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Effect of Activated Carbon on Growth of Ginger *(Zingiber officinale)*

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ABSTRACT

Activated carbon(AC) can be utilized as a soil conditioner in agricultural crop areas. This study was conducted to investigate the effect of AC on growth and yield of Ginger*(Zingiber officinale)* as affected by different amounts of AC.

The results obtained are summarized as follows. Growth characteristics including plant height and leaf length were the highest when activated carbon added with 5-10%, suggesting that optimum amount of activated carbon was ranged from 5 to 15%. Growth and enlargement of the root were improved by 10% AC with higher rhizome length and weight.

Key words : Activated carbon, Ginger*(Zingiber officinale)* growth, quality, yield

INTRODUCTION

Ginger is a tropical perennial that grows from a tuberous underground stem, or rhizome. Each year, the plant produces a round, 3-foot stem with thin, pointed, lance-shaped, 6-inch leaves and a single, large, yellow and purple flower.

The rhizome of ginger is thiner than turmeric(*Curcuma longa* L). The rhizome is being utilized as a medicinal material. Ginger is on the FDA list of herbs generally regarded as safe. For adults, ginger is safe when used in the amounts typically recommended. Use ginger to taste in cooking to create warm, spicy, aromatic dishes(Michael Castleman, 2001).

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 absorbed 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).

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Therefore, 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

Rhizomes with two-three sprouts (5cm long, 2-4g weight) of Ginger (*Zingiber officinale*) were transplanted at 0, 5, 10, 15 and 20% were mixed with clay loam soil that sterilized with heat. All treatments were replicated five times using a randomized complete block design. All cultural management for Ginger (*Zingiber officinale*) were followed standard methods from Rural Development Adminstration(RDA), Korea(RDA, 1995). During plant growth, the growing conditions were maintained near field capacity by sub-irrigation. Growth of all plants were determined 120 days after transplanting, and harvest for rhizome was made at 230 days after transplanting.

Emergence rate was determined 3-5 weeks after transplanting, plant height, leaf length, and leaf width were measured on September 25, and the rhizome was harvested on November 10, 2004. All measurements for plant growth and yield were referred to standard measurement of RDA, Korea (RDA, 1989)

RESULTS AND DISCUSSION

Effect of Activated carbon on Top growth of Ginger (*Zingiber officinale*)

When the charcoal was added into pot, effect of activated carbon on top growth of Ginger as affected by different amounts was determined. The results on responses of emergence rate, plant height, leaf length and leaf width were shown Table 1.

Emergence of turmeric was made on May 19 (29 days after transplanting), showing 87-92% in emergence rate. It is generally accepted that turmeric are higher emergence rate and short emergence period when faced with high soil temperature (Ahn, 1987).

Treatment of activated carbon at 10% showed the highest plant height compared with control and followed by 15% AC treatment, 5% AC and 20% AC.

The result suggests that optimum amount of activated carbon was ranged from 5 to 15% for enhancing growth of turmeric due to increasing of water and nutrient holding capacities as well as improving soil physical property. Leaf length and width at 10% AC treatment were 11.5 cm and 1.4 cm while those at control were 11.5 cm and 1.1 cm, respectively, showing a similar tendency to the top-growth. However, no significant difference among treatments were observed.

Taking together, the results are supported by the report of Park (1996) who reported that optimized

Table 1. Effect of activated carbon on the growth of Ginger (*Zingiber officinale*)

treatment	Emergence		Heght of plant(cm)	Leave length(cm)	Leave width(cm)
	Date	Ratio(%)			
Control	May 19	87	53b[z]	11.5a	1.1a
Activated Charcoal 5%	May 19	91	65a	11.6a	1.3a
Activated Charcoal 10%	May 20	92	65a	11.5a	1.4a
Activated Charcoal 15%	May 19	90	60a	11.5a	1.3a
Activated Charcoal 20%	May 19	89	56ab	11.6a	1.1a

[z] : Same alphabetical letters indicate no significant difference at 5% level of DMRT.

amount of AC stimulate crop growth by improving soil physical characteristics. Choi et al(2002), in another study, reported that treatment of AC around 20% improved the growth of medicinal plants, and exhibited differently depending on crop species.

Effect of Activated Carbon on Rhizome Growth of Ginger (*Zingiber officinale*).

To determine the effect of AC on rhizome growth of ginger, length and weight of rhizomes were measured on a plant (Table. 2)

In pot test, Diameter of rhizome was ranged from 16m to 19m, and rhizome weight a plant from 98 to 119mg when treated with AC. Rhizome Diameter was significantly increased to 17-19 mm compared with control when treated with 5-10% AC. AC at 5% increased rhizome weight by 119 mg while control was 98mg. However, no significant difference in weight was observed when treated with above 20% AC. As the results, it was thought that optimum amount of AC was ranged with 5%-10% and improved rhizome length and weight due to increasing water and nutrient holding capacities as well as physical properties of cultivated soil.

This result supports the report that AC treated with optimum amount significantly can stimulate crop growth (Park, 1996). On the other hand, color of rhizome coat was light to dark yellow and not differ among treatment amounts.

These results require further more detail studies on effects of treatment methods on growth responses of ginger (Zingiber officinale) as affected by different growing stages.

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Table 2. Effect of activated carbon on the growth characteristic of rhizome in ginger (*Zingiber officinale*)

Treatment	Rhizome Diameter(mm)	Rhizome wt.(mg)	Rhizome color
Control	16	98b[z]	Yellow
Activated Carbon 5%	18	119a	Light Yellow
Activated Carbon 10%	19	116a	Yellow
Activated Carbon 15%	17	112a	Yellow
Activated Carbon 20%	17	105ab	Dark Yellow

[z] : Mean separation within column by Duncan's multiple range test, 5% level of significance.

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