

Effects of the addition of clinker ash to the propagation medium on rooting of rabbiteye blueberry cuttings

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Abstract

The recommendation for a propagation medium of rabbiteye blueberry (*Vaccinium ashei* Reade) in Japan includes the incorporation of peat moss and Kanumatsuti (a volcanic ash deposit). This experiment compared the use of coal ash (clinker ash) and Kanumatsuti to peat moss as soil conditioner for rooting rabbiteye blueberry cutting. The numbers of cuttings survived and the root dry weight of plants propagated in clinker ash- peat moss mixes were almost the same as cuttings propagated in kanumatsuti- peat moss mix. While the quadratic model between the root dry weight and the clinker ash content in the medium was significant, the maximum root dry weight was estimated to reach about 0.2 g when the proportion of clinker ash in the medium was about 40%. These findings indicate that clinker ash can be used in the propagation medium of rabbiteye blueberry.

Key words: Clinker ash, cutting, propagation, rabbiteye blueberry, rooting

Introduction

Coal continues to play a vital role in electricity generation in the world. While coal-fired electrical generation supplied 39% of the world's electricity in 2002, this value is likely not to change over the next three decades (World Coal Institute, 2005a). After burning of coal for electric purposes, a huge amount of coal ash is generated. Coal ash mainly consists of SiO₂, Al₂O₃ and Fe₂O₃ and is classified into fly and clinker ash depending on the production processes (Schlossberg *et al.*, 2004). Clinker ash, which is coarser than fly ash, is a dark gray, granular and porous substance (Table 1).

Coal ash production will increase continuously in the coming three decades, hence its recycling for a wide range of uses is required. Coal ash has been utilized as building material and for other constructional purpose (World Coal Institute, 2005b). Since coal ash has desirable horticultural characteristics, including low cost, good drainage and its soil amendment effect, it has been started to be utilized as a horticultural material (Schlossberg *et al.*, 2004; Stevens and Dunn, 2004). Black and Zimmerman (2002) showed the growth and yield of highbush blueberry plants in coal ash- compost mixes were similar to or exceeded those of plants in berryland sand. Rabbiteye blueberry can be propagated by hardwood cuttings and have been propagated in many kinds of medium, including peat moss, sand, sawdust, perlite and pine bark (Austin, 1994). In New Jersey, North California and Massachusetts, a mixture of half sand and half peat moss are used to root blueberry plants (Mainland, 1966).

In this study, we investigated the effects of adding clinker ash to the propagation medium on the rooting of rabbiteye blueberry and evaluated whether it could serve as a suitable component of the propagation medium for blueberry cuttings.

Materials and methods

Clinker ash (3~7 mm in diameter) was obtained from the Chugoku Electric Power Co., INC. Misumi power plant in Shimane, Japan. The components of the propagation medium were combined in the proportions listed in Table 2. Kanumatsuti, a volcanic ash deposit, was used in our studies as a substitute for the control, since a mixture of peat moss and Kanumatsuti is generally used as the propagation medium of blueberry plants in Japan (Tamada, 1997). Mature bushes of rabbiteye blueberry 'Tifblue' growing on the experimental farm of Shimane University were used. On 14 Feb, 2005, well-matured and healthy shoots of the former growing season were collected and stored at 4°C. Fifty cuttings (10 cm in length) were prepared from the shoots for each medium combination on Apr, 7, 2005. Before planting the cuttings in the mediums, we confirmed that the mean diameter of cuttings was not significantly different between treatments (Table 3). The cuttings were planted in 9 cm plastic pots containing 300 mL of each medium. After adequate watering, the pots were placed in plastic propagation tunnels. Mist spray was applied from 08: 30 to 09: 00 and 16: 00 to 16: 30 daily.

The numbers of cuttings that formed callus, rooted and survived cuttings were recorded when almost all of the leaves fallen (about seven months after their planting). Root dry weight was determined by weighting roots after oven drying at 80° for 7 days. The measurements of root dry weight were replicated 5 times per treatment.

Results and discussion

Almost all the cuttings formed callus, but the number of cuttings that rooted and survived decreased with an increase in the proportion of clinker ash in the medium (Table 3). It is

Table 1. Physical properties of clinker ash

Location of power plant	Soil phase (vol %)			Water retention characteristics (pF=1.5, wt %)	Bulk density
	Solid phase	Liquid phase	Air phase		
Misumi in Shimane, Japan	45.2	39.3	15.5	30	0.86
Shinonoda in Yamaguchi, Japan	50.7	28.2	21.1	19.1	1.06

Table 2. Composition of medium treatments expressed as a relative percentage

Treatment	Component (vol %)		
	Clinker ash	Kanumatsuti	Peat moss
1(Control)	-	50	50
2	0	-	100
3	25	-	75
4	50	-	50
5	75	-	25
6	100	-	0

well known that solid agents in plant propagation medium can regulate moisture reserves and improve aeration, since these substances have a range of porosity. The results obtained in our study indicate that drought damages was induced with an increase in the proportion of clinker ash in the medium.

The No. 3 and 4 medium resulted in the highest root dry weights and there was no significant differences in root dry weight between the No. 1 (control), 3 and 4 mediums (Table 3). In medium No.

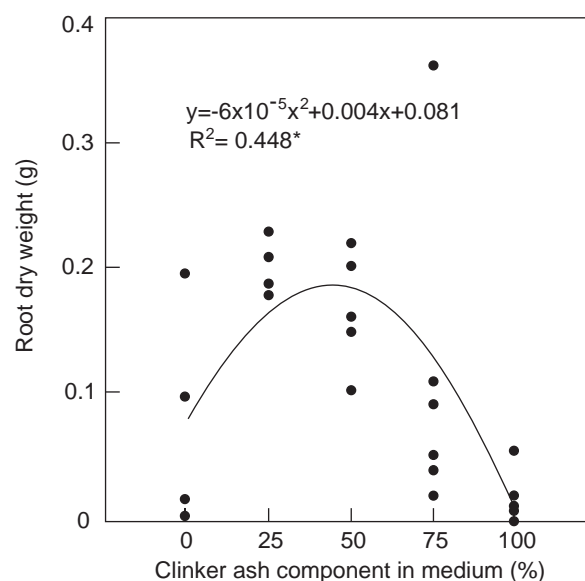


Fig. 1. Relationship between the root dry weight and clinker ash composition in the medium. The curve was tested with a polynomial regression analysis. * means significant at the 5% level.

Table 3. Effects of the addition of clinker ash to the propagation medium on the rooting of rabbiteye blueberry cuttings

Treatment	Average diameter of cuttings (mm)	Number of callus formed cuttings	Number of rooted cuttings	Number of survived cuttings	Root dry weight (g)
1(Control)	8.30 NS ^a	50	48	48	0.128 ab ^b
2	8.17 NS	49	49	49	0.069ab
3	8.38 NS	50	50	50	0.197a
4	8.32 NS	50	46	46	0.168a
5	8.48 NS	49	43	41	0.124ab
6	8.26 NS	50	26	22	0.017b

^aNon significant at 5% level by the Tukey's test. ^bDifferent letters within a column indicate significance at 5% level by the Tukey's test.

2 and 6, the root dry weight was lower than that of the other four mediums. Fig. 1 shows a significant relationship between the root dry weight and the clinker ash content in the medium. While this quadratic model was significant, the maximum root dry weight was estimated to reach about 0.2 g when the proportion of clinker ash in the medium was about 40%. In general, propagation medium of cuttings requires a high moisture holding ability and good drainage (Preece and Read, 1993). The low values in root dry weight from No. 2 medium may be attributed to excessive moisture level, since this medium consisted of only peat moss. In contrast, a high proportion of clinker ash in the propagation medium will inhibit the root growth of rabbiteye blueberry cuttings, because its moisture holding ability will be low.

In the present study, we clarified certain effects of clinker ash when added to the propagation medium on the rooting of rabbiteye blueberry cuttings. The growths of cuttings in the clinker ash-peat moss mixes was similar to or exceeded that of cuttings in normal medium. These findings indicate that clinker ash can be successfully used as a propagation medium for rabbiteye blueberry cuttings.

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