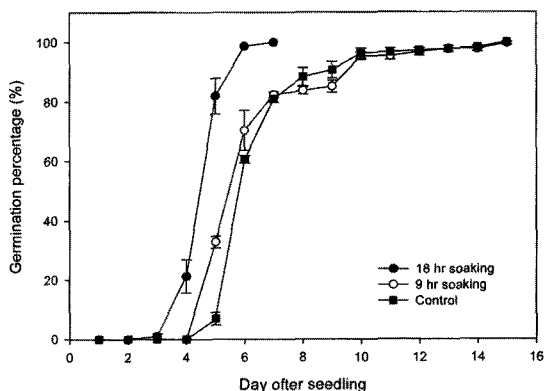


Fig. 1. Effect of various time of soaking seeds for germination before sowing.

lowed by air drying to 50% of its moisture content significantly enhanced germination, vegetative growth and yield.

The mean data recorded for different planting distant revealed that the maximum height was 217.9 cm by 45 × 75 cm planted distant with 2 plants per hill, whereas, the minimum height was 123 cm by 45 × 25 cm planted distant with 4 plants per hill, the maximum diameter of stem was 22.2 mm by 45 × 75 cm planted distant with 2 plants per hill, whereas, the minimum diameter of stem was 14.3 mm by 45 × 25 cm planted distant with 4 plants per hill and the maximum number of node was 63.5 by 45 × 75 cm planted distant with 2 plants per hill, whereas, the minimum number of node was 21.9 by 45 × 25 cm planted distant with 4 plants per hill.

Khan et al. (2009) recorded that okra is widely grown

Table 4. Comparison of growth trait as effected by planting distant of “Greensode”.

Planting distant (cm)	Number of plant standing per hill	Plant height (cm)	Diameter of stem (mm)	Number of node
45 × 75	2	217.9 a	22.2 a	63.5 a
	3	200.1 ab	19.5 b	59.7 ab
	4	193.1 b	18.1 b	50.1 b
45 × 50	2	187.4 a	17.5 a	52.6 a
	3	178.8 b	18.9 a	41.3 b
	4	164.0 c	18.1 a	40.1 b
45 × 25	2	175.7 a	17.1 a	45.0 a
	3	179.9 a	14.9 b	28.9 b
	4	123.3 b	14.3 b	21.9 b

*Planting time: 2009. 3. 12., Investigating term: 2009. 06. 10~11. 10.

*DMRT P = 0.05.

in many tropical areas and the okra grows to 183 cm in height in Sierra Leone. Some indigenous African varieties may grow to be 366 cm in height with a base stem of 10 cm in diameter.

The mean value of data recorded for different planting distant revealed that the maximum pods weight was 18.9 g by 45 × 75 cm planted distant with 2 plants per hill, whereas, the minimum height was 13.3 g by 45 × 25 cm planted distant with 5 plants per hill, the maximum pods width was 20.5 mm by 45 × 75 cm planted distant with 2 plants per hill and by 45 × 50 cm planted distant with 3 plants per hill, whereas, the minimum diameter of stem was 19.6 mm by 45 × 25 cm planted distant with 5 plants per hill, the maximum pods length

was 123.3 by 45 × 75 cm planted distant with 2 plants per hill, whereas, the minimum number of node was 107.0 by 45 × 50 cm planted distant with 4 plants per hill and the maximum pods yields was 13,148 kg/10a by 45 × 75 cm planted distant with 3 plants per hill, whereas, the minimum number of node was 6,214 kg/10a by 45 × 50 cm planted distant with 4 plants per hill.

Prabhakar et al. (2009) showed the yield potential of okra has been reported to be as high as 30~40 ton/ha or yield up to 0.4~0.5 kg per plant. Normally, 7 to 10 cm long fruits are considered appropriate for consumption and since fruit elongation starts soon after pollination end is very rapid, picking must be done regularly, 4 to 6 days after fruit set, to ensure good consumer quality (Akoroda, 1986; Singh et al., 1990; Iremiren et al., 1991). But the fruit in the plastic house can keep the soft flesh fruit length reach 10 to 14 cm long, and can grow more longer than the fruit of open field.

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Table 5. Comparison of pods yield and trait as effected by planting distant of “Greensode”.

Planting distant (cm)	Number of planted of one hole	Pods weight (g)	Pods width (mm)	Pods length (mm)	Yields (kg/10a)	Goods rate (%)
45 × 75	2	18.9 a	20.5	124.3	9,972 b	98.3
	3	17.0 b	20.3	120.1	13,148 a	97.8
	4	17.1 b	20.1	119.4	13,115 a	97.7
45 × 50	2	15.5 b	19.5	112.2	7,670 c	98.1
	3	18.0 a	20.5	123.4	8,289 b	98.1
	4	14.0 b	18.8	107.0	10,845 a	96.8
45 × 25	2	15.4 a	19.2	111.9	6,214 b	97.9
	3	15.4 a	19.1	114.3	6,928 a	96.0
	4	13.3 b	18.6	107.4	6,279 b	97.9

*Planting time: 2009. 3. 12., Investigating term: 2009. 06. 10~11. 10.

*DMRT P = 0.05.

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제주지역에서 오크라 무가온 재배에 따른 품종별 특성

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적 요. 본 실험은 무가온 하우스에서 오크라를 생산하기 위한 재배법을 개발하기 위해 11개의 품종에 대한 특성조사를 하였다. 또한 무가온 재배 시 적정 재식 밀도를 구명하기 위해 "Greensode" 품종의 발아조건과 재식간격을 구명하였다. 먼저 11개 품종의 특성을 조사한 결과 'No. 1', 'No. 4', 'No. 5'는 'No. 2', 'No. 3'에 비해 발아력이 다소 우수하였다. 생육은 No. 4의 초장이 109.2cm로 타 집단보다 길었다. 착과부위를 나타내는 마디수는 대부분 4.2~6.5개의 분포를 보였는데, 'Greenrocket' 품종의 마디수가 가장 많았다. 수량은 'Greensode', 'No. 2', 'No. 5'가 많았다. 또한 오크라 'Greensode' 육묘 재배 시 발아율 향상을 위하여 종자 침지 시간을 달리하여 시험한 결과, 18시간 종자 침지 처리구가 9시간 침지와 무침지 처리구에 비하여 발아속도가 우수하였다. 18시간 종자 침지 처리구의 100% 발아 시점이 파종 후 8일 재로 9시간 침지와 무처리구 보다 7일 가량 빨리 발아되었다. 오크라 'Greensode' 무가온 재배를 위한 적정 재식밀도를 구명하기 위해 재식간격, 구당주수 처리를 달리 하여 직파 재배하였다. 처리구 간 초장의 차이는 발생하지 않았으나 재식간격이 좁아질수록 경경이 작아지는 경향이 나타났다. 45 × 75cm 간격으로 파종하되 3~4주를 모아 심을 처리에서 수량이 가장 많아 무가온 재배에 적합했다.

주제어 : 무가온재배, 오크라, *Abelmoschus esculentus*