

'BIO-GREEN' FUNCTIONAL WATER SUPPLY INFLUENCES MINERAL UPTAKE AND FRUIT QUALITILE IN 'TSUGARU' APPLES

'바이오 그린' 機能水 處理가 사과 '쓰가루' 品種의 無機成分 吸水와 果實品質에 미치는 影響

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1. Introduction

In recent years there have been conducted some revolutionary research projects to solve the environmental problems, and to improve yield and quality by using new materials and ultra-functional substances in agriculture.

In fact they have been commercially applied in crop cultivation with Effective Microorganisms¹ (EM) in Japan and Korea (Matsmoto, 1994), mineral complex of Spray-N-Grow in U.S.A. (Nightingale, 1994), electrolytic water in Japan and Korea (Miyaki, 1994), ultrasonic irradiated water in Japan and U.S.A. (Koda and Nomura, 1994), functional water in Japan (Masayo, 1994), pi (π) water in Japan (Makino, 1994), and B.G. functional water in Korea (Kim et al., 1995).

The objectives of this investigation were to determine the functions and effects on the growth and development of 'Tsugaru' apples with the energized B.G. functional water.

2. Materials and Methods

Manufacturing of energized B.G. functional water; In order to produce B.G. functional water 4 steps were processed by Kyungwon Enterprise Co.

Through the first step the energized water was obtained by micro-filtering with tap water, exposure to limited magnetic fields, adding catalysts, and energy imprint in platinum columns. The second step was to produce the energized solid powder by maintaining high temperature with liquid catalyst + zeolite in iron belt, and adding photosynthetic bacteria. After mixing with energized water plus energized solid power, the third step was carried in the microbial fermenter at 25°C for 15 day. The last step was filtering the ferment substances to separate to 2 phases of filtrated liquid and residues; the filtrated liquid, B.G. functional water used for irrigation to crops, as well as the residues for soil conditioner before planting crops.

Treatment of B.G. functional water ; Ten year old 'Tsugaru' apple trees grafted on M26 rootstock were used in this experiment. Trees were trained to a vertical axe system at a spacing of 3.5m×6.0m (470 trees · ha⁻¹). The experiment was designed as a randomized block design with three replicates within two-trees plot for a total of 18 trees. After dispersing the energized B.G. powders under apple trees as much as 3kg tree⁻¹ and then plowing soil surface, aqueous B.G. functional water of 5 or 10 was applied around the trunk of each tree in the soil line in Horticultural Research Institute, Suwon, Korea at three times monthly from april 20, 1995.

3. Results and Discussion

The treatment of B.G. functional water significantly increased soil pH, Ca and Mg content in orchard soils. Especially, the higher B.G. functional water supply showed the higher levels of soil pH and exchangeable cations of Ca and Mg from soil extraction. However, the levels of P₂O₅, K and B were not influenced by the treatment of B.G. functional water (Table 1).

Table 1. Effect of B.G. functional water supply on the pH and mineral elements of the orchard soils in 'Tsugaru' apples. Soil sampled on July 10, 1995.

Treatment ^z	pH (1:2.5)	P ₂ O ₅ (ppm)	Exchangeable cation (me/100g)			B (ppm)
			K	Ca	Mg	
Control	5.73 b ^y	662 a	0.50 a	4.17 c	1.17 b	0.48 a
5 l B.G. functional water	6.31 a	640 a	0.53 a	5.90 b	1.39 ab	0.46 a
10 l B.G. functional water	6.43 a	657 a	0.58 a	6.21 a	1.46 a	0.41 a

In terms of fruit characteristics of 'Tsugaru' apples, soluble solids were increased as much as 12.6 ° Bx in the treatment of 10 liters of B.G. functional water in comparison to 11.0 ° Bx of control (Table 2). In addition anthocyanin contents in fruit skin were increased by B.G. functional water supply. There were no significant differences in fruit weight, organic acidity, and fruit firmness among the treatments.

Table 2. Effect of B.G. functional water supply on the fruit characteristics of 'Tsugaru' apples.

Treatment ^z	Fruit wt. (g)	Soluble solids (° Bx)	Organicacidity (%)	Firmness (kg/5mm)	Anthocyanin (mg/cm ²)
Control	252 a ^y	11.0 c	0.30 a	0.57 a	7.6 b
5 l B.G. functional water	253 a	11.7 b	0.25 a	0.54 a	9.3 a
10 l B.G. functional water	263 a	12.6 a	0.23 a	0.69 a	9.8 a

During the storage at 5°C bitter pit, a physiological disorder of 'Tsugaru' apples was significantly decreased by supply of 5 to 10 liters of B.G. functional water, although very high levels of bitter pit have observed in control without B.G. functional water. In addition, bitter rot (*Gloeosporium fructigenum*) of the 'Tsugaru' apples fruit during preharvest period was dramatically reduced from the apple trees supplied with 10 liters of B. G. functional water (Table 3). Genetically 'Tsugaru' apples are susceptible to bitter pit as postharvest physiological disorder, and bitter rot as preharvest disease.

Table 3. Effect of B.G. functional water supply on the bitter pit^z and bitter rot^y of 'Tsugaru' apples.

Treatment ^x	Bitter pit (%)	Bitter rot (%)
Control	10.0 a ^w	29.3 a
5 l B.G. functional water	5.7 b	10.0 b
10 l B.G. functional water	2.1 b	7.9 b

Kim et al. (1995) suggested that the B.G. functional water have distinct functions of neutralizing agent for acid soil, increasing cations of Ca and Mg, and native micro-organisms in the farm lands, activating nutrient metabolism in plants, and disease resistance, etc. In this experiment the supply of B.G. functional water to the orchard soil of 'Tsugaru' apples significantly influenced to increase soil pH and Ca contents in soils and fruit, although there were not same trends of Mg in soils and N in fruit. The experimental result of the increased soluble solids content in apple fruit considered to relate to promotion of root activity and photosynthetic rate as affected by B.G. functional water supply. In these studies, the B.G. functional water supply resulted in orchard soil conditioning with increased pH, Ca and Mg content, and increased soluble solids and Ca content in 'Tsugaru' fruit, higher root activity and net photosynthetic rate of the leaves, and increased potential of fruit storage as lower respiration and ethylene evolution during storage. Especially bitter rot of diseases and bitter pit of fruit physiological disorders were remarkably reduced by supply of B.G. functional water.

4. Abstract

Bio-Green(B.G.) functional water was manufactured by Kyungwon Enterprise Co. through a series of processes ; water → ultra-purification → adding catalysts → energy imprinting fermenting with energized water + zeolite and others + photosynthetic bacteria in fermenter → filtering. Control(0), 5 or 10 liters of B.G. functional water were supplied to the orchard soil under canopy of 10 year old 'Tsugaru' / M26 apple trees on March 20, May 20 and June 20, 1995, respectively. Some orchard soil characteristics, not only pH, but also Ca and Mg of exchangeable cations were increased by supply with B.G. functional water. However, P₂O₅, K, and B contents were not influenced by the treatment. At harvest time soluble solid content of flesh and anthocyanin of fruit skin were increased by the treatment. B.G. functional water treatment showed higher root activities, and photosynthesis of leaves than that of control. Also B.G. functional water treatment showed higher Ca content in fruit skin and flesh tissues, whereas not affected N, K, and Mg contents. During storage at 4°C cold room, the more volume of B.G. functional water supply showed lower bitter pit symptom. Respiration and ethylene evolution in fruit were decreased, while fruit firmness increased by the treatment during storage.

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