Korean J. Crop Sci. 46(1): 64~67(2001)

Determination of Seeding and Harvesting Time in Snap Bean

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ABSTRACT: Snap bean is a new corp in Korea but believed to have a great deal of potentials for both domestic and overseas markets. The present study was performed to obtain the basic information about growth- and quality-related characteristics and to determinate the optimum seeding date and harvesting time for snap bean. Pod yield was significantly affected by seeding date. The highest pod yield was obtained from March 20 for determinate type and April 4 for indeterminate one, respectively, with the range of 13.0-23.7 t/ha. The pod length of indeterminate type was over 13 cm, and the pod length was over 5 grams. The pod width for tested varieties was less than 1.0 cm. Considering the pod growth characters such as pod length, pod width, and pod weight, the optimum harvesting time for immature pods of snap bean was supposed to be from 15 to 20 days after flowering. The daily yield of snap bean was begun to sharply increase from 15 days after the first flowering and the maximum yield was recorded at 30 days after flowering. For the accumulated yield, nearly 90% of total yield was obtained in 42 days after flowering.

Keywords **:** snap bean, seeding date, optimum harvesting time, pod characteristics, vitamin C content, crude protein content

The eating quality of vegetables may be measured directly by subjective sensory methods or indirectly through chemical and physical measurements. Substantial effort has been extended to develop sound objective tests for the quality evaluation of feed in an effort to replace sensory evaluation (Martens, 1985). One of the most important indices of snap bean quality is maturity (Robinson *et al.*, 1963; Moss & Muirhead, 1983). Maturity has been described by seed index based on the product of seed weight by length and weight-to-length ratio (W/L) (Ramaswamy *et al*, 1980). Sisatrunk (1969) found that the chemical composition of snap beans changes rapidly with maturation. Sugar content in the seed is largely sucrose, which decrease rapidly after the 15th day from flowering.

Four clusters were obtained and named acceptability measures, objective measures, ascorbic acid, and appearance measures according to the variable within each group. Acceptability, mouth feel and flavor were the most important, objective measures while hue angle and moisture were the most important objective measures of post harvest quality (Resurreccion *et al.*, 1987).

The influence of the time of sowing on the yield and quality of the snap bean is not known of this area. The information is necessary so that cropping strategies can be defined which will allow economic production of snap beans over as long a period as possible. The purpose of this study was to fine out optimum seeding date and harvesting time based on the change of pod components after flowering in snap bean.

MATERIALS AND METHODS

Snap bean varieties used were four varieties, as shown in Table 1. They were planted 7 times from March 20 to June 18 with 15 days intervals; March 20, April 4, April 19, May 4, May 19, June 3, and June 18, in 2000. The seeds were directly planted in Kunwi experimental field of College of Agriculture, Kyungpook National University. Seeds were planted in 60 cm rows with 15 cm between hills and one seed per hill.

Fertilizers were applied at the level of 40-70-60 Kg/ha for N, P_2O_5, and K_2O, respectively, before planting. The experimental plot was laid out in a split plot design with two replications, varieties in main plot and seeding date in sub-plot.

The changes in major characteristics of immature pod such as pod length, pod width, pod weight, moisture content, crude protein contents, and crude fat content at different stages were determined. The moisture content of beans was determined by the difference in weight of 2 g sample before and after drying for 4~6 hours at 105~110°C. Vitamin C content was analyzed by 2,4-dinitrophenyl-hydrazine method, and total ascorbic acid content was calculated thereafter. After immature pod was dried at 70°C, the ends snipped, and crushed into a powder, crude protein was extracted by Kjeldahl method.

RESULTS AND DISCUSSION

Agronomic characteristics based on seeding date of snap bean

The agronomic characteristics of four varieties are shown in Table 2. The days to flowering were 43 for Gangnangkong 1, the earliest variety and 52 for KLG50026, the

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<Received February 26, 2001>

Table 1. Growth habit, flower color and hypocotyl color, and 100-seed weight of snap bean varieties used in this experiment.

Variety	Growth habit	Flower color	Hypocotyl color	100 seed[†] weight (g)
Gangnangkong 1	Determinate	Purple	Purple	24.0[a]
KLG50019	Determinate	White	White	16.3[c]
KLG50026	Indeterminate	White	White	13.2[d]
KLG50027	Indeterminate	White	White	20.3[b]

[†]Means followed by the same letter within a column are not significantly different at 5% probability level by Duncan's multiple range test.

Table 2. Agronomic characteristics of four snap bean varieties planted on May 5.

Variety	Days to flowering	Duration of flowering	Plant height (cm)	No. of branches	No. of nodes	Total no. of green pods per plant	Pod yield (t/ha)
Gangnangkong 1	43[c]	42[ab]	36.9[b]	3[b]	8[b]	27[a]	9.8[bc]
KLG50019	47[b]	47[ab]	45.4[b]	6[b]	9[b]	41[a]	7.6[c]
KLG50026	52[a]	39[b]	202.5[a]	20[a]	28[a]	36[a]	12.6[c]
KLG50027	48[b]	48[a]	258.3[a]	21[a]	28[a]	41[a]	20.7[ab]

Means followed by the same letter within a column are not significantly different at 5% probability level by Duncan's multiple range test.

latest one. Indeterminate type, KLG50026 and KLG 50027, was over 200 cm and determinate type, Gangnangkong 1 and KLG 50019, was less than 50 cm in plant height. Total number of green pods per plant was ranged from 27 to 41 and the green pod yields ranged from 7.6 to 20.7 t/ha.

Mean days of shortening by delaying of planting from March 20 to June 18 was 0.30, 0.50, 0.39, and 0.37 for days to emergence, days to flowering, duration of flowering, and days to green pod stage, respectively. The length of time required from seeding to harvest was variable according to the plant type of snap bean: determinate type needed less than indeterminate one.

Varietal differences in pod yield are shown in Table 4 . Pod yield was significantly affected by seeding date. The highest pod yield was obtained from March 20 for determinate type and April 4 for indeterminate one, respectively, with the range of 13.0~23.7 t/ha. The differences in pod yield of snap bean among different seeding dates were primarily due to differences in the number of pods per plant. Our results indicated that optimum seeding date of snap bean in this area would be late March or early April.

Optimum harvesting time of snap bean

In general, crop quality as foods is evaluated by nutritional value and morphological characteristics affected by days to maturity and days to flower, and chemical composition changed by these factors (Shin & Choi, 1996). More detailed data related with pods are shown in Table 5.

The length of pod of indeterminate type was over 13 cm with more than 5 gram of pod weight. The pod width for tested varieties was less than 1.0 cm. Much difference between determinate and indeterminate types was recognized.

Both pod length and pod width were reached to nearly full size around 20 days after flowering. The pod weight in snap bean was proportional to the days after flowering (Fig. 1). No great varietal difference in pod yield was recognized during the early pod development, up to 15 days after flowering, but Gangnangkong 1, KLG50026, and KLG50027 produced higher pod yield than KLG50019 during the optimum harvesting time, from 15 to 20 days after flowering, thus those three varieties were considered to be better ones than this one. Moisture content in pod was the most important factor for post harvest quality (Resurreccion *et al.*, 1987). Moisture content showed continuously decreasing trends from ten days after flowering.

Total vitamin C content of immature pods of snap bean was reversely proportional to days after flowering. Raw product of vitamine C content, dry weight basis, was 152 mg/100 g (Van Buren *et al.*, 1982). However, it was only 47 mg/100 g in fresh pod weight basis in this experiment. Chung & Hwang (1996) reported that vitamin C content in the seeds of vegetable soybeans followed similar trends to seed weight development, thus could be a criteria for the optimum harvesting time. In soybean sprout, the content of vitamin C increased rapidly for several days after germination and decreased thereafter (Park *et al.*, 1995).

Considering the above results of pod growth characters such as pod length, pod width, and pod weight, the optimum harvesting time for immature pods of snap bean was supposed to be from 15 to 20 days after flowering. Moon & Hwang (2000) reported that the optimum time for pod-edi-

Table 3. Major agronomic characteristics of snap bean varieties in different seeding date.

Variety	Seeding date	Duration of flowering	Days to green pod stage	Duration of harvesting	Times of harvesting	No. of accumulated pods per plant
Gangnangkong 1	March 20	86	88	35	10	41
	April 4	71	73	35	8	31
	April 19	60	63	49	13	35
	May 4	57	55	42	11	27
	May 19	60	52	44	14	25
	June 3	59	51	30	9	21
	June 18	50	46	23	7	12
	Mean	63	61.1	37	10	27
KLG50019	March 20	88	88	54	14	67
	April 4	76	73	65	18	55
	April 19	58	70	54	17	58
	May 4	64	61	47	14	41
	May 19	65	66	30	9	15
	June 3	56	53	26	7	16
	June 18	56	57	1	2	1
	Mean	66	66.7	39	11	36
KLG50026	March 20	79	95	55	17	43
	April 4	66	83	62	18	59
	April 19	57	76	47	17	42
	May 4	52	72	39	15	36
	May 19	46	70	30	9	14
	June 3	44	64	26	9	7
	June 18	36	75	7	3	1
	Mean	54	76.3	38	12	29
KLG50027	March 20	86	98	40	14	37
	April 4	71	85	40	13	46
	April 19	57	69	66	10	27
	May 4	48	63	48	13	38
	May 19	50	66	48	13	24
	June 3	45	61	21	9	15
	June 18	35	51	25	10	19
	Mean	56	70.1	41	12	28
LSD(5%) between means of variety		4.5	5.3	8.6	2.6	12.9
LSD(5%) between means of seeding dates within a variety		4.8	5.3	9.8	2.5	12.3

Table 4. Green pod yield of four snap bean varieties in different seeding dates.

Variety	Seeding date						
	March 20	April 4	April 19	May 4	May 19	June3	June18
	---------- t/ha ----------						
Gangnangkong 1	13.1^{a}	10.0^{bc}	11.7^{ab}	9.8^{bc}	7.8^{c}	7.5^{c}	3.5^{d}
KLG50019	17.7^{a}	13.1^{b}	12.9^{b}	7.6^{c}	4.9^{d}	2.9^{d}	0.2^{e}
KLG50026	21.9^{a}	23.7^{a}	10.4^{bc}	12.6^{b}	6.6^{cd}	3.0^{de}	0.3^{e}
KLG50027	14.6^{bc}	21.8^{a}	5.0^{de}	20.7^{ab}	11.4^{cd}	8.2^{cde}	1.9^{e}
LSD(5%) between varieties 5.9		2.0	4.3	8.1	4.3	3.8	0.8

Means followed by the same letter within a row are not significantly different at 5% probability level by Duncan'a multiple range test.

Table 5. The characteristics of green pod for snap bean varieties.

Variety	Pod color	Pod shape	Pod length (cm)	Pod width (cm)	Fresh weight per pod (g)
Gangnangkong 1	Light Green	Round	13.0[a]	0.8[a]	3.5[b]
KLG50019	Dark Green	Round	11.8[a]	0.8[a]	3.5[b]
KLG50026	Dark Green	Round	15.7[a]	1.0[a]	6.1[a]
KLG50027	Light Green	Oval	13.8[ab]	1.0[a]	5.9[a]

Means followed by the same letter within a column are not significantly different at 5% probability level by Duncan's multiple range test.

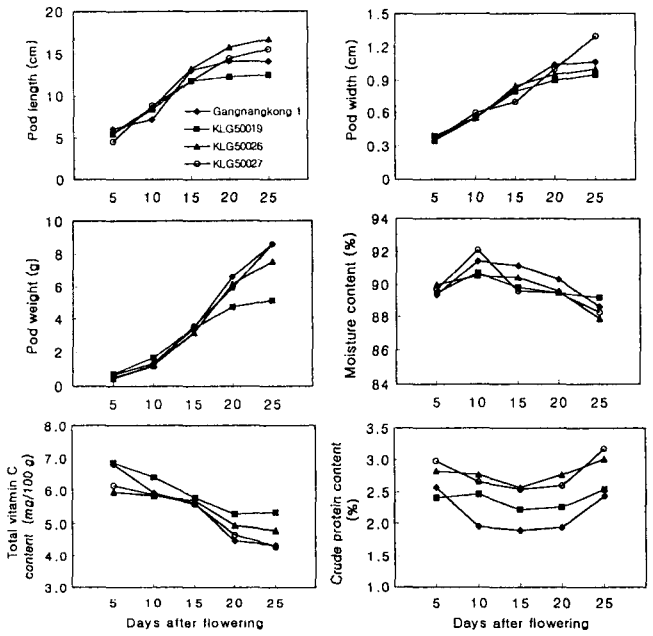

Fig. 1. Change in characteristics of green pod after flowering in snap bean varieties.

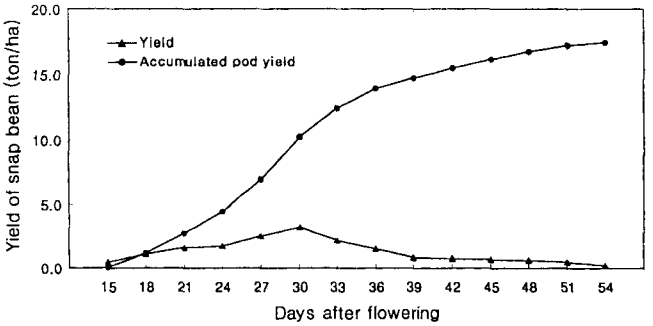

Fig. 2. Daily and accumulated green pod yield of snap beans.

ble peas was considered to be 10~15 days after flowering based on panel score.

The daily green pod yield after flowering of KLG50019, one of the varieties selected are shown in Fig. 2. The daily yield of snap bean began to increase from 15 days after flowering and the maximum yield was recorded 30 days after flowering. For the accumulated yield, nearly 90% of the total yield was obtained at 42 days after flowering.

ACKNOWLEDGMENTS

The authors thank the Research and Development Center for Agriculture and Forestry for its financial support.

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