

Characteristics of Seed and Plant Growth in Local Collections of *Agastache rugosa*

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ABSTRACT

Characteristics of seed and plant growth of the nine local collections of the medicinal plant, *Agastache rugosa* were evaluated. Seed size of the collection from Garyungsan was larger than the others. Seeds of Damyang collection were the smallest in size. Seeds of the collections were mostly oval shaped. There were no differences between brown and black seed coat color groups in seed width, ratio of seed length to seed width and 1,000 seed weight. Stem lengths of Garyungsan and Bongpyung collections were 99.9 and 95.6 cm, respectively, and were longer than Damyang and Jindo collections. Garyungsan collection had long leaf shape. Leaf size was the smallest for Damyang collection, but was the largest for Bongpyung collection. Inflorescence length of Mokpo collection (15.6 cm) was longer than the average over all collections (12.3 cm). Damyang collection was the shortest (10.1 cm) in inflorescence. Top dry weight of each collection from Soonchun, Bongpyung, Mokpo, Jindo, and Gurye was greater than the average over all collections (20.38 g/plant). Jinju and Damyang collections had less top dry matter than others. There was no difference in the growth traits examined between brown and black seed coat groups. The brown seed group was greater in leaf weight than the black seed group. However, these two groups were not different in stem and inflorescence weight. Collections of *A. rugosa* from Bongpyung, Soonchun, and Mokpo were promising for commercial cultivation because of their great top dry weight, especially in leaf and inflorescence.

Key words : *Agastache rugosa*, local collections, seed characteristics, growth characteristics.

Agastache rugosa grows naturally in Korea and its essential oil has been used as a medicine (Jung & Shin, 1990). Essential oil content was reported as 0.29% (leaves) and 0.38% (inflorescence) (Lee et al, 1994). About 80% of the essential oil was composed of ethyl chavicol (estragole). Limonene, anethol and anisaldehyde were also detected (Ahn & Yang, 1991; Lee et al, 1994). Estragole has been used for perfume, sweet flavors, dressing and reducing agent of unpleasant meat flavor. Therefore, there is a great interest in *A. rugosa* with abundant estragole and its commercial utilization. It is known that flavor synthesis is controlled by genetic background of the plants at the habitat (Hay & Waterman, 1993). Growth patterns and weights of leaf and inflorescence parts are very important for extraction of essential oil

from *A. rugosa* (Ahn & Yang, 1991; Lee et al, 1994).

In this study, we evaluated the external seed traits and plant growth in the locally collected accessions of *A. rugosa*.

MATERIALS AND METHODS

A total of nine accessions of *A. rugosa* were locally collected in Bongpyung of Kangwon-do, Garyungsan of Choongchungbuk-do, Jinju of Kyungsangnam-do, and Gure, Damyang, Mokpo, Soonchun, Jindo and Kwangyang of Chunlanam-do. Seed color, seed length and width were measured for external seed shape.

These accessions were planted on nursery after soaking in GA₃ solution for 24 hrs. Fifty-day-old seedlings were transplanted with 50×50 cm density in the College Experimental Farm, Seoul National University, Suwon. Experimental plots were layed out in randomized complete block design with two replications. Individual plants were tagged at flowering stage and examined for the growth characteristics such as stem length, length of the longest branch per plant, number of lateral branches per plant, leaf length and width, inflorescence length and top dry weight.

RESULTS AND DISCUSSION

Characteristics of seeds

Seeds of the whole collections were oval shaped and covered with fine short hairs. They were classified into two color groups, i.e. black and brown seed groups (Table 1). The mean values of seed length, seed width and 1,000 seed weight in the nine collections were 10.64 mm and 284.4 mg, respectively. Seed size and 1,000 seed weight of Garyungsan collection were relatively greater than those of others. Seeds of Damyang collection were the smallest among collections. Seeds of Jindo collection were round oval shape but their 1,000 seed weight was greater than those of others. Seeds of Mokpo collection were the lowest in 1,000 seed weight among nine collections. Seeds of Gure collection had long oval shape.

Table 2 shows that there was no difference between the two seed color groups for seed width, ratio of seed length to seed width and 1,000 seed weight. However, the brown seed group was longer in seed length than the black seed

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Table 1. Seed size, seed color, and 1,000 seed weight of local collections of *Agastache rugosa*.

Collections	Seed coat color	Seed size			1,000 seed weight (mg)
		Length (mm)	Width (mm)	Length /width	
Bongpyung	brown	1.08bcd [†]	0.60cd	1.82ab	197.3d
Garyungsan	black	1.22a	0.75a	1.63bc	412.8a
Jinju	black	1.06bcd	0.64bc	1.70bc	285.6c
Soonchun	black	1.04cd	0.65bc	1.59c	310.0c
Mokpo	brown	1.12b	0.69b	1.64bc	188.6d
Damyang	black	0.94e	0.55d	1.71bc	215.8d
Jindo	brown	1.02d	0.65bc	1.59c	352.0b
Gurye	brown	1.10bc	0.58d	1.95a	313.2bc
Gwangyang	brown	1.05cd	0.65bc	1.62bc	280.7c
Mean	—	1.07	0.64	1.70	284.4

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

Table 2. Comparison of seed size between brown and black seed coat groups of *A. rugosa*.

Seed coat color	Seed size			1,000 seed weight (mg)
	Length (mm)	Width (mm)	Length /width	
Brown	1.12	0.66	1.70	26.96
Black	1.06	0.64	1.66	29.90
LSD _{0.05}	0.05	0.03	0.07	4.96

Table 3. Flowering dates measured in Suwon for nine collections of *A. rugosa*.

Collections	Half blooming [†]	Full blooming [‡]	Days to anthesis [§]
Bongpyung	8/20 ~ 8/24	8/24 ~ 8/28	4 ~ 8
Garyungsan	8/16 ~ 8/20	9/ 1 ~ 9/ 5	16 ~ 20
Jinju	8/28 ~ 9/ 1	9/5 ~ 9/ 9	8 ~ 12
Soonchun	8/12 ~ 8/16	8/20 ~ 8/24	8 ~ 12
Mokpo	8/20 ~ 8/24	8/24 ~ 8/28	4 ~ 8
Damyang	8/24 ~ 8/28	9/ 1 ~ 9/ 5	8 ~ 12
Jindo	8/28 ~ 9/ 1	9/ 5 ~ 9/ 9	12 ~ 16
Gurye	8/12 ~ 8/16	9/ 1 ~ 9/ 5	20 ~ 24
Gwangyang	8/12 ~ 8/16	8/24 ~ 8/28	12 ~ 16

[†] : 40% flowering. [‡] : 80% flowering. [§] Difference between half and full blooming dates.

group.

Characteristics of Plant Growth

Half blooming when 40% of plant flowered was mid August to late August. Full blooming when more than 80% of plants flowered was late August to early September (Table 3). The difference between half and full blooming dates, defined as the days to anthesis in this study, was 10~14 days. Collections from Kwangyang, Gurye and Soonchun showed earlier blooming than those from Jinju and Jindo. Days to anthesis were shorter in the collections of Bongpyung and Mokpo than those from Garyungsan and Gurye.

As shown in Table 4, average stem length over all collections was 88.9 cm. Mean stem lengths of the collections from Garyungsan and Bongpyung were 99.9 and 95.6 cm, respectively, and were longer than those from Damyang and Jindo. Average lateral branch length over all collections was 51 cm. Mokpo and Jindo collections had shorter branch length than others. The number of branches per plant were different among collections. Damyang and Mokpo collections had more branches than those from Soonchun. Average leaf length over all collections was 9.8 cm and there was no difference among collections except Damyang which had the shortest leaf length. Collections, however, had greater variation in leaf width than in leaf length. Soonchun and

Table 4. Plant growth characteristics in nine collections of *A. rugosa* at anthesis.

Collections	Stem length (cm)	Lateral branch length (cm)	Lateral branch number	Leaf length (cm)	Leaf width (cm)	Inflorescence length (cm)	Top dry matter (g / plant)
Bongpyung	95.59ab [†])	57.42a	22.44cd	10.37a	7.16ab	13.57b	24.56a
Garyungsan	99.89a	51.23ab	23.50bcd	10.65a	6.00d	13.13b	19.56ab
Jinju	89.85b	52.63ab	23.20bcd	9.65ab	7.00ab	10.41de	17.68bc
Soonchun	91.17b	51.91ab	21.40d	9.84ab	7.38a	12.93b	22.98ab
Mokpo	89.97b	42.78b	25.57ab	10.18a	7.17ab	15.58a	23.00ab
Damyang	82.39c	55.34ab	28.40a	8.85c	6.79abc	10.01e	13.38c
Jindo	72.35d	44.71b	22.60bcd	9.89a	7.38a	11.10cde	20.59ab
Gurye	88.03bc	51.43ab	25.43bc	9.40ab	6.35cd	11.43cd	21.84ab
Gwangyang	90.50b	51.67ab	22.80bcd	9.41ab	6.65bc	12.27bc	19.81ab
Mean	88.86	51.01	23.93	9.80	6.88	12.27	20.38

[†] Means within column followed by same letters are not significantly different at 5% level by Duncan's multiple test.

Table 5. Comparison of growth characteristics between brown and black seed coat color groups.

Seed coat color	Stem length (cm)	Lateral branch length (cm)	Lateral branch number	Leaf length (cm)	Leaf width (cm)	Leaf length / leaf width	Inflorescence length (cm)
Brown	87.29	49.60	23.77	9.85	6.94	1.33	12.79
Black	90.83	52.78	22.73	9.75	6.79	1.55	11.63
LSD _{0.05}	12.92	7.32	2.13	0.93	0.79	0.32	0.80

Table 6. Comparison of top dry weight (g / plant) between brown and black seed coat color groups.

Seed coat color	Leaf	Stem	Inflorescence
Brown	10.67	7.37	4.10
Black	8.06	6.21	4.22
LSD _{0.05}	2.05	1.65	2.14

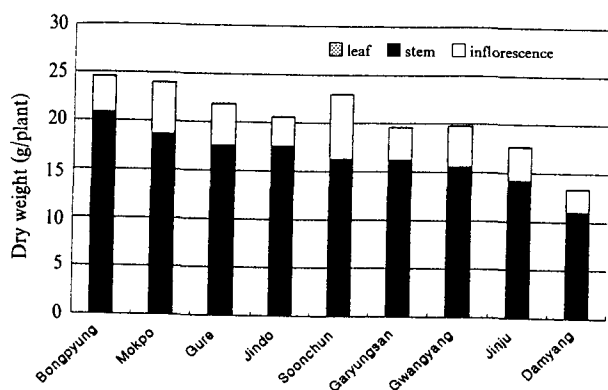


Fig. 1. Top dry weight (g / plant) of nine collections of *A. rugosa* at anthesis.

Jindo collections had wider leaves than Garyungsan col-

lection.

Inflorescence length of Mokpo collection was 15.6 cm and was longer than the average (12.3 cm) over all collections. Damyang collection had the shortest (10.1 cm) inflorescence length. Top dry weight of each collection from Soonchun, Bongpyung, Mokpo, Jindo, and Gurye was greater than the average (20.38 g/plant) over all collections. Jinju and Damyang collections had less top dry matter than others. Figure 1 shows the relative differences in dry weight for leaf, stem and inflorescence parts among collections. Both leaf or inflorescence weights of Bongpyung, Mokpo, and Soonchun collections were greater than those of the others and these traits are more important for essential oil extraction (Lee et al, 1994).

As shown in Table 5, the black seed group was relatively higher in stem length, lateral branch length, ratio of leaf length to width than the brown seed group. However, no significant differences between these two groups were observed for the growth traits except for inflorescence length. The brown seed group was greater in leaf weight than the black seed group. However, these two groups were not different in stem and inflorescence weight (Table 6).

It might be concluded that collections of *A. rugosa* from Bongpyung, Soonchun, and Mokpo were promising for commercial cultivation because of their great top dry weight, especially in leaf and inflorescence.

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