Effect of Activated Carbon on Growth of *Agastache rugosa* in Greenhouse

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ABSTRACT

This study was conducted to investigate the effect of activated carbon on leaf and stem production of *Agastache rugosa* as affected by different amounts of activated carbon.

The results obtained are summarized as follows. 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 20%. Growth and enlargement of the root were improved by 10% AC. Activated carbon can be utilized as a soil conditioner in agricultural crop areas.

Key words : Activated carbon, *Agastache rugosa*, green house, leaf, production, stem

INTRODUCTION

Agastache is a genus of mostly aromatic plants with small flowers in spikes. A genus of some 20 species of perennials found in China, Japan, Korea and North America. The latin name comes from the Greek: "aga" meaning "very much" and "stachys" meaning "ears of wheat." They're suitable in herb gardens and mixed flower borders. Because they are so aromatic they are very attractive to pollinating insects and many aviaries plant *Agastaches nearby* to feed the bees with sweet pollen. 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 45cm-1.8m tall. 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). Species are easily grown in moist, well-drained soil and prefer a sunny position. hardiness varies, but most species will tolerate occasional frosts down to -7℃ propagate from seed or cuttings. They are very easy to start from seeds. Germinate them when the soil is between 55 and 64°F(13 and 18℃), or provide just a bit of bottom heat if started earlier in spring(Susan, 2004).

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Agastaches nearby species from China and japan grows to 1.2m toll with branching stems that make it more shrubby than most 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. 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 a increasing field in organic agriculture and soil science(Park, 1996). 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 a year is required for protecting environmental contamination and cleaning up water and air. However, the waste of activated carbon as a industrial abandon after using is increased every year (Park, 1996). Choi and Park(2005) reported that treatment of activated carbon around 10% improved the growth of medicinal plants.

Therefore, this study was conducted to determine feasibility of production system of *Agastaches nearby* leaf-stem using activated carbon in greenhouse. Also this study was conducted to develop recycling methods of the wasteful activated carbon for agricultural cropping system and industrial areas. It would be very useful as a soil-modifying material for enhancing crop productivity.

MATERIALS AND METHODS

Seeds of *Agastaches nearby* as a native variety were harvested at the medicinal plant garden of Sunchon National University in July to August, 2004. After collection, the seeds were stored in a refrigerator at 4℃ for three weeks. The seeds were planted in pot(Ø20㎝) in greenhouse of Missouri University Agronomy on 15th of October, 2004. The pots was filled with activated carbon of 0, 10, 20, 30 and 40%. Stand soil mixtures of Sta-Green and Peat Moss mixed with 50:50 ratio. The soil Sta-Green includes N-P_2O_5-K_2O=0.05-0.03-0.03. Five seeds per pot, collected in 2004, were planted onto pots, and three seedlings per pot were finally selected for the experiment. Harvest was made when the plant height reached 8°≠12 cm high. The shoot and root fresh weight of whole plants 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

Germination time and rate seed by activated carbon are shown in Table 1.

Germination of *Agastaches nearby* was made on November first or third (14days after sowing), showing 91~95% in germination rate. It is generally accepted that *Agastaches nearby* are higher germination rate and short germination period. Choi *et al.*(2004) reported that *Angelica acutiloba* is higher germination rate and short germination period when faced with high soil temperature in the greenhouse.

Growth characteristics and fresh weight of Agastaches rugosa

Table 1. Effect of activated carbon on the seed germination of *Agastaches nearby*

Treatment	Germination		
	first day	date	rate(%)
Control	Nov. 1	Nov. 5	93
Activated Charcoal 10%	Nov. 2	Nov. 5	91
Activated Charcoal 20%	Nov. 1	Nov. 4	92
Activated Charcoal 30%	Nov. 3	Nov. 5	94
Activated Charcoal 40%	Nov. 2	Nov. 5	95

Table 2. Effect of activated carbon on the growth of *Agastaches rugosa*

Treatment	Plant height (cm)	Number of leaf	Weight (g)
Control	8.3b*	5.1b	22.0b
Activated Charcoal 10%	9.8a	6.9a	28.8a
Activated Charcoal 20%	9.7a	6.8a	25.1ab
Activated Charcoal 30%	9.6a	5.8ab	22.9b
Activated Charcoal 40%	8.8ab	5.2b	23.3b

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

Growth of *Agastaches nearby* as affected by different activated carbon is shown Table 2. Plant height, number of leaves per plant, and fresh weight of *Agastaches nearby* grown in control were 8.3 cm, 5.1 and 22.0 g, respectively. In different activated carbon, plant height, number of leaves per plant, and fresh weight of *Agastaches nearby* were 8.8~9.8cm, 5.2~6.9 and 22.9~28.8g, 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 20%. Leaf and stem fresh weight of *Agastaches nearby* was very low in 40% treatment of activated carbon. 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 nearby*.

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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(Received Apr. 18, 2005)
(Accepted Jul. 27, 2005)