Improvement in rooting of cuttings of FDR-1, a dwarfing rootstock for kaki©

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INTRODUCTION

The 'Fuyu' Japanese persimmon (*Diospyros kaki* Thunb.) tree grafted onto FDR-1 (Fukuoka Dwarfing Rootstock No. 1) showed a semi-dwarfing growth habit in the orchard of Fukuoka Agriculture and Forestry Research Center. After cutting off from the rootstock, the roots sprouted root-suckers. The explants (buds) were collected from the root-suckers and were micropropagated easily. Young trees of 'Taishu' Japanese persimmon grafted onto the micropropagated FDR-1 rootstocks showed dwarfing growth (Haranoushiro et al., 2010). Although the cutting propagation of kaki in the mist system was shown to be a cheap and commercial propagation (Tetsumura et al., 2011), the rooting percentages of cuttings of FDR-1 was low in our preliminary experiments. Hence, the objective of this study was to improve rooting of cuttings of FDR-1.

MATERIALS AND METHODS

Root-suckers from FDR-1 roots and shoots of FDR-1 hedges were collected from May to September in 2011-2015. Single-node stem cuttings with one leaf and one bud were prepared from the root-suckers and the shoots, dipped at their bases in 50% aqueous ethanol with 3000 ppm indole-3-butyric acid (IBA) for 5 s, planted singly in a plastic pot (EG-90, 300 ml, Minamide Inc., Japan) which was filled with Metro-Mix® 360 (Sun Gro, Horticulture Distribution Inc., Washington D.C.), and then placed under a vaporized aluminum netting in a propagation frame covered with plastic film. The propagation frame was intermittently misted (30 s mist and 15 min stop in the daytime) and was ventilated with fans when the ambient air reached 38°C. In addition to this mist system, a fog system, in which the unit with humidification spray nozzles (Mini Fogger II, Spraying Systems Co., Japan) intermittently produced fog (30 s mist and 1 min stop in the daytime) under a vaporized aluminum netting in a propagation frame covered with plastic film without fans, was used in this study. Data loggers (TR-72i, T&D Corporation, Japan) measured the temperature and the relative humidity in the systems. In vitro shoots of FDR-1 tended to root better when dipped in 2.5 mM IBA, which was twice as high as the concentration normally used (Tetsumura et al., 2015b). Hence, some FDR-1 cuttings were dipped in 6000 ppm IBA for 5 s. Ten cuttings per each treatment in each year were used. The rooting percentage and number and length of roots were investigated 2 months after cutting, and then the rooted cuttings were transplanted singly to a plastic pot (EG-105, 400 mL, Minamide Inc., Japan). The pots were filled with Metro-Mix® 360 and were placed in a propagation frame covered with plastic film but opened at the sides. Soon after transplanting, leaf SPAD values of the rooted cuttings were measured with a chlorophyll meter (SPAD-502, Minolta Camera Co., Japan). The survival of rooted cuttings was investigated in April of the following year.

RESULTS AND DISCUSSION

Only 6% of the cuttings collected in July, August, and September rooted. Although 30% of the cuttings collected in mid-May rooted, the bases of some cuttings were damaged by the treatment of high concentration IBA solution possibly because they were soft. Collecting the cuttings in May did not seem to be practicable, because at that time we collected fewer cuttings from the stock plants, shoots from which did not elongate well.

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Table 1 shows the results of the cuttings collected at the beginning of June in 2012, 2014, and 2015, in which the stock plants produced many shoots for cuttings and the irrigation systems worked well. The rooting percentages was higher in the cuttings from root-suckers than those from hedges (Figure 1.). The fog system was superior to the mist system in the rooting percentages of FDR-1 cuttings. The rooting percentages of the cuttings treated with 6000 ppm IBA was higher than those with 3000 ppm IBA.

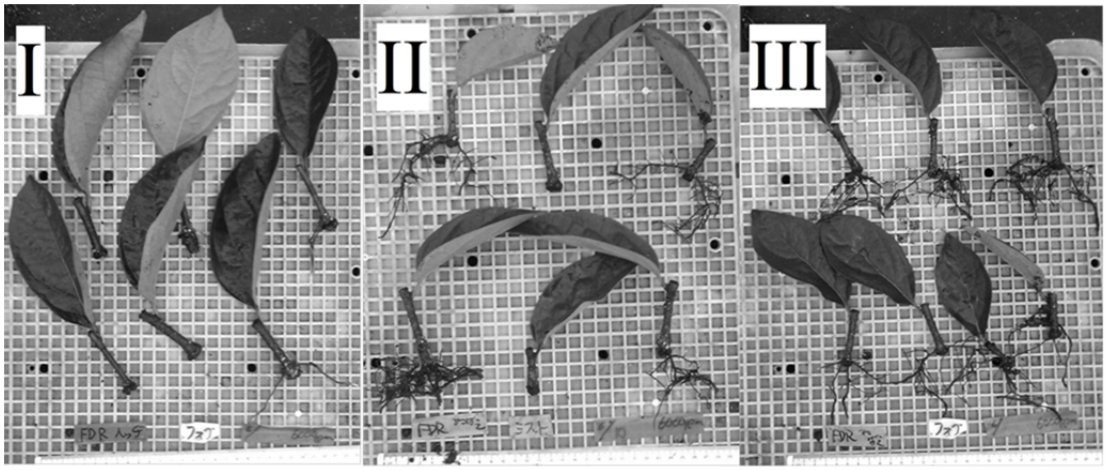

Figure 1. FDR-1 cuttings 2 months after planting on 10 June 2014: (I): the cuttings collected from hedges, irrigated by fog, and treated with 6000 ppm IBA; (II): the cuttings from root suckers, treated with mist, and with 6000 ppm; (III): the cuttings from root-suckers, treated with fog and with 6000 ppm.

The cuttings from root-suckers of 'Nishimura Wase' Japanese persimmon and 'MKR1' dwarfing rootstock for kaki also rooted better (Tetsumura et al., 2001, 2011, 2015a). The relative humidity in the mist system dropped below 50% in the daytime of summer because the fans ran to keep the temperature setting. On the other hand, the relative humidity and the temperature in the fog system closed by plastic film were maintained over 95% and below 40°C, respectively. The amount of water used per 10 m^2 in the fog system was 3.6 L h^{-1}, which was one-fifth of those in the mist system. The small amount of water provided by the fog system possibly reduced leaching from the leaves of cuttings, which showed higher SPAD value (51.1 of the leaves of the rooted cuttings in the fog system vs. 42.9 of those in the mist system in 2014 and 50.9 vs. 43.7 in 2015), because SPAD values of persimmon leaves were highly correlated with N concentration of the leaves (Choi et al., 2011). In these conditions, photosynthetic rates of the leaves in the fog system may have been higher than those in the mist system, and consequently the rooting percentages of the former were assumed to be higher than those of the latter.

The treatments improving the rooting percentages did not improve the number and length of roots (Table 1). Almost all of rooted cuttings survived 1 year after cutting. FDR-1 nursery plants propagated by cutting were seemed to be more vigorous than 'MKR1'.

In conclusion, rooting of FDR-1 cuttings was improved when they were collected from root-suckers at the beginning of June, put in the fog system and treated with 6000 ppm IBA. However, there were annual variations in the rooting percentage. For example, 80% of the cuttings collected from hedge, put in the fog system and treated with 6000 ppm IBA in 2012 rooted, while 20% of those cuttings rooted in 2014. Hence, we should investigate other factor influencing rooting of FDR-1 cuttings.

Table 1. Effects of stock plant, irrigation system and concentration of IBA on rooting of cuttings of FDR-1, a dwarfing rootstock for kaki, collected at the beginning of June in 2012, 2014 and 2015. (The data of Root + Fog + 3000 ppm and Root + Fog + 6000 ppm were collected in 2014 and 2015).

Stock plant	Irrigation system	Conc. of IBA (ppm)	Rooting (%)	Roots per rooted cutting	Total length of roots (cm)
Hedge	Mist	3000	17±10	1.9±0.1	14±0
		6000	27±12	2.1±0.2	11±1
	Fog	3000	20±6	3.1±1.1	24±5
		6000	47±17	2.3±0.1	18±1
Root	Mist	3000	33±5	2.0±0.3	15±2
		6000	60±9	4.0±0.9	26±5
	Fog	3000	45±8	1.5±0.4	11±3
		6000	80±7	3.3±0.6	22±3

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