Effect on growth and quality of berries of wine grapes by the Soil Conditioner FFC-Ace©

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1. Introduction

We focused our attention on the behavior of certain ions, especially iron ion in water or interactions of water molecules with them. Since 1984, Akatsuka Garden Company has continued research on various solutions to not only accelerate plant growth, but also activate physiological functions of plants. Based on this research, we have developed FFC materials such as “FFC-Ceramics” (a water improvement device), “FFC-Ace” (a soil conditioner) and so on. On the other hand, many agricultural producers in Japan have been utilizing FFC materials to rejuvenate plants, and increase profits. Those producers have also explored many other original methods for using FFC materials, and consequently found good ways to fit them into their actual production sites. As a result, it turned out that they obtained many advantages over years of use, for instance, productivity enhancement, cost reduction, decreased amount of agricultural chemicals required and so on. In addition to that, it is reported that “FFC-Ace” enhances the growth of plants under laboratory conditions, and improves disease resistance, and drought and salt stress tolerance of plants (Ichikawa et. al., 2013; Fujita et. al., 2010; Hasegawa et. al., 2006; Konkol et. al., 2012; Shiraishi et. al., 2010; Toyoda et. al., 2010). In this paper, we will report a part of the results on the effectiveness of FFC-Ace for a woody vine under field conditions.

Yamanashi Prefecture is Japan’s top producer of grapes. However, the high quality grape berries for brewing are not cultivated easily in the cultivation environment of Japan (Asai, 1993; Nakayama, 1993). Therefore, we started the examinations for promotion of the growth of the Chardonnay and quality improvement of the berries by using the FFC materials. In addition, we also examined about the other kind of grape, called ‘Koshu (*Vitis vinifera* cv.)’. ‘Koshu’ grapes are widely cultivated in Central Japan, particularly Yamanashi Prefecture. ‘Koshu’ is an

indigenous grape cultivar and are known as raw materials of the ‘Koshu’ wine, which is a special product of Yamanashi Prefecture.

2. Materials and Methods

2.1 Field experiments of FFC-Ace by using Chardonnay and ‘ Koshu’ grapevines.

18 Chardonnay grapevines (guyot-style cultivation) were tested. 2 holes of approximately 50 cm depth were dug at the place approximately 0.5m away from the main trunk of the grapevines. The required amount of FFC-Ace was put into the holes, and also scattered on the ground surface of the range of approximately 1m in diameter from the main trunk of the grapevines.

6 ‘Koshu’ grapevines (shelf-style cultivation (overhead trellis)) were tested. 4 holes of approximately 50 cm depth were dug at the place approximately 2 m away from the main trunk of the grapevines. The required amount of FFC-Ace was put into the holes, and scattered on the ground surface of the range of approximately 4 m from the main trunk of the grapevines. The FFC-Ace was annually applied in the examination fields every February from 2008 to 2011. Table 1 shows the amount of FFC-Ace which was applied each year. 20 berries were randomly sampled from each grapevine to measure grape berry compositions, and divided into two groups. Each fresh berry’s weight, the average of total soluble solid (expressed as degrees Brix), the average of pH, the average of titratable acidity, and the average of total phenolics concentration in juice extracted from the two groups were measured.

2.2 Pot experiments by using young plants of Chardonnay and ‘Koshu’ grapes

Young one year old plants of Chardonnay and ‘Koshu’ grapes were tested. We cultivated the young plant in Wagner pot (1/2000a) holding field soil mixed with FFC-Ace (3% w/w) or in untreated field soil. Growth of the young plant was estimated by measuring the length of young shoots, the number of the young shoot leaves, and chlorophyll content (SPAD-unit) in the young shoot leaves.

3. Results and discussions

Degrees Brix in Chardonnay berries were increased by using FFC-Ace (Fig. 1). Because sugars in berries change to alcohol by fermentation, increase of degrees Brix in berries enhances the value of the wine grape. Titratable acidity of Chardonnay

berries during early growth in the field treated with the FFC-Ace declined earlier than without FFC-Ace. This result for Chardonnay grapes is similar with that of Koshu grapes. Therefore, it was suggested that the application of the FFC-Ace promoted maturation of both kinds of berries. Fresh berry weights, pHs and total phenolics concentrations of both kinds of grapes were not influenced by the application of FFC-Ace. The young plants (1 year-old) of Chardonnay and 'Koshu' grapes were transplanted in Wagner pot (1/2000a) holding FFC-Ace treated soil or untreated field soil. Growths of the young plants were observed (Fig. 2). The length of the young shoot of 'Koshu' plant in the soil treated with 3 % of FFC-Ace was significantly longer than without FFC-Ace during early growth (105 days after the planting). In addition, the 'Koshu' young plants treated with FFC-Ace had larger numbers of leaves than without FFC-Ace, and the SPAD-unit of the grape leaves treated with FFC-Ace is higher than without FFC-Ace. On the other hand, the results of Chardonnay were also similar to those of 'Koshu', although no statistically significant difference was observed. These results indicate that the application of FFC-Ace for young grape plants might stimulate the plant growth in early stages, accelerate maturation of berries, and increase degrees Brix in the juice of berries.

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Table 1
The weight of FFC-Ace provided to each grape each year.

'Chardonnay' grapes

	2009	2010	2011
No FFC-Ace	—	—	—
FFC-Ace 3.7kg-1	3.7 kg	—	—
FFC-Ace 3.7kg-2	3.7 kg	3.7 kg	3.7 kg
FFC-Ace 23kg-1	23 kg	—	—
FFC-Ace 23kg-2	23 kg	23 kg	23 kg

(per 1 tree)

'Koshu' grapes

	2008	2009	2010	2011
No FFC-Ace	—	—	—	—
FFC-Ace treated	3.7 kg	3.7 kg	45 kg	7.5 kg

(per 1 tree)

Fig. 1 Degrees Brix in juice of Chardonnay berries cultivated in field experiments. (Results of the year 2011)

Fig. 2 Growth conditions of young ‘Koshu’ grapes plants (105 days after the planting) in pot experiments (Results of the year 2009)