

Growth and Optimum Harvesting Time of Pod-edible Peas (*Pisum sativum* L.)

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ABSTRACT: The present study was performed to obtain the basic information about growth and quality related characteristics and optimum harvesting time for pod-edible pea which is a new crop in Korea but believed to have a great deal of potentials for both domestic and overseas markets. They can be consumed either as a fresh succulent vegetable or as tender green pods. The daily green pod yield of pod-edible peas started to increase from ten days after flowering and the maximum yield was recorded on 26 days after flowering. Ninety percent of pod yields could be harvested from 16 to 36 days after flowering. Mean green pod yield for the tested varieties was approximately 8.0 t/ha. Total vitamin C content of pod-edible peas showed continuously decreasing trends from five days after flowering. The highest sucrose content was obtained at ten days after flowering. The highest panel score based on sweetness, chewiness, and hardness for the processed green pods was shown at 10~15 days after flowering in all varieties tested, indicating that the optimum harvesting time for pod-edible peas was considered to be 10~15 days after flowering.

Keywords : pod-edible pea, vitamin C content, sugar content, hardness.

Peas have various uses. They can be consumed either as a fresh succulent vegetable (green peas or unripe seeds) or as tender green pods (unripe pods) which lack the parchment layer on the inside of the pod, the latter are called sugar peas, snow peas or chinese peas (Amurrio, 1992; Wehner & Gritton, 1981; Wellensiek, 1925). Snap pea plants homozygous recessive for the *n* gene have pods with thick walls, while plants with the dominant allele have the normal, thin-walled pods. Lamprecht (1955) reported that *nn* plants had pod walls with larger parenchyma cells, and the walls were 1.3 to nearly 2 times as thick as those *N*-plants. He found that width and length of the pods of *nn* plants were 21.4 and 27.2% less, respectively, and that pod cross-section was circular rather than flat.

Fiberless trait in pods is controlled by two genes designated *p* and *v* (Vilmorin, 1910; White, 1917). Normal (*P-V-*) plants have sclerenchyma on the inside of the pod walls

which makes them unpalatable. The other three genotypes produce pods with reduced amounts of fiber. The genotype *ppV-* has sclerenchyma along only the pod wall sutures. *P-vv* types have small patches of fiber over the entire inner pod wall surface, and *ppvv* plants are fiberless (Wellensiek, 1925). Rasmusson (1927) presented photographs of dry pods to show differences in wall fiber content and fiber location in the 3 types of pods which he called parchmented (*P-V-*), semi-parchmented (*P-vv* or *ppV-*), and non-parchmented (*ppvv*).

The objective of this study was to obtain the basic information about growth and quality related characteristics and to determine optimum harvesting time of pod-edible pea which is somewhat new crop in Korea but believed to have a great deal of potentials for both domestic and overseas markets.

MATERIALS AND METHODS

Some of the characteristics of pod-edible pea varieties used in the experiment are shown in Table 1. Those varieties are the selected ones from the observational yield trials out of 100 introductions mainly from U.S.A. and Japan.

The seeds were directly planted in the experimental fields of the College of Agriculture, Kyungpook National University on March 10 with the planting density of 40 × 15 cm and one plant per hill. Fertilizers of 20-70-60 kg/ha for N, P₂O₅, and K₂O, respectively, were applied before planting. The experimental plot was laid out in a split plot design with two replications, varieties in main plot and fertilizers in sub-

Table 1. Some of the characteristics of pod-edible pea varieties used in the experiment.

Variety	Growth habit	Flower color	100-seed weight (g)	Seed shape
G49701	Determinate	Red	13.2	Wrinkled
G49702	Determinate	White	20.8	Dimple
G49703	Determinate	White	23.9	Dimple
G49704	Determinate	Red	16.4	Dimple
G49705	Determinate	Red	16.8	Wrinkled
G49706	Determinate	White	17.5	Round
G48707	Determinate	Red	23.0	Wrinkled

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plot. Agronomic characteristics of pod-edible peas and quality related characteristics such as pod length, pod weight, pod width, hardness, sucrose content, vitamin C content, and panel scores were measured.

After vitamin C content was analyzed by hydrazine method, total ascorbic acid content was calculated thereafter. Sucrose content was analyzed by HPLC (Water Co. Model 6002). Pod-edible peas were dried at 70°C and crushed into a powder. Crude oil was extracted by Soxhlet method and 0.5 g of powder was dissolved in 10 ml of distilled water. The solution was filtered by Whatman No. 2 and the remnant was centrifuged for 25 minutes at 12,000 rpm. The filtered solution was refiltered by 0.45 µm membrane filter for the final analysis. Crude fiber content was analyzed by A.O.A.C. method.

RESULTS AND DISCUSSION

Varietal evaluation based on agronomic characteristics

The agronomic characteristics of tested seven varieties which were preliminary selected out of 100 introductions are shown in Table 2. The days to flower was 51 for G49704, the earliest variety and 70 for G49707, the latest one. Much variation was observed in plant height though all were belonged to determinate plant types. The number of pods per plant was more or less than 20. The green pods could be harvested from 10 to 15 days after flowering and harvesting could be finished within 27 to 36 days depending on varieties, which were calculated as 97 and 105 days from planting to harvest for G49701, early variety and G49707, late one, respectively. Therefore, considering the fact that pod-edible peas can be planted at the early March, it can be cultivated successfully for the

Table 2. Agronomic characteristics of pod-edible pea varieties at 10 days after flowering.

Variety	Days to flower	Plant height (cm)	No. of branches	No. of nodes	No. of pods/plant	Duration [†] (Days)		Green pod yield (t/ha)
						A	B	
G49701	69 ^a	72 ^b	3.3 ^a	14.9 ^a	22.4 ^a	27	100	3.4 ^a
G49702	51 ^c	132 ^a	1.5 ^b	17.0 ^a	23.5 ^a	37	100	2.5 ^b
G49703	53 ^d	123 ^a	1.3 ^b	16.2 ^a	19.9 ^a	36	100	2.0 ^b
G49704	60 ^b	77 ^b	3.1 ^a	14.8 ^a	23.0 ^a	29	105	3.3 ^a
G49705	61 ^b	79 ^b	3.0 ^a	16.0 ^a	25.1 ^a	34	105	3.3 ^a
G49706	57 ^c	66 ^b	2.5 ^{ab}	15.3 ^a	21.2 ^a	30	105	2.6 ^{ab}
G49707	70 ^a	137 ^a	2.5 ^{ab}	17.6 ^a	18.9 ^a	25	101	2.7 ^{ab}

[†]A: duration of green pod harvest. B: days from planting to final harvest of green pods.

Means followed by the same letter within a column are not significantly different at 5% level by DMRT.

cropping before rice transplanting in the southern part of Korea.

The green pod yields ranged from 2.5 to 3.3 t/ha in the experimental plot tested. But the yield was far less than that of farmer's fields. In the experimental field, the plants were much damaged by labelling for checking flowering and pod harvesting. In the farmer's fields separately investigated from the experimental plot, the yields of green pods were approximately 8.0 t/ha.

More detailed data related with pods are shown in Table 3. The length of pods for G49701, G49704, G49705, and G49707 was over 6.0 cm and that for the rest of the varieties was more or less than 5.0 cm. Pod width for the tested varieties ranged from 1.10 to 1.60 cm with the range from 1.2 to 2.1 gr of pod weight.

The daily green pod yields after flowering of G49706, one of the best varieties selected are shown in Fig. 1. Pod harvest was begun at the time of seed filling inside pods, which was considered to be the optimum time for the best eating quality verified by preliminary tests. Yields began to increase from 10 days after flowering, reached to maximum on 26 days after flowering, and showed decreasing trends thereafter. As shown in the accumulated yields, about 90% of pods were harvested from 16 to 36 days after flowering and more than 97% of pods were harvested up to 41 days after flowering. In economical stand point, about one month of pod harvesting after flowering is recommended.

Optimum harvesting time of pod-edible peas

It is known that the most important factor in the production of pod-edible peas is to harvest the pods on time for the best eating quality. The results of evaluation on quality related characteristics are shown in Fig. 2. The pod yields increase up to 20 days after flowering; the later harvesting would bring the higher pod yields. Both pod length and pod width were reached to nearly full size at around 10 to 15

Table 3. The length, width, and weight of green pods for the pod-edible pea varieties.

Variety	Pod length (cm)	Pod width (cm)	Pod weight (g/pod)
G49701	6.75 ^a	1.35 ^{bc}	1.8 ^{bc}
G49702	5.48 ^{bc}	1.20 ^{cd}	1.5 ^d
G49703	4.90 ^c	1.10 ^d	1.4 ^d
G49704	6.75 ^a	1.43 ^{ab}	1.7 ^c
G49705	6.23 ^{ab}	1.25 ^{bcd}	2.0 ^{ab}
G49706	5.13 ^{bc}	1.28 ^{bc}	1.2 ^d
G49707	6.90 ^a	1.60 ^a	2.1 ^a

Means followed by the same letter within a column are not significantly different at 5% level by DMRT.

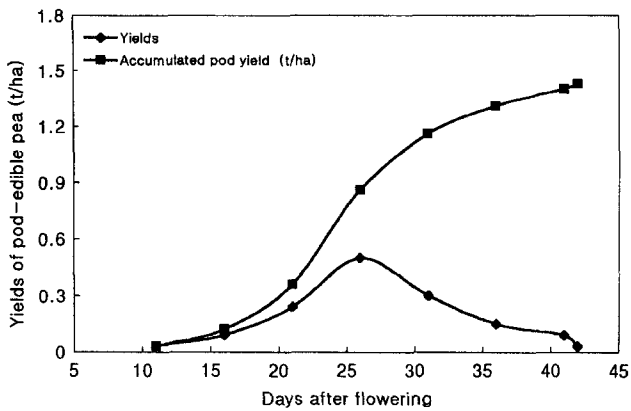


Fig. 1. Daily and accumulated green pod yields of pod-edible peas.

days after flowering regardless of varieties. Total vitamin C content showed continuous decreasing trends from the date of first observation was made, five days after flowering. Sucrose contents which determine the sweetness in the green pods (Tsou & Hong, 1991) increased up to ten days

after flowering and decreased thereafter in all three varieties. But the contents of crude fiber in the green pods showed not much variation in all harvesting dates although much variation was recognized among the varieties.

Chung & Hwang (1966) 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 but they found a great deal varietal differences in the content of sugars. In soybean sprout, the content of vitamin C increased rapidly for several days after germination and decreased thereafter (Park *et al.*, 1995).

In general, crop quality as foods is evaluated by nutritional value and morphological characteristics affected by days to maturity, days to flower, and chemical composition changed by these factors (Shin & Choi, 1996). Considering the above results related with pod related characteristics, the optimum harvesting time for pod-edible peas was supposed to be from 10 to 15 days after flowering. Some of the eating quality such as sweetness, chewiness, total score, and hardness for the green pods harvested at different days after flowering was evaluated as shown in Table 4. Regardless of varieties

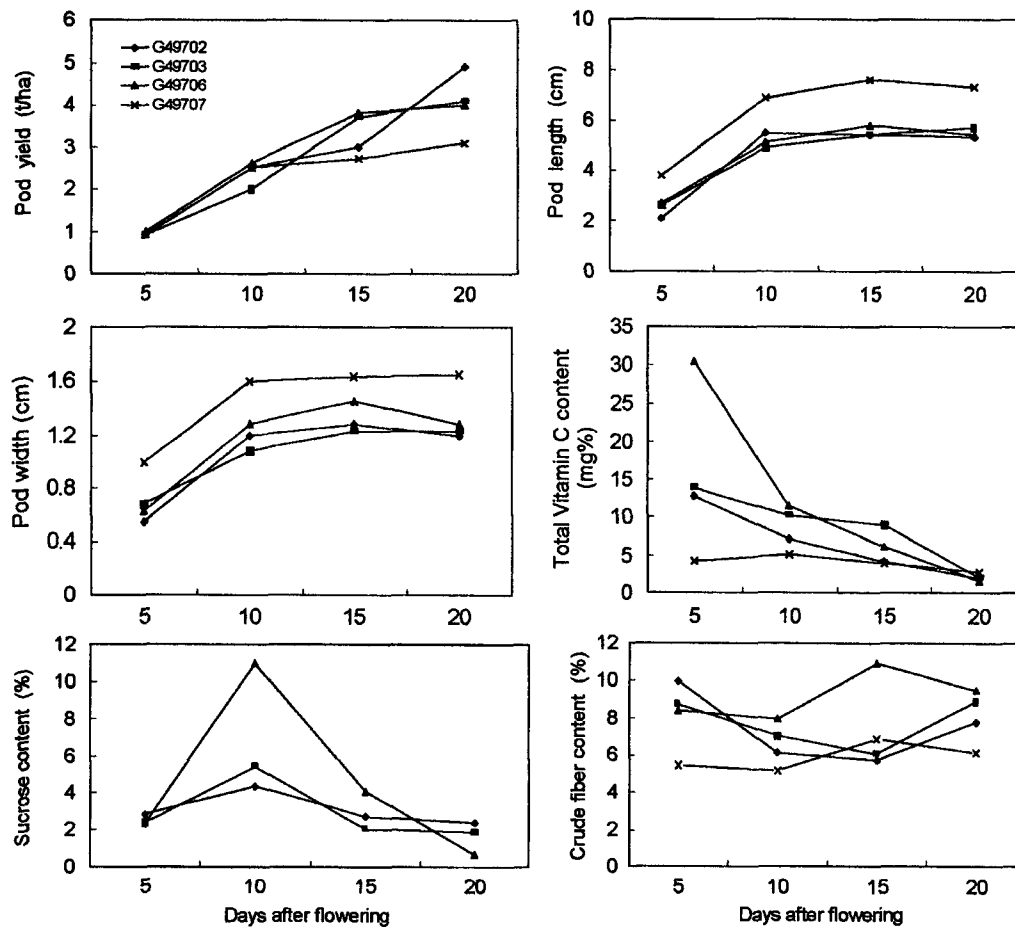


Fig. 2. Change in pod yield, length, width, vitamin C, sucrose content, and crude fiber content of pod-edible peas after flowering.

Table 4. Effect of harvesting time of pod-edible peas on panel scores and hardness for the processed green pods.

Variety	Days after flowering (DAF)	Panel test			Texture
		Sweetness	Chewiness	Total score	Hardness (kg/cm ³)
G49701	5	1.5	2.2	2.0	0.7
	10	2.3	2.9	2.3	1.2
	15	2.5	2.5	2.4	1.6
	20	2.2	2.2	2.3	2.0
	mean	2.1	2.4	2.3	1.3
G49702	5	2.0	2.3	2.2	0.7
	10	3.0	3.3	3.1	1.3
	15	3.1	2.7	3.0	1.6
	20	3.0	2.5	2.8	2.1
	mean	2.8	2.7	2.8	1.4
G49703	5	2.0	2.8	2.3	0.9
	10	2.5	2.9	2.7	1.4
	15	3.4	3.0	3.3	1.5
	20	2.5	2.3	2.8	2.0
	mean	2.6	2.8	2.8	1.4
G49704	5	1.7	2.5	2.0	0.8
	10	2.4	2.5	2.8	1.3
	15	2.2	2.0	2.3	1.8
	20	2.2	2.4	2.6	1.9
	mean	2.1	2.4	2.4	1.4
G49705	5	1.8	2.2	2.1	0.9
	10	2.4	2.4	2.2	1.3
	15	2.3	2.8	2.6	1.7
	20	1.7	1.9	1.9	2.0
	mean	2.1	2.3	2.2	1.5
G49706	5	1.5	2.2	1.7	0.7
	10	2.7	3.3	2.8	1.1
	15	3.3	2.9	3.2	1.6
	20	2.6	2.6	2.9	1.7
	mean	2.5	2.8	2.7	1.3
G49707	5	1.9	2.2	2.0	0.8
	10	2.6	2.8	2.6	1.3
	15	3.1	2.6	2.7	1.5
	20	2.1	2.1	2.0	2.1
	mean	2.4	2.4	2.3	1.4
Mean	5	1.8	2.3	2.0	0.8
	10	2.6	2.9	2.6	1.3
	15	2.8	2.6	2.8	1.6
	20	2.3	2.3	2.5	2.0
LSD (5%): Bet. means of varieties		0.4	0.5	0.5	0.2
Bet. means of DAF within a variety		0.3	0.3	0.3	0.1

tested, panel scores for sweetness, chewiness, and total scores of the green pods were the highest for those harvested at 10~15 days after flowering. The hardness which is the most important physical factor (Masuda, 1991) increases with days after flowering.

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