Plant biotech research and development for agribusiness in Jeju

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Abstract. **The citrus industry represents a major sector of agribusiness in Jeju successfully nurtured by the local governmental farm bureaus for the past three decades. However, in the face of increasing imports effected under the international free trade agreement, the continuous economic viability of the island's citrus industry is no longer assured. Thus, it entails exploration and development of new agribusiness potentials that are supplemental and/or alternative to the citrus industry. In this presentation, I will discuss two projects of such potentials. (i) Under the tripartite collaboration among Kumho Life and Environmental Science Laboratory, Cheju National University and South Jeju County, genetically engineered turfgrass cultivars possessing both herbicide- and shade-tolerances (gene pyramiding) are currently at final phase of phenotype evaluations and environmental safety assessments. (ii) Fig fruits with longer shelf-life are being developed with support from Jeju HiTech Industrial Development Institute (HiDI) and at its initial phase of development.**

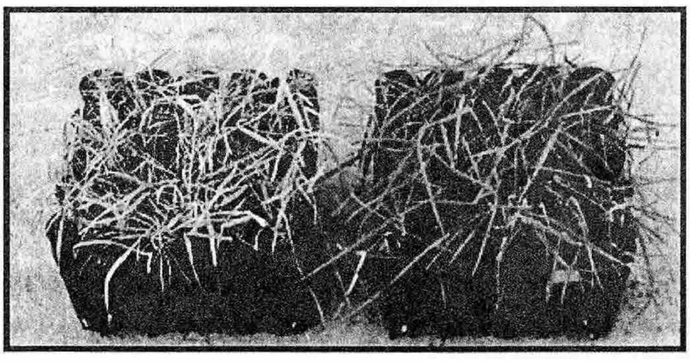
Turfgrass Biotechnology

Turfgrass plays an important role in our life adding beauty to the environment and providing the foundation for recreational sports. Turfgrass is a good commercial target plant for biotechnological application because of the big and fast-growing market potential in the world (Wang et al., 2001; Chai and Sticklen, 1998; Lee, 1996). As the utilization area of turfgrass species increases, the demand for genetically improved cultivars increases. Thus, the turfgrass with new traits genetically engineered will have substantial marketability. The most attractive target trait in this regard is to reduce managementcost of turfgrass including significantly reduced watering, mowing and agrochemical application, and resistant to environmental stresses and diseases. In the United States, more than thirty billion dollars are spent annually for the maintenance of turfgrass. Therefore, it is economically and environmentally useful to develop the turfgrass requiring low-maintenance. The immediate goals of this research are to establish the core technology for genetic transformation of turfgrasses and to make genetically modified (GM) turfgrasses that is commercially valuable, including herbicide resistant (lower maintenance cost and lower environmental problem), shade tolerant (shorter and greener), stress-tolerant (lower maintenance and higher value), disease-resistant, well-being (pollen-free), colored, and multiple traits-containing turfgrasses. Herbicide resistant turfgrass will provide a useful tool for controlling weed species in the turfgrass area, and reduce the number and amount of agrochemicals that can decrease the environmental pollution (Fig. 1). The shade avoidance-suppressed turfgrass is expected to be greener, shorter and healthier than wild-type turfgrass (Fig. 2). Stress-tolerant and disease-resistant turfgrasses are very useful for lowering the maintenance cost. Well-being concept turfgrass in which potent allergen (pollen) is removed, colored turfgrass, multiple traits-containing turfgrasses will be expected to have substantial marketability. We are currently performing environmental risks assessments of developed genetically engineered turfgrasses on the fields located in Jeju.

Figs Biotechnology

Citrus fruit (*Citrus unshiu*) is the most important economic fruit crop in Jeju island, but the production of this fruit has been over-saturated and its usage in industries has been limited since 2000. In order to maintain the citrus industry in Jeju, the production and cultivation area of citrus fruit need to be kept properly, and a new fruit crop which has a competitive power to tropical fruits being massively imported, such as orange, banana, pineapple, kiwi fruit, mango, etc., should be chosen. One of the strongest candidate fruit is a fig tree. Figs (*Ficus carica* L.), a tropical fruit tree, are mostly cultivated (over 90%) in Youngam county, southern area of Korea. This fruit tree has characteristics, such as rapid fruit setting, morphological advantage of fruit setting, relatively low labor competition, labor-saving culture in management. Thus, fig fruit is one of the complementary candidate fruit crop for citrus fruit.

Fig fruit is worldwidely produced about a million metric ton, but a short shelf-life of fresh fig fruits causes a limit of extending market size. Thus, before this fruit tree is cultivated in Jeju, fig fruit cultivars with longer shelf life should be developed. Using biotechnology, our focus is on underlying fruit development and ripening/senescence to improve shelf life of fig fruit for growers and the fresh market as well as processing industries (Giovannoni, 2004; Brummel and Harpster, 2001). To reach the goal, we are applying biotechnological approaches using tomato and some tropical fruits as fruit models. It is known that ethylene gas acts as a dominant hormone in fruit ripening. Ethylene is synthesized from S-adenosylmethionine (SAM) by a sequential action of two



Non-Transgenic **Transgenic**

Fig 1. Comparison of herbicide resistance between non-transgenic and transgenic turfgrasses after herbicide spray key enzymes, 1-aminocyclopropane-1-carboxylate (ACC) synthase and ACC oxidase. In addition, polygalacturonases (PG) is involved in fruit ripening. Therefore, genetic manipulation of ripening-specific gene(s) will contribute to the practical application of this knowledge to extent the shelf life of fig fruits. In addition, fig tree germplasms are being introduced for their adaptability trials in cultivation environments of Jeju. Thus, development of fig fruits with longer shelf life will provide a competitive opportunity to next generations in agricultural industry of Jeju.

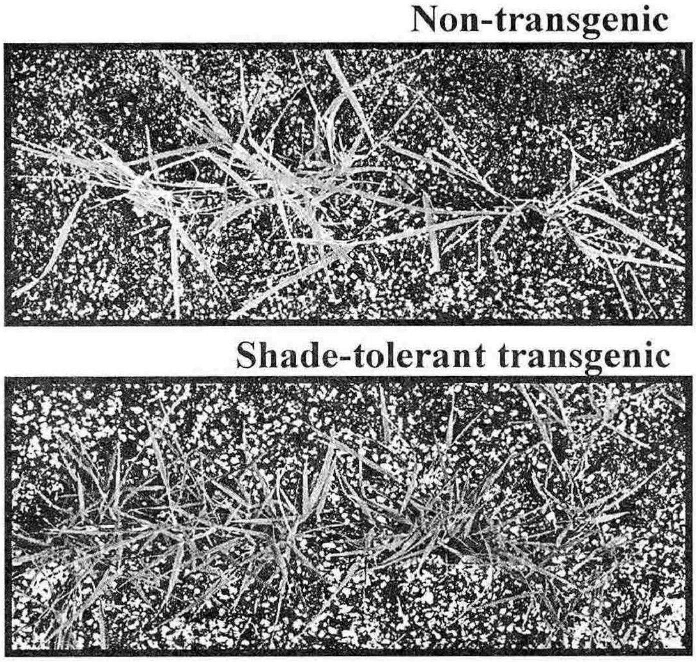


Fig 2. Phenotypic comparison between non-transgenic and shade-tolerant transgenic turfgrasses.

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