

Breeding of Korean Ginseng (*Panax ginseng* C. A. Meyer)

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ABSTRACT

A lot of individual ginseng plants were selected in the farmer's fields to develop new ginseng varieties with desirable traits. Among them, a promising lines have been developed through comparative cultivation of several lines selected with pure line separation of local races. It was then designated as "KG (denotes Korean Ginseng)" and tested in the regional yield and adaptation trials for 10 years. KG lines grew vigorously after 4 years of age. Especially, KG 102 line among them showed traits of multiple and short stems. As for the root characters, the length of taproot of KG 101 line was longer than that of local race, Jakyung-jong, or other lines and the root weight of KG 102 line was 15 % higher than that of local race. In general, KG 101, KG 103, KG 104, and Hwangsuk-jong had good root shape. Total amount of ginsenosides of ginseng taproot was the highest in KG 103 line than in local race and other lines. In these studies, we selected three superior lines, KG 101, KG 102, and KG 103, having characteristics of good root shape, high yield, and large amount of ginsenoside, respectively.

Introduction

Korean ginseng (*Panax ginseng* C.A. Meyer) is the only one of the economical crop in our country but the yield of high quality ginseng is low because of the difficulty in growth management and the lack of varietal differentiation. In contrast with most other crops in which a selection of variety is available depending on different geographic and environmental conditions, no variety in Korean ginseng, despite of its economic importance, has been developed yet in Korea and only the mixed native variety is available for commercial cultivation. Such a lack of varietal differentiation in Korean ginseng is mainly due to the long generation time and difficulty in growth management. For example, ginseng seeds can germinate only after about 5 months of dormancy period ; need about 17 months of nursery care before transplant ; and need additional three years for seed production. Whereas we have selected a lot of individual ginseng plants in the farmer's fields to develop a new ginseng varieties with good quality and high yield²⁻⁶⁾. Among them, a promising lines named KG (Korean Ginseng) have been developed through comparative cultivation of several lines selected with pure

line separation of local races in Korea Ginseng & Tobacco Research Institute. In the course of this experiment, the characteristics of growth and ginsenosides were clarified in promising lines of Korean ginseng.

Materials and Methods

The ginseng lines for this study were selected by the pure-line isolation method for four to five generations in Korea Ginseng & Tobacco Research Institute and tested in regional yield and adaptation trials for 10 years²⁻⁶). Characteristics of the aerial parts were measured for four-year old plants and root characters were investigated for the six-year old plants. The measurement was conducted for ten plants per replicate in three replicates. Six-year old roots were collected for ginsenoside analysis. Taproots were separated from five to seven roots with similar diameter, cut into pieces, dried in the shade for 24 hours and subsequently in the oven at 65 °C, and then pulverized. Analysis was conducted for 10 grams of powder in three replicates by the method reported by Ando *et al.*¹⁾ Ginsenoside pattern was obtained by HPLC.

Results and Discussion

Local race of Korean ginseng, Jakyung-jong, has a violet stem with red berry. On the other hand, KG 101 line has a green stem with light violet and orange-yellow fruit and flowers 3~7 days later than local race, Jakyung-jong. KG 102 line shows high frequency of multiple stem at above 3 years of age, KG 103 line has dark violet stem, KG 104 line shows early appearance, KG 105 line shows late appearance, and Hwangsuk-jong has green stem with yellow berry. The unique characteristics of each lines were expressed after 4-year old (Table 1).

Table 1. Characteristics of aerial parts in 4-year old superior lines of Korean ginseng (*Panax ginseng* C. A. Meyer)

Superior lines	Stem		No. of		Leaf	
	length (cm)	diameter (mm)	leaves	leaflets	length (cm)	width (mm)
Jakyung-jong	35.8	8.06	5.4	27.8	16.2	6.5
KG 101	40.4	9.74	5.1	25.5	16.1	6.2
KG 102	24.4	9.08	5.0	25.0	15.1	6.2
KG 103	34.1	10.00	5.2	26.0	17.9	7.4
KG 104	36.4	9.90	5.9	29.2	18.3	7.2
KG 105	34.8	9.28	5.4	26.8	14.7	7.1
Hwangsuk-jong	32.8	6.97	4.8	24.0	17.7	6.9
L.S.D.(0.05)	4.82	1.12	NS	2.35	1.85	NS

The stem diameters of KG lines were thicker than that in Jakyung-jong. Stem length of KG 102 was decreased to 24.4cm comparing with 35.8cm of Jakyung-jong. Leaf morphology of KG 103 and KG 104 were longer and wider than that of other lines. The characteristics of multiple stem^(a) were showed in 40~50 percent of KG 102 line, and did not affect on the total growth rate of aerial part.

Morphological characteristics of 6-year old roots in superior lines are presented in Table 2.

Table 2. Characteristics of 6-year old roots in superior lines of Korean ginseng (*Panax ginseng* C. A. Meyer)

Superior lines	Diameter taproot (cm)	Length of		Weight of root/plant (g)	No. of lateral roots
		taproot (cm)	root (cm)		
Jakyung-jong	3.1	5.3	27.1	98.0	3.1
KG 101	2.8	7.0	35.1	87.5	2.8
KG 102	3.3	5.5	28.8	112.4	3.3
KG 104	2.9	6.5	29.6	85.5	2.7
Hwangsuk-jong	2.6	6.7	30.7	104.3	2.9
L.S.D.(0.05)	0.35	0.71	NS	11.45	NS

The taproot diameter of KG 102 was 3.3cm, which was larger than other lines and Jakyung-jong. Taproot lengths of KG lines and Hwangsuk-jong were longer than that of Jakyung-jong. Especially, KG101 line had the longest taproot among KG lines. The quality of red ginseng is affected by inside cavity, inside white, cracking, and root shape. Among them, the quality of root shape is depending upon taproot length. In general, the quality of red ginseng have been evaluated excellently when the taproot is 7 to 10 cm in length. Therefore, it was found that KG 101 line had a superior root shape in this experiment. The root weight of KG 102 line was 112.4 g/plant, which was 15% higher than that of Jakyung-jong. In this experiment, it is suggested that KG 101 and KG 102 lines are good candidates for red ginseng and high yield varieties, respectively. Pharmacological active component of Korean ginseng is ginseng saponin. Ginseng saponin is called "ginsenoside", which is a combination of the words, ginseng and glycoside. It is known that Korean ginseng contains more than 30 kinds of ginsenosides. Figures 1 to 6 shows total amounts and patterns of major ginsenosides in 6-year old taproots of ginseng superior lines. Amounts of total ginsenoside in KG 101, KG 102, KG 103, KG 104, KG 105, and Hwangsuk-jong were 9.21 mg/g DW, 9.30 mg/g DW, 18.36 mg/g DW, 8.8 mg/g DW, 8.04 mg/g DW, and 8.96 mg/g DW, respectively (Figs.1-6). Especially, ginsenoside content of KG 103 line was two times higher than that of other lines. Ginsenosides Rb₁, Rf, and Rg₁ in KG 101, KG 102, KG 103, and KG 104 lines and ginsenoside Rb₂ in KG 103 and Hwangsuk-jong showed higher contents than those in other lines and Jakyung-jong (Figs.1-6).

In the contents of Rb₁ and Rg₁, KG lines contained more than Jakyung-jong and Hwangsuk-jong. In this experiment, we found that KG 103 line had the highest productivity of total ginsenoside.

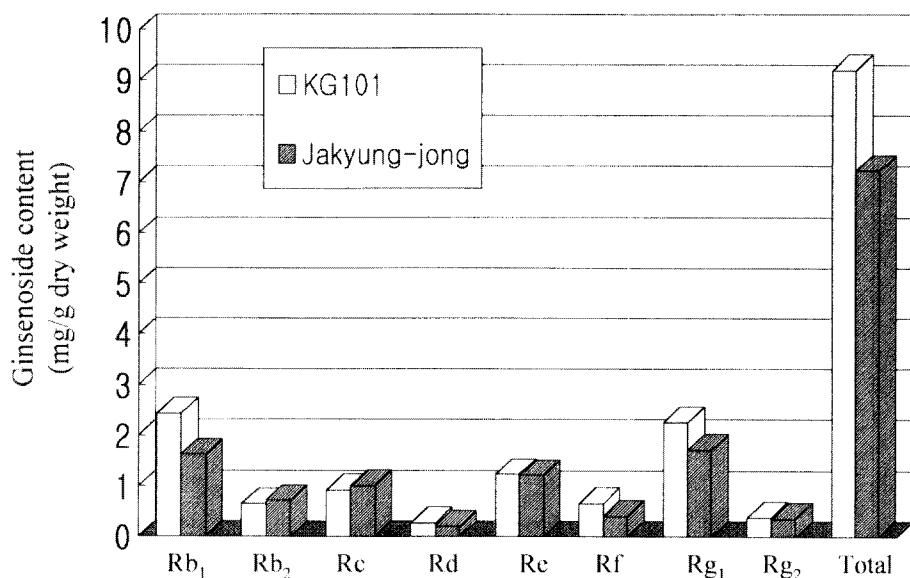


Fig. 1. Contents of ginsenosides of 6-year old taproots in KG101 line and Jakyung-jong of Korean ginseng (*Panax ginseng* C. A. Meyer).

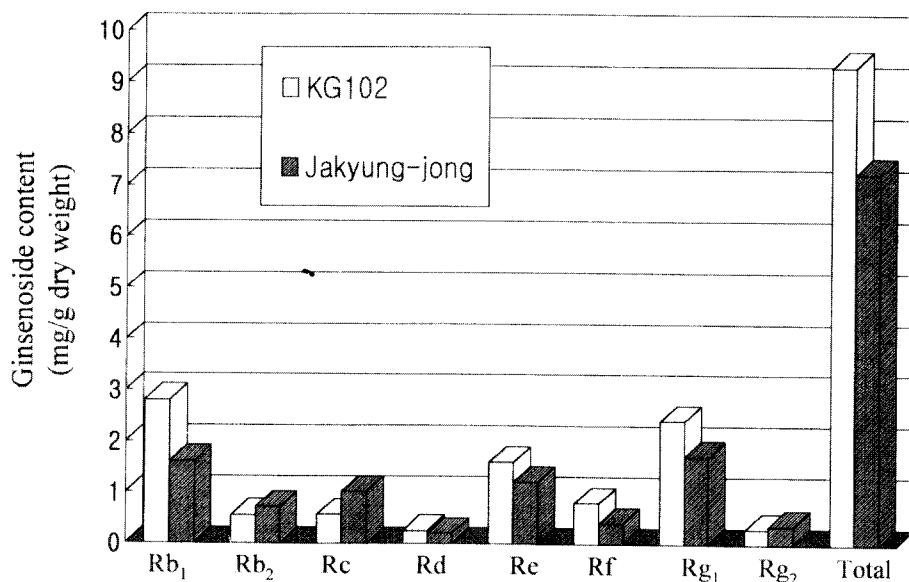


Fig. 2. Contents of ginsenosides of 6-year old taproots in KG102 line and Jagkyung-jong of Korean ginseng (*Panax ginseng* C. A. Meyer).

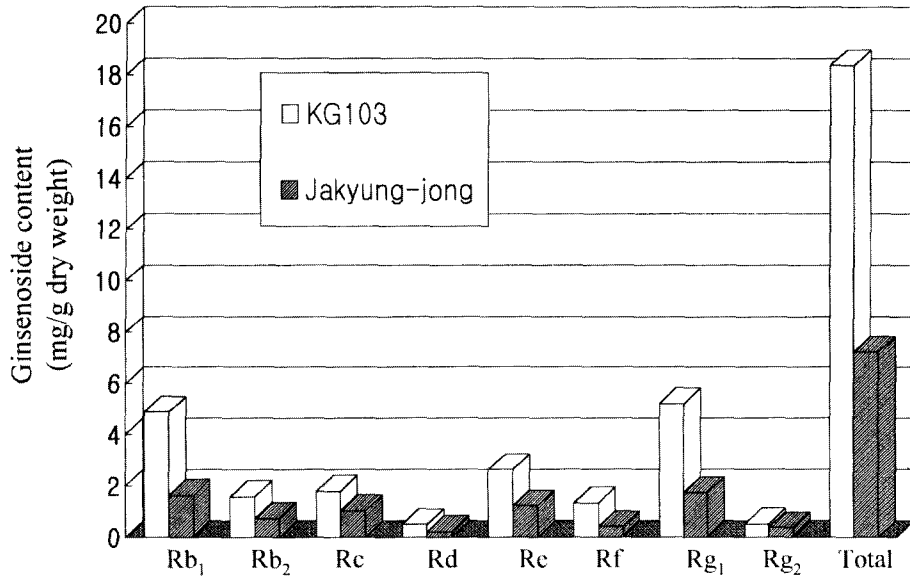


Fig. 3. Contents of ginsenosides of 6-year old taproots in KG103 line and Jakyung-jong of Korean ginseng (*Panax ginseng* C. A. Meyer).

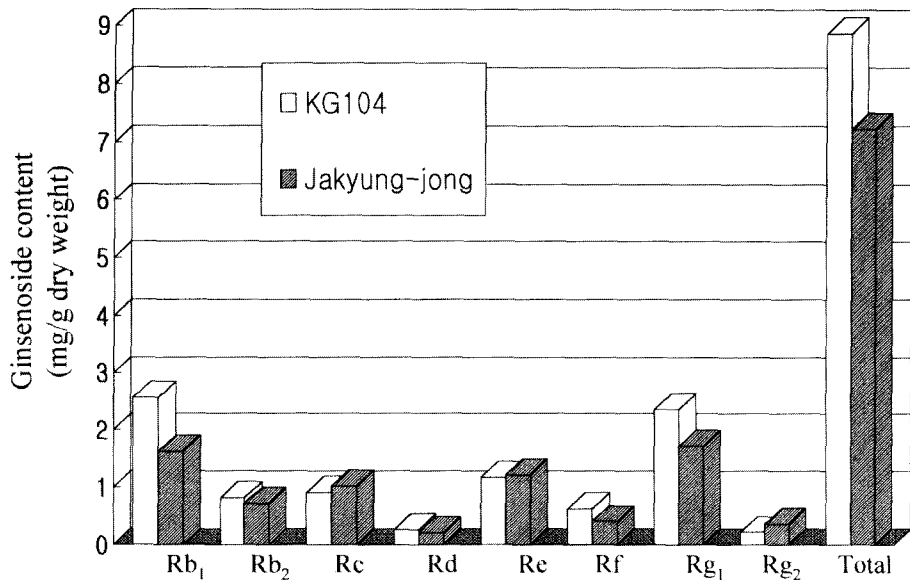


Fig. 4. Contents of ginsenosides of 6-year old taproots in KG104 line and Jakyung-jong of Korean ginseng (*Panax ginseng* C. A. Meyer).

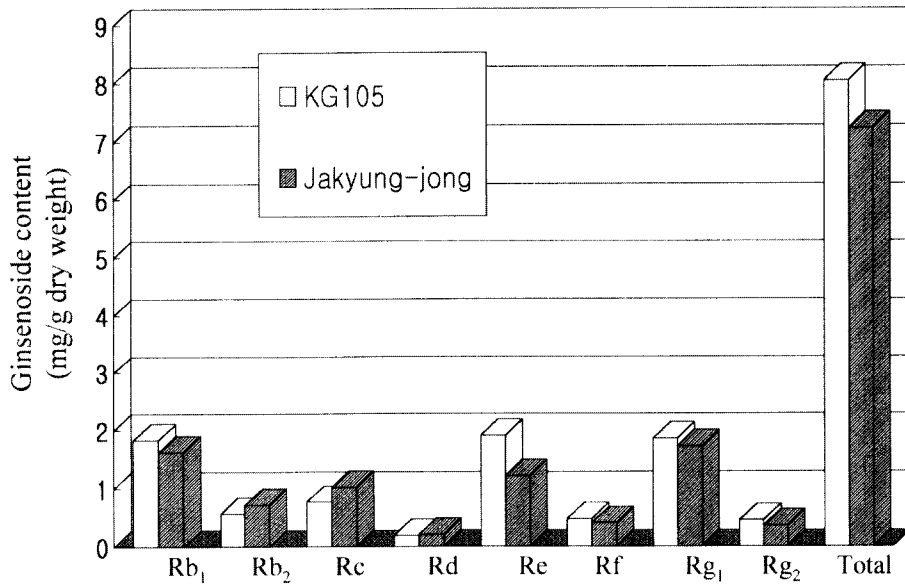


Fig. 5. Contents of ginsenosides of 6-year old taproots in KG105 line and Jakyung-jong of Korean ginseng (*Panax ginseng* C. A. Meyer).

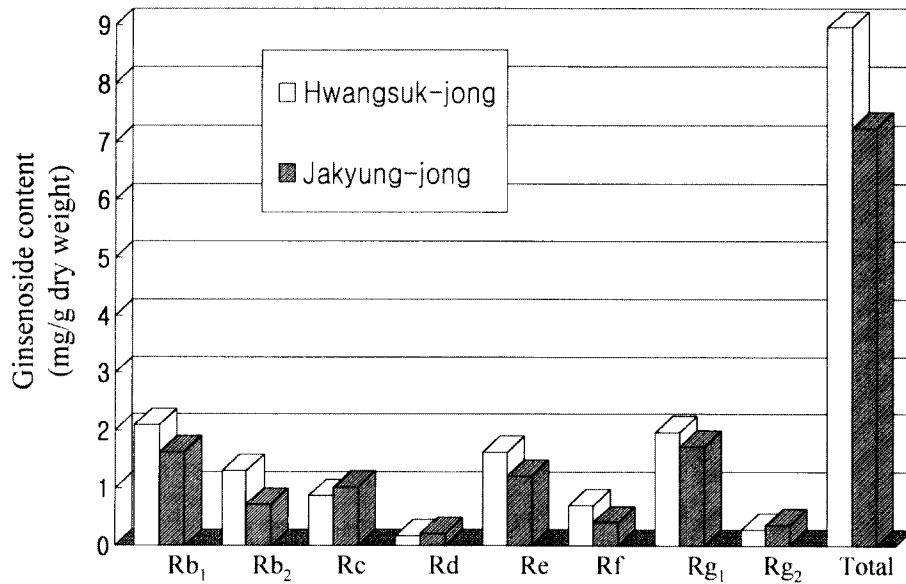


Fig. 6. Contents of ginsenosides of 6-year old taproots in Hwangsuk-jong and Jakyung-jong of Korean ginseng (*Panax ginseng* C. A. Meyer).

In conclusion, we selected three ginseng superior lines, KG 101, KG 102, and KG 103, having characteristics of superior root shape, high yield, and large amount of ginsenoside, respectively. These superior lines are to be bred for new ginseng varieties.

References

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