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Quality of Irrigated Water with Nanometer Pottery Tray Treatment and Its Effects on Seed Soaking

HUANG Jun-rong[1, 2], WANG Ai-juan[3], WANG Guo-rong[4], LIU Lian-meng[1], HUANG Shi-wen[1]

([1]China National Rice Research Institute, Hangzhou 310006, China; [2]Zhejiang University, Hangzhou 310007, China; [3]Master Station of Yuhang District of Hangzhou for Administrative Agroecology and Plant Protection, Hangzhou 311100, China; [4]Agricultural Bureau of Xiaoshan District of Hangzhou, Hangzhou 311201, China)

Abstract: To study the impacts of nanometer pottery trays (NPTs) on different rice varieties, three rice varieties, Zhongzheyou 1, Jinzao 47 and Xiushui 09, were treated with four NPTs (NPT-A, NPT-B, NPT-C and NPT-D) with different energies, respectively. The results showed that when the same rice variety was treated with different NPTs or different rice varieties were treated with the same NPT, the impacts on seed germination rate, seedling growth, plant height, panicle length and weight, the number of filled grains, seed-setting rate and 1000-grain weight varied between different rice variety-NPT interaction groups. In general, high energy NPT-C and NPT-D treatments obviously enhanced the functions of most examined rice characters. For example, NPT-C and NPT-D treatments improved the germination rate of all the three rice varieties, and promoted the root growth of seedlings, and increased seedling fresh weight, single panicle weight, filled grain number per panicle, seed-setting rate and 1000-grain weight. On the contrary, low energy NPT-A treatment restrained the seed germination rate in Jinzao 47 and Zhongzheyou 1, and decreased the seedling fresh weight in Zhongzheyou 1. NPT-B treatment restrained the seedling growth in Jinzao 47 but increased the panicle length of Zhongzheyou 1. NPT-A and NPT-C treatments obviously decreased the 1000-grain weight in Xiushui 09. Therefore, when treating crop seeds or plants using nanomaterials or nanotechnologies, different types of crops/varieties should select the nanomaterials or nanotechnologies with suitable energies to reduce the negative effects.

Key words: nanomaterial; nanotechnology; nanometer pottery tray; seed soaking; rice; variety

Nanomaterials or nanotechnologies, information science and technology, and life science and technology are the current mainstreams of science development. Nanomaterials have unique physical and chemical properties which arise from their small size, shape, surface area, conductivity and surface chemistry, and have been applied in numerous ways in many fields such as textiles, electronics, agriculture, engineering and medicine (Smith et al, 2007). Since 2000, the governments of various countries, institutional frameworks and enterprises have all attached great importance to the research, development and application of nanotechnologies. Some countries have also enacted relevant strategies or plans, and invested substantial sums of funds to seize the strategic highland of nanotechnology (Huang et al, 2015).

Nanomaterials are able to radiate specific far infrared wave. The resonance can happen between far infrared wave and water molecule perssad, and high energy water is generated. When crop seeds are soaked with high energy water, the buds of seed embryos can be promoted and the germination speed and rate can be increased. When high energy water is used for irrigation, it can make the crop roots flourishing, grow and develop fast, and lead seedlings to grow well at late stage. More tillers and full filled grains will be produced, and the objective of high yield can be achieved.

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Corresponding author: HUANG Shi-wen (huangshiwen@caas.cn)

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Currently, the application of nanotechnology in agriculture lags behind other industries, but there are also some successful application examples (Huang et al, 2015). The function of nanotechnology in promoting biological metabolism has been applied in many aspects. For example, when crop seeds are treated or plants are irrigated with nanotechnology-treated water, it can promote crop growth, increase yield and improve the quality of crop products. Although the application of nanotechnology in food and agriculture is still at its budding stage, we hope to see a largely increased use of nanotechnology tools and techniques in agricultural fields in the next few years (Tuteja and Gill, 2013).

Nanotechnology can promote seed germination and increase seedling quality, yield, and product quality in different crops. In a previous study, the seeds of cowpea and radish are soaked with nanometer pottery tray (NPT)-treated water, and the germinative force, germination rate and seedling fresh weight are all significantly increased (Chen et al, 2000). The soybean seeds soaked by nanotechnology-treated water show enhanced root vitality and water absorbing capacity. This treatment also increases the antioxidant enzyme activities and improves the stress resistant ability of plants (Lu et al, 2002).

The change of water molecule clusters can be investigated by ultraviolet absorption spectrum and nuclear magnetic resonance atlas. The light absorption ability of nanomaterials-treated water at 190–325 nm in ultraviolet absorption spectrum is enhanced, which indicates that the changes of water molecule structure and energy state occur. The half-peak breadth of ^{17}O-NMR becomes narrow, undergoes chemical shift diminution and moves to the low field. In other words, the molecular group diminishes and the activity is increased when water is treated by nanomaterials (Liu and Liao, 2008). Microcluster water is also known as activated water. This water is alkalized after free ionization by nanoparticles. The major function of activated water is to improve the microcirculation of the living body *in vivo*. The alkalescence-activated water can stimulate the activity of calcium ions inside the living body, motivate the acid system of biological cells, and ultimately increase cell activity and promote metabolism.

When a Qiangdi nano-863 biological assistant growth apparatus (BAGA) (disc) (Fig. 1) is immersed into water, it absorbs and radiates the electromagnetic waves in specific frequencies, causes the large water molecule cluster to produce resonance. Then large water molecule cluster is broken down into a micromolecule clusters. The movement of micromolecule cluster is fast. It brings a mass of kinetic energy which is 30% higher than that of normal water. The activated water carrying high energy can enter biological body and continuously strike the cells of living body. Therefore, cell energy is activated and their function is stimulated, which promote the metabolism of living body. The living body's performances are improved and their immunocompetences are enhanced. Plants will have faster seed germination, higher germination rate and flourishing root system. At late stage, the plants grow well, there are more tillers and full filled grains. When rice seeds are soaked in the water treated by the Qiangdi nano-863 disc and the rice plants are irrigated by the treated water, a good harvest can be achieved. The key reason of improved rice yield is that the treated water can increase the numbers of productive panicles and full filled grains, and enhance 1000-grain weight (Liu et al, 2007b). The rice treated with the Qiangdi nano-863 disc performs better than the control rice (treated with normal water). Compared with the control, there are an increase of 0.2–0.5 leaves per treated plant, the seedling height is increased by 0.5 cm, the number of productive panicles per square meter is increased by 10–15, the number of filled grains per panicle is increased by 1–5, 1000-grain weight is increased by 0.2–0.5 g, and yield is increased by 1 041 kg/hm^2 (16.7%) (Liu et al, 2007b). The most obvious effect is achieved at the tillering stage when rice is treated with different nanomaterials (He, 2005; Liu et al, 2007a). Rice biomass is increased by 30.8%–37.4%, root weight is increased by 12.3%–35.2%, and the total length, superficial areas and volume index of roots are all substantially improved (Liu et al, 2007a). When rice grows up to

Fig. 1. Different types of biological assistant growth apparatus ceramic discs (nanometer pottery trays).

Qiangdi nano-863 (the biggest green one in the center), Suzhou Zhongchi (a, b, c and d discs around).