Korean J. Plant Res. 22(3) : 215~219 (2009)

Effect of Gamiojeoksan Remnants used as Fertilizer on Growth and Yield of Korean mint

Jaihyunk Ryu, Seongkyu Choi*, Kyeong Won Yun, Youngnam Seo[1], Kyoungsun Seo[2] and Hyunjin Kim

Department of Oriental Medicine Resources, Sunchon National University, Suncheon 540-742, Korea
[1]Kumkangdang Oriental Medicine Dispensary, Yeosu 550-200, Korea
[2]Shinhung pharmaceuticals Company, Yeosu 540-955, Korea

Abstract - In these experiments Gamiojeoksan remnant components were analyzed to recycle this medicinal herb remnant fertilizers. The basic growth of Korean mint by application of Gamiojeoksan remnants were higher than control. As the amount of fertilizers were increased, plant height, stem diameter, number of leaves and number of branches were increased. The growth and yield were the highest in the treatment of 30 g/pot. Weight of whole plant of Korean mint has a tendency to be heavy in application of herbs remnant than that of control.

Key words - Application, fertilizer, Gamiojeoksan remnant, growth character, Korean mint

Introduction

The oriental medicine has been used not only treatment for disease but also restorative (Choi *et al*., 2004).

In the past, the oriental medicine herb remnants were posed for little problem because the oriental medicines were packaged and boiled down personally. However, professional clinics for medical decoctions have opened recently. And the amount of herb remnants production has been increasing abruptly. Most herb remnants are disposed of landfills, river dumping or composting. So, the solutions to the problems are strongly demanded for the matter of the protection of environment (Jin and Park, 1997; Jin, 1999). Gamiojeoksan has been used for a sedative and treating stress origin disease.

Therefore, recycling of the remnants as fertilizer is required for protection of environment and it will make short period of plant growth. And we are sure that this method is able to increase the yield of medicinal plants that have high contents of useful components.

According to the Korean Herbal Pharmacopoeia, *Agastache rugosa* is the source of Korean mint (Korean Herbal Pharmacopoeia, 2007). *Pogostemon cablin* is listed in Korean Pharmacopoeia and Chinese Pharmacopoeia. It is different from *Agastache rugosa*.

The optimal sowing season of the *Agastache rugosa* is the end of March (Rural Development Administration, 2005). Ryu *et al*. (1998) reported that the optimal seed germination temperature is ranged 20 - 25℃, and the early growth was good at 30% shading, weight of whole plant is the heaviest in planting distance 15×15 cm (Choi and Seo, 2007).

Korean mint is used for various purposes including fresh vegetable, seasoned green, herbal tea and using the leaves and flowers.

Industrialized agriculture system dependent on large inputs of fertilizers and pesticides has generally the potential for maximum yield being inevitably associated with risks due to the instability of ecosystem (Bezdicek *et al*., 1984). But organic farmers do not use synthetic fertilizers and pesticides and attempt close nutrient cycle on their farms, protect the quality of environment, and enhance beneficial biological interactions and processes (Vandermer, 1995).

The purpose of this study was examined the effect of Gamiojeoksan remnant on the growth of Korean mint.

*Corresponding author. E-mail : skchoi@sunchon.ac.kr

Table 1. The composition of Gamiojeoksan

Prescription	Gamiojeoksan
Herbs	*Atractylodes japonica* *Plantago asiatica* *Pueraria lobata* *Astragalus membranaceus* *Pachymae fungus* *Inula helenium* *Agastache rugosa* *Glycyrrhiza uralensis* *Myristica fragrans* *Psoralea corylifolia* *Rosa laevigata* *Alisma canaliculatum* *Dioscorea japonica* *Dolichos lablab* *Amomum xanthioides* *Silver magnolia* *Zingiber officinale*

Materials and methods

Plant materials

The seeds of Korean mint were procured on October 2007 from the medicinal plant garden of Sunchon National University. The seeds were soaked in a tap water for 24 hours and then sowed in GP pot (Jiffy-7, Norway) on september 7th.

The GP pot as transplanted in experimental pot (20 cm diameter, 25 cm depth) within a week. The experimental pots were incubated at 20℃ for 6 month. The light intensity was maintained at 2,000 lux.

Gamiojeoksan remnant remnants used in experiments

The Gamiojeoksan remnant was procured from the *Kumgangdang* dispensary of oriental medicine in Yeosu on July 2007.

Sample analysis

Three samples were air dried and then the samples were taken from 5 parts. Those samples were dried at 105℃ in drying oven for 6 hours to measure water content, which was taken into consideration in the calculation of dry matter basis (A.O.A.C., 1990).

The content of nitrogen was measured by macro-Kjeldahl analysis procedure (Walinga *et al*, 1995).

The concentration of salt was measured by method of the association of official analytical chemists (A.O.A.C., 1990).

The analysis of component was performed using an atomic absorption spectrophotometer (AAS, Perkin Elmer Analyst 300, USA) and inductively coupled plasma (ICP, Agilent 8453, USA).

Experimental design and treatments

The Gamiojeoksan remnants were used for growth experiments of Korean mint. Experimental plots were layed out in randomized complete block design with nine replications (Ok and Chae, 1998). The amount of Gamiojeoksan remnants application used in the experiments were; 0, 10, 20, 30, 40, and 50 g. The composition of Gamiojeoksan remnants were shown in Table 1.

Items of investigation

Individual samples were tagged to examined for the growth characteristics such as stem length, branch length, the number of branches and the length and width of leaves. General cultural procedure and management such as weed control followed conventional culture methods for medicinal plants (R.D.A., 1995). All measurements for plant growth and yield were referred to standard measurement of R.D.A.(1989).

Results and discussion

Table 2. Physicochemical composition of Gamiojeoksan remnant (%)

Items	Moisture	Organic matter	Salt	Organic/Nitrogen	N	P	K
*Ga. R.	5.3±0.2	90.8±1.1	0.1±0.0	40.6±0.3	2.2±0.1	0.2±0.0	0.6±0.0
Official Fixture Standard	50(max)	25(min)	1.0(max)	50(max)	-	-	-

*Ga. R..: Gamiojeoksan remnant.

Table 3. Contents of heavy metal in Oriental medicine remnant (ppm)

Inorganic elements	As	Cr	Zn	Cu	Cd	Ni	Pb
*/Ga. R.	2.91±0.1	2.75±0.1	48.17±1.2	12.45±0.4	1.00±0.0	2.68±0.2	8.50±0.1
Official fixture standard	50(max)	300(max)	900(max)	300(max)	5(max)	50(max)	150(max)

*/ Ga. R..(Gamiojeoksan); kind of Herbs remnant.

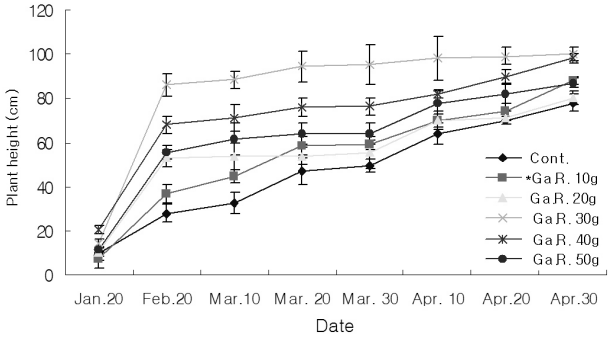

Fig. 1. Comparison of the plant height by application amount of Gamiojeoksan remnants
*Ga. R. : Gamiojeoksan

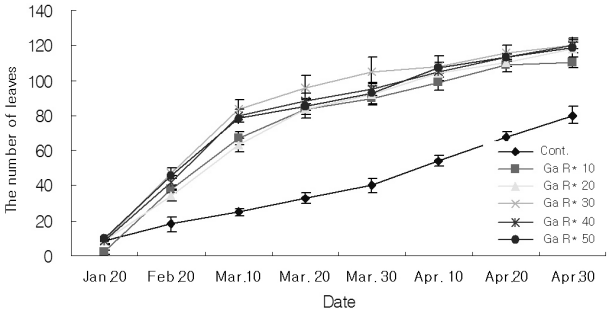

Fig. 2. Comparison of the number of leaves by application amount of Gamiojeoksan remnants
*Ga. R. : Gamiojeoksan

Composition of herbs remnant Proximate composition

Table 2 showed concentration of organic matter, salt, moisture, ratio of organic and nitrogen, phosphoric acid and potassium in Herbs remnant.

The organic matter content of the remnant was 90.8%. The salinity was 0.1%, this is too low to inhibit the growth of herbs.

Gamiojeoksan remnant has a high content of nitrogen, phosphoric acid and potassium. Nitrogen content of the remnant was 2.2%. The content of phosphoric acid and potassium was 0.2% and 0.6%, respectively.

The chemical composition of Gamiojeoksan remnant were similar to that of medicinal herbs for feeds (Jin, 1999).

The contents of heavy metals in the oriental medicine herb remnants were shown in Table 3.

The content of arsenic was 2.91 ppm too low to in inhibit herb growth. chromium was contained as 2.75 ppm.

The contents of zinc and copper were 48.17 ppm and 12.45 ppm, respectively. cadmium was contained as 1.0 ppm and nickel was contained as 2.68 ppm. The plumbum was contained as 8.50 ppm.

These results showed that these remnants were safe because the concentration of heavy metals was low. It was different with the effect of cadmium and leed on the growth of Salvia spendens (Chang *et al*., 1977; Kim and Park, 1992; Page *et al*, 1972).

The variation of Korean mint by an application of herbs remnant.

An application of Gamiojeoksan remnants were effective to the height of Korean mint (Fig. 1).

Effects on increased the plant height with applications of Gamiojeoksan remnants. But the application of 10 g and 20 g Gamiojeoksan remnant were not affect to height of Korean mint. The plant height with an application of 30 g Gamiojeoksan remnant was the highest among treatments.

In addition to, Choi (2007) has reported that the application of Sta-green and activated carbon was effective to growth of Korean mint. It was similar with an application of Gamiojeoksan remnants.

An application of Gamiojeoksan remnants were effective to the number of leaves in Korean mint (Fig. 2).

The application of Gamiojeoksan remnants had the effect to increased the number of leaves.

The vegetables were grown in three treatment combination plots and in conventional fertilizer plot with recommended levels of nitrogen, phosphorus and potassium. The leaf number were no significant in differences fertilizer levels (Kim *et al*.,

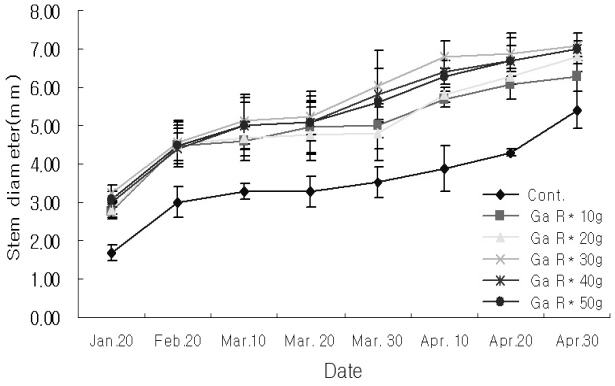

Fig. 3. Comparison of the stem diameter by application amount of Gamiojeoksan remnants.
*Ga. R. : Gamiojeoksan

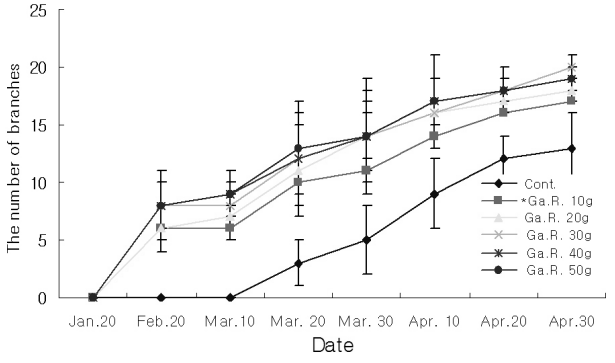

Fig. 4. Comparison of the number of branch by application amount of Gamiojeoksan remnants
*Ga. R. : Application of Gamiojeoksan remnants

2007). The application of oriental medicine herb remnants was effective to increase of leaves number.

The effect of Gamiojeoksan remnants on stem diameter is shown in Fig. 3.

The stem diameter with application of Gamiojeoksan remnants were in the order of 30 g/pot, 40 g/pot, 50 g/pot, 20 g/pot and 10 g.

Kim *et al*. (2000) reported that the treatment of undiluted waste nutrient solution had no effect on stem diameter. But Gamiojeoksan remnant are effective in growth of stem diameter.

The effect of Gamiojeoksan remnants on the number of branches were shown in Fig. 4.

The number of branches with application of Gamiojeoksan remnants is more than control. The most appropriate the number of branch with application of 30 g/pot Gamiojeoksan remnant.

Ohk *et al*. (2000) reported that the rate of nitrogen fertilizer

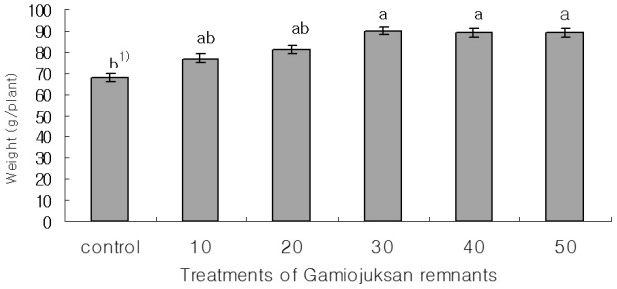

Fig. 5. Comparison of different application amount of Gamiojeoksan remnants on the whole plant weight of Korean mint
1) Values are significant for each groups at P<0.05 by Duncan's multiple range test

Table 4. The flowering time of Korean mint by remnants

Remnants / Blooming stage	Control	Ga. R.*30 g
Blooming begin	Feb.5	Feb.4
Blooming full	Feb.26	Feb.27
Blooming end	Mar.20	Mar.19

* Ga. R. : Application of Gamiojeoksan remnants

had more influenced on length and width of leaves and lateral branch length than other fertilizers on growth of Korean mint. The number of branch with application of Gamiojeoksan remnants were increased significantly in growth of Korean mint.

Variation of blooming

The effect of the application of Gamiojeoksan remnants on blooming season of Korean mint were shown in Table 4. The application of Gamiojeoksan remnants did not effect to blooming variation, regardless of treatments. However, the increased ionic strength of nutrient solutions were the most effective in flowering stage of plants (Chung *et al*., 1997; Hwang *et al*., 1997).

Weight of Korean mint

The effect on the application of Gamiojeoksan remnants on the weight of Korean mint at April 30th were shown in Fig. 5.

The weight of Korean mint with application of Gamiojeoksan remnants were heavier than control. Especially, weight of whole plant with application of 30 g/pot Gamiojeoksan remnant was the heaviest among the treatments.

In the test of cultivation in greenhouse the application of organic fertilizer and active carbon was effective on growth of Korean mint (Choi and Seo, 2007). And slow-release fertilizer

applied into the whole layer showed better rice growth and nitrogen use efficiency than conventional fertilizer (Park, 1993). The treatment of undiluted waste nutrient solution were effective in yield of vegetables (Kim *et al*., 2000).

According to these results it may be concluded that Gamiojeoksan remnants improve the growth of Korean mint. For the successful establishment of cultivation of plants, further studies are needed.

Literature Cited

A.O.A.C. 1990. Official Methods of Analysis. 15th. ed. Association of Official Analutical Chemists. Washington. DC.

Bezdicek, D.F., J.F. Power, D. R. Keeney, and M. J. Wright. 1984. Organic farming; Current technology and its role in a sustainable agriculture. American Society of Agronomy. Madison. WI. USA.

Chang, N.K. and C.S. Mok. 1977. Physiolosical studies of the vegetation on ore deposits. I. Zinc flora and indicator plants on the 2nd Yunwha Mine. Kor. J. Bot. 20: 45-72.

Choi, H.J., N.Y. Bang, B.W. Song, N.J. Kim and B.H. Ryu. 2004. Survey on the Preference for the Dosage Forms of Oriental Herbal Medicine. J. Kyung Hee Univ. Med. Cent. 20: 356-367.

Choi, S.K. and Y.N. Seo. 2007. Effect of sta-green and Activated Carbon on growth of *Agastache rugosa* in green house. Plant Resources society of Korea 20: 255-257.

Chung, S.J. and B.S. Lee. 1997. Effects of changes in ionic strength of nutrient solution by growth stage on growth and fruit yield of aeroponically grown tomato. J. Kor. Soc. Hort. Sci. 38: 633-637.

Hwang, I.T., J.K. Kim, S.K. Kim, W.S. Kim, and K.S. Kim. 1997. Effects of nutrient solution strength and irrigation frequency on rice hulled-media in gerbera. R.D.A. J. Agr. Sci. 39: 1-7.

Jin, S.K. 1999. Effect of the Used Medicinal Herb on Live Performance, Carcass Traits and Physicochemical Characteristics of the Fresh Meat in Cross-bred Finishing Pigs. J. Industrial Technology Res. Inst. 6: 289-286.

Jin, S.K. and G.B. Park. 1997. Effect of Feeding Used Medicinal Herbs on Carcass Characteristics of Finishing Pigs. J. Agric. Tech. Res. Inst. 10: 117-125.

Kim, B.W. and J.S. Park. 1992. Study on the Resistance of Various herbaceous Plants to the Effect of Heavy Metals. Kor. J. Ecol. 15: 433-449.

Kim, H.K., D.C. Seo, Y.H. Cheong, C.S. Kang, B.K. Sohn, D.J. Lee, J.G. Kang, M.S. Park, J.S. Kim and J.S. Cho. 2007. Effects of Different Humic Acids on Growth and Fruit Quality of Tomato Plant. Korean J. Environ. Agric. 26: 313-318.

Kim, J.G., K.B. Lee, D.B. Lee, S.B. Lee and S.J. Kim. 1998. Effect of Chicken Manure Compost Application on the Growth of Vegetables and Nutrients Utilization in Upland Soil. J. Korean Soc. Soil Sci. Fert. 31: 177-182.

Kim, J.H., T.J. Kim, H.H. Kim., H.D. Lee. J.W. Lee, C.H. Lee and K.Y. Paek. 2000. Growth and Development of 'Gutbier V-10 Amy' Poinsettia (*Euphorbia pulcherrima* Willd.) as Affected by Application of Waste Nutrient Solution. Kor. J. Hort. Sci. Technol. 18: 518-522.

Korea Food and Drug Administration. 2007. Korean Herbal Pharmacopoeia Shin-Il Publishing Company: 52.

Ohk, H.C., J.I. Song and Y.A. Chae. 2000. Effect of Forms and Levels of Nitrogen Fertilizer on Plant Growth and Essential Oil Content of *Agastache rugosa*. Kor. J. Crop Sci. 45 : 128-133.

Ok, H.C. and Y.A. Chae. 1998. Characteristics of Seed and Plant Growth in Local Collections of *Agastache rugosa*. Kor. J. Crop Sci. 43: 269-272.

Page, A.L., F.T. Bingham and C. Nelson. 1972. Cadmium absorption and growth of various plant species as by solution cadmium concentration. J. Environ. Quality 1: 288-291.

Park, K.B. 1993. Effects of the whole-layer application of slow-release fertilizer on growth and yield of rice. Kor. J. Crop Sci. 37: 499-505.

Rural Development Administration. 1989. Research investigation standard of agriculture(medicinal crop). Rural Development Administration: 5-8.

Rural Development Administration. 1995. Research investigation standard of agriculture. Rural Development Administration:. 583-585.

Rural Development Administration. 2005. A field of medical crop agriculture practical use data Korea-mint. Rural Development Administration : 72.

Ryu, J.H., W.J. Baek, S.Y. Choi and K. S. Lee. 1998. Studies on the Cultivation and Use of *Agastache rugosa* Kuntze. Bull. of the Agric. Col. Chonbuk National University 29: 70-79.

Vandermer, J. 1995. The ecological basis of alternative agriculture, Annu. Res. Ecol. Systematics 26: 703-707.

Walinga, I., J.J. van Lee, V.J.G. Houba, W. van Vark and I.

Novozamsky. 1995. Plant Analysis Manual. Kluwer Academic Publishers Dordecht Netherlands: 19-21.

(Received 5 March 2009 ; Accepted 4 June 2009)