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Effect of Sta-Green and Activated Carbon on Growth of *Agastache rugosa* in Green House

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Abstract - This study was conducted to investigate the effect of sta-green and activated carbon on leaf and stem growth of *Agastache rugosa* as it is affected by different amounts of sta-green and activated carbon. The results obtained are summarized as follows. Growth characteristics including plant height and leaf number were the highest when treated with 30% of sta-green. The weight of fresh leaf and stem of *Agastaches rugosa* was very low in control. Also, fresh weight of *Angelica acutiloba* was higher in 10% treatment of activated carbon. However, when the plants were grown in 10% activated carbon, all these promoters were the biggest. Sta-green and activated carbon can be utilized as a soil conditioner in agricultural crop areas.

Key words - Sta-green, Activated carbon, *Agastache rugosa*, Green house

Introduction

Agastaches rugosa species are suitable in herb gardens and mixed flower borders. They are so aromatic, that they are very attractive to pollinating insects and many aviaries plant *Agastaches* nearby to feed the bees with sweet pollen.

Agastaches rugosa species from China and Japan grows to 1.2m tall with branching stems that make it more shrubby than other species. The leaves are around 8cm long and rather sticky. The flower spikes are up to 10cm long with small pink or mauve flowers that have white lobes.

The latin name comes from the Greek: "aga" means "very much" and "stachys" means "ears of wheat." *Agastache* is a genus of mostly aromatic plants with small flowers in spikes.

A genus of 20 species of perennials are found in China, Japan, Korea and North America. Most species are very upright with stiff, angular stems clothed in toothed-edged, lance-shaped leaves from 1.2-15cm long depending on the species. Heights range from 45 cm-1.8m. Upright spikes of tubular, 2-lipped flowers develop at the stem tips in summer. the flower color is usually white, pink, mauve or purple with the bracts that back the flowers being of the same or a slightly contrasting color (Susan 2004).

Many studies on the soil conditioner have conducted to enhance yield and quality of agricultural crops, especially in Japan. In Korea, researches on the soil modifier for improving productivity in crops are increasing in the field of organic agriculture and soil science (Park, 1996).

Sta-green can be utilized as a soil conditioner in agricultural crop areas. Choi and Yang (2005) reported that treatment of sta-green around 45% improved the growth of medicinal plants.

The utility of activated carbon varies for multi-purposes in environmental and agricultural areas. Especially, it will be utilized as a multi-pore carbon absorbent for protecting environmental contamination and as a soil modifying material for improving soil physical property and sustainable nutrient sources, through mixing with it into soil (Park, 1996).

Recently, in Korea, 45,000 tons of activated carbon per a year is required for protecting environmental contamination and cleaning up water and air. However, the waste of activated carbon as a industrial abandon has increased every year (Park, 1996).

Choi and Park (2005) reported that treatment of 10% activated carbon improved the growth of medicinal plants.

Therefore, this study was conducted to determine feasibility of production system of *Agastaches rugosa* using sta-green and activated carbon in greenhouse.

Materials and Methods

Seeds of *Agastaches rugosa* as a native variety were harvested at the medicinal plant garden of Sunchon National University in July

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Table 1. Composition of soil sta-green

Guaranteed Analysis	Content (%)	Others
Total Nitrogen (N)	0.05	Ammoniacal Nitrogen 0.01% Nitrate Nitrogen 0.01% Urea Nitrogen 0.03%
Available Phosphate (P_2O_4)	0.03	Ammonium Phosphate
Soluble Potash (K_2O)	0.03	Potassium Nitrate

to August, 2006. After collection, the seeds were stored in a refrigerator at 4℃ for three weeks. The seeds were planted in pot (45cm × 45cm × 60cm) on 15th of October, 2006.

Sta-green treatment: At 2 weeks before transplanting, the pots were filled with 0, 10, 20, 30, 40 and 50% of sta-green. Stand soil mixtures of Peat Moss.

The soil sta-green includes N-P_2O_5-K_2O=0.05-0.03-0.03 (Table1)

Activated carbon treatment: At 2 weeks before transplanting, activated charcoal at 0, 5, 10, 15 and 20% were mixed with clay loam soil that sterilized with heat.

Five seeds per pot, collected in 2005, were planted onto pots, and three seedlings per pot were finally selected for the experiment. Harvest was made when the plant height reached 8~12cm. The weight of fresh shoot and root were measured.

All treatments were replicated five times using a randomized complete block design.

General cultural procedure and management such as weed control followed conventional culture methods for medicinal plants (Rural Development Administration, 1995). Also all measurements for plant growth and yield were referred to standard measurement of Rural Development Administration (RDA), Korea (RDA, 1989).

Results and Discussion

Germination of *Agastaches rugosa* was made on November first or third (2 weeks after sowing), showing 90~96% in germination rate. It has been generally accepted that *Agastaches rugosa* showed higher germination rate and short germination period.

Choi *et al.* (2004) reported that *Angelica acutiloba* showed higher germination rate and short germination period when faced with high soil temperature in the greenhouse.

Effect of sta-green treatment

The result on growth of *Agastaches rugosa* as affected by sta-green are shown in Table 2.

In control, plant height, number of leaves per plant, and fresh weight of *Agastaches rugosa* grown were 7.2cm, 5.9 and 22.3g, respectively. The fresh weight of leaf and stem fresh weight of *Agastaches rugosa* was very low in control. Plant height, number of leaves per plant, and fresh weight of *Agastaches rugosa* in sta-green treatment were 9.5~10.2cm, 6.3~7.0 and 26.4~30.2g, respectively. However, when the plants were grown in 30% sta-green treatment, all these promoters were the biggest.

The results show that leaf and stem growth of *Agastaches rugosa* can be improved by using sta-green. Choi and Yang (2005) reported that treatment of sta-green around 45% improved the growth of

Table 2. Effect of sta-green treatment on the growth of *Agastaches rugosa*

Treatment	Plant height (cm)	Number of leaf	Fresh weight per plant (g)
Conntrol	7.2b*	5.9a	22.3b
Sta-Green 10%	9.5a	6.3a	26.4ab
Sta-Green 20%	9.9a	6.4a	29.8a
Sta-Green 30%	10.2a	7.0a	30.2a
Sta-Green 40%	10.1a	6.9a	29.9a
Sta-Green 50%	10.0a	6.5a	30.0a

*Mean separation within column by Duncan's multiple range test, 5% level of significance.

Table 3. Effect of activated carbon on the growth of *Agastaches rugosa*

Treatment	Plant height (cm)	Number of leaf	Fresh weight per plant (g)
Control	7.3b*	5.8a	25.1b
Activated Carbon 5%	9.5a	6.4a	28.8a
Activated Carbon 10%	10.1a	6.9a	30.1a
Activated Carbon 15%	9.8a	6.6a	28.9a
Activated Carbon 20%	9.6a	6.7b	29.3a

*Mean separation within column by Duncan's multiple range test, 5% level of significance.

medicinal plants.

These results require further more detail studies on effects of treatment methods on growth responses of *Agastaches rugosa* as affected by different growing stages.

Effect of activated carbon treatment

Growth of *Agastaches rugosa* was affected by concentration of activated carbon. The result is shown Table 3.

Plant height, number of leaves per plant, and fresh weight of *Agastaches rugosa* grown in control were 7.3cm, 5.8 and 25.1g, respectively. In different activated carbon, plant height, number of leaves per plant, and fresh weight of *Agastaches rugosa* were 9.5～9.8cm, 6.4～6.9 and 28.8～30.1g, respectively.

Growth characteristics including plant height and leaf length were the highest when activated carbon added with 10%, suggesting that optimum amount of activated carbon was ranged from 10 to 15%.

Leaf and stem fresh weight of *Agastaches rugosa* was very low in control. And fresh weight of *Angelica acutiloba* was higher in 10% treatment of activated carbon. However, when the plants were grown in activated carbon 10%. The results show that activated carbon produce more growth of *Agastaches rugosa*.

Taking together, the results are supported by the report of Park (1996) who reported that optimized amount of activated carbon stimulate crop growth by improving soil physical characteristics. Choi *et al* (2002), in another study, reported that treatment of activated carbon around 20% improved the growth of medicinal plants, and exhibited differently depending on crop species.

This result supports the report that activated carbon treated with optimum amount significantly can stimulate crop growth (Park, 1996; Choi and Park, 2005).

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