Effect of Activated Carbon on Growth of *Allium tuberosum* in Green House

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ABSTRACT

This study was conducted to investigate the effect of activated carbon on leave production of *Allium tuberosum*. Growth characteristics including plant height and leaf length were the highest when activated carbon was added with 5%, suggesting that optimum amount of activated carbon was ranged from 5 to 10%. Weight of fresh green vegetable in *Allium tuberosum* was low in control. And fresh weight of *Allium tuberosum* was higher in 5% treatment of activated carbon. However, when the plants were grown in activated carbon of 5 ~10%, fresh yield of green vegetable of *Allium tuberosum* can be increased by using Activated Carbon. Activated carbon can be utilized as a soil conditioner in agricultural crop areas.

Kew words : Activated carbon, *Allium tuberosum*, Chinese chives, green house, green vegetable.

INTRODUCTION

Allium is a large genus consisting of more than 700 species of bulbous perennials and biennials that occur in temperate regions of the northern hemisphere and range in height from 10 cm-1.5 m. Some species are edible, including onions, garlic and chives, the most ornamental species, which are brightly colored with beautiful flowers, mostly come from west and central Asia. Common to the genus is the oniony smell emitted when the leaves are bruised of cut (Yamaguchi, 1983).

Allium tuberosum is a member of the *Amaryllidaceae* (amaryllis) family.

Varieties usually listed as Chinese Chive or Garlic Chive. The common name, Chinese chives is most often used for *Allium tuberosum*, but it is also called oriental garlic, Chinese leek, garlic chives, or flowering leek. All parts of the plant have a mild garlic flavor like common chives, Chinese chives are mainly used as a fresh culinary herb.

Allium tuberosum Rottler ex Sprengel, syn. *A. odorum* (Chinese chives) have a long history of cultivation for culinary and medicinal use. Cultivated for centuries in India and China, this edible species is now widely grown throughout Asia as well as other parts of the world for its leaves, used as a green vegetable. Three horticultural products are derived from *Allium tuberosum*, the green and blanched leaves and the closed flower buds. In addition, the bulbs may be harvested and used like garlic (Harrington, 1984).

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This perennial plant grows in clumps and spreads by means of well-developed rhizomes. *Allium tuberosum* is a perennial plant 30 to 45 cm in height that grows in a clump of 4 to 10 bulbs, each producing 4 to 5 thin flat leaves. It is grown only a little in the USA, but extensively in China, where it is called "Kau tsai", in Japan, "Nira". Fragrant, star-shaped white flowers are borne from summer to fall. Although grown in the tropics, this species is fairly frost tolerant. Mature clumps are easily divided.

Allium tuberosum is a cool-season vegetable which flowers in the hot summer months. The plants live for many years, developing large spreading rhizomes. Also, it is suitable in herb gardens and mixed flower borders. Because it is so aromatic, it is very attractive to pollinating insects and many aviaries plant *Allium tuberosum* nearby to feed the bees with sweet pollen.

Allium tuberosum tolerates a wide range of climates and soils. 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. 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).

Allium tuberosum prefers cool climates or temperatures; production will be greatest in spring. Flowering occurs in the summer; most varieties will go dormant in hot weather. Growth will resume in the fall and be very slow during the winter. Chinese chives can be started from seeds, usually in late winter or early spring. Once started, with proper culture, they can remain productive for ten years or more.

The flat leaves are used like common chives, the flowers are also commonly eaten both have a garlic flavor. The leaves are often blanched. The bulbs can also be harvested and used. It has a long tradition of use in herbal medicine, for recovery from fatigue. Blanched *Allium tuberosum* are higher respiring and more perishable than the green leaves, and shelf-life is 5 days. Both green and blanched chives are packed in waxed boxes containing 5 to 10 kilos of product.

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 (2005a) reported that treatment of activated carbon around 10% improved the growth of medicinal plants.

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

MATERIALS AND METHODS

Seeds of *Allium tuberosum* 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 (Ø30㎝) in greenhouse of Missouri University Agronomy on 10th of October, 2004.

The pots were filled with activated carbon of 0, 5, 10, 15 and 20%. 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 (Table1).

Ten seeds per pot, collected in 2004, were planted

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 (P2O4)	0.03	Ammonium Phosphate
Soluble Potash (K2O)	0.03	Potassium Nitrate

onto pots, and five seedlings per pot were finally selected for the experiment. Harvest was made when the plant height reached 20∼25 cm high. The fresh leaf weight of plant was 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, and all measurements for plant growth and yield were referred to standard measurement of Rural Development Administration (RDA, 1989,1995).

RESULTS AND DISCUSSION

Germination rate of *Allium tuberosum* by activated carbon

Germination time and rate of *Allium tuberosum* seed by activated carbon are shown in Table 2.

Germination of *Allium tuberosum* was made on November forth or sixth (25days after sowing), showing 92∼94% in germination rate. It is generally accepted that *Allium tuberosum* are higher germination rate and short germination period. Choi *et al.* (2002) reported that *Angelica acutiloba* has higher germination rate and short germination period when faced with high soil temperature in the greenhouse. Also, Choi and Park (2005b) reported that *Zingiber officinale* is higher germination rate and short germination period when faced with high soil temperature in the greenhouse.

Growth and yield of *Allium tuberosum* by activated carbon

(1) Growth of *Allium tuberosum*

Growth of *Allium tuberosum* affected by different activated carbon is shown in Table 3.

Plant height, number of leaves per plant, plant width, clump of bulbs and number of root per plant of *Allium tuberosum* grown in control were 21.1 cm, 6.1, 3.3 mm, 4.1 and 10.0, respectively. In different activated carbon, plant height, number of leaves per plant, plant width, clump of bulbs and number of root per plant of *Allium tuberosum* were 26.8∼28.2 cm, 8.7∼9.1, 3.3∼3.9 mm, 4.3∼4.9 and 11.8∼13.8 g, respectively. Choi (2003) reported that the medicinal plants were grown in

Table 2. The Effect of activated carbon on the seed germination of *Allium tuberosum*.

Treatment	Germination		
	first day	date	rate (%)
Control	Nov. 5	Nov. 9	93
Activated Carbon 5%	Nov. 5	Nov. 8	93
Activated Carbon 10%	Nov. 4	Nov. 9	94
Activated Carbon 15%	Nov. 5	Nov. 8	92
Activated Carbon 20%	Nov. 6	Nov. 5	93

Table 3. Effect of activated carbon on the growth of *Allium tuberosum*.

Treatmen	TreatmenPlant height(cm)	Number of leaf /per plant	Plant width (mm)	Clump of bulbs /per plant	Number ofroot /per plan
Control	21.1b2)	6.1b	3.3a	4.1a	10.0b
AC1) 5%	27.7a	8.9a	3.8a	4.8a	11.8ab
AC 10%	28.2a	9.1a	3.4a	4.9a	13.6a
AC 15%	26.8a	8.8a	3.9a	4.6a	13.7a
AC 20%	27.5a	8.7b	3.3a	4.3a	13.8a

1) AC: Activated carbon,

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

activated carbon (10%).

Growth characteristics including plant height, number of leafs and bulb clump per plant were the highest when activated carbon added with 10%, suggesting that optimum amount of activated carbon was ranged from 5 to 10%. The results show that activated carbon produce more growth of *Allium tuberosum*.

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

(2) Yield of fresh green vegetable

The result on yield of fresh green vegetable in *Allium tuberosum* as affected by activated carbon treatment is shown in Fig. 1.

Weight of fresh green vegetable of *Allium tuberosum* was low in control. And fresh weight of *Allium tuberosum* was higher in 5% treatment of activated carbon. However, when the plants were grown in activated carbon 5~10%.

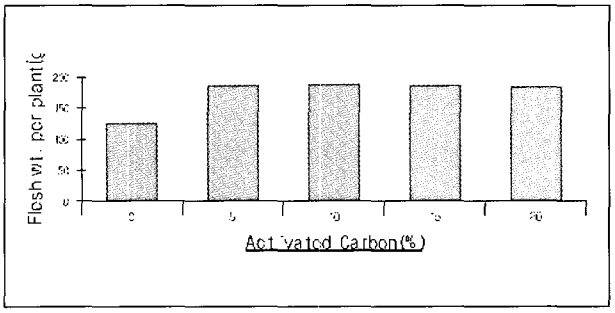

Fig. 1. Effects of activated carbon treatment on the yield of fresh green vegetable in *Allium tuberosum*.

Growth characteristics including plant height and leaf length were the highest when activated carbon added with 5%, suggesting that optimum amount of activated carbon was ranged from 5 to 10%. Growth and enlargement of the bulb were improved by 5% activated carbon. These results indicate that production of fresh green vegetable in *Allium tuberosum* can be improved by using Activated Carbon. Also, this result supports the report that activated carbon treated with optimum amount significantly can stimulate crop growth (Lee *et al.*, 2001; Choi *et al.*, 2003).

These results require further studies on effects of treatment methods on growth responses of *Allium tuberosum* as affected by different Activated Carbon.

LITERATURE CITED

Choi, S.K., Y.T. Park and K.W. Yun 2002. The effect of activated charcoal on growth and yield of medicinal plants. Korean. J. Plant. Res 15(1) : 57 - 61.

Choi, S.K. 2003. The Effect of Activated Charcoal on Growth and Yield in *Bupleurum falcatum* Linne. Kor. J. Plant. Res. 16(2) : 130-133.

Choi, Seong-kyu, Yun Kyeong-Won, Sang-Uk Chon. 2003. Effect of activated charcoal on growth and yield of *Curcuma longa* linne. Korean J. Plant. Res. 6(3) : 175-177.

Choi, S.K. and Y.T. Park. 2005a. Effect of Activated carbon on Growth of Ginger(*Zingiber officinale*). Korean J. Plant Res. 8(1) : 44-47.

Choi, S.K. and Y.T. Park. 2005b. Leaf and Stem Production of *Angelica acutiloba* by Activated carbon in Greenhouse. Korean J. Plant Res. 8(1) : 71-74.

Harrington, Geri. 1984. Grow Your Own Chinese Vegetables. Garden Way Publishing, Pownal, Vermont. PP. 268.

Lee, J. I., Choi S.K. and Yun K.W. 2001. The effect of activated charcoal on growth and yield in *Scutellaria baicalensis* Kor. J. Plant Res 14(3). 147-151.

Park, Y.T. 1996. Active Carbons. Dong Hwa Technology Publishing Co. PP.371.

Rual Development Administration (R. D. A.) 1989. Research investigation standard of agriculture(medicinal crop). PP. 5-8.

Rual Development Administration (R. D. A.). 1995. Research investigation standard of agriculture. PP. 583-585.

Yamaguchi, M. 1983. World Vegetables. AVI Publishing Company, Inc., Westport Connecticut. PP. 415.

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