ABSTRACT OF EXHIBIT
2005 TAIWAN INTERNATIONAL SCIENCE FAIR

CATEGORY: Botany
TITLE: Mathematical Analysis of Root Growth in Gamma-irradiated Cashew (*Anacardium occidentale* L.) and Mangosteen (*Garcinia mangostana* L.) Using Fractals
NAME: Klarizze Anne M. Puzon
COUNTRY: Philippines

Root growth is related to the acquisition, distribution, and consumption of water and nutrients of plants. As a vital organ, roots directly take the effect of environmental change and its behavior is closely related to the growth of the whole plant. With such, the importance of root systems has motivated botanists to seek a better understanding of root branching complexity. This complexity, which has been difficult to comprehend using simple Euclidean methods (i.e. lines and circles), is important to the survival of plants, especially when the distribution of resources in the environment is scarce. Mathematical models using fractals and computers can be applied to accurately understand the growth and form complexity of plant root systems. This study was conducted to analyze the root growth of gamma-irradiated cashew and mangosteen using fractals.

Seeds of cashew (n=360) gamma-irradiated at 0 Gy, 150 Gy, 300 Gy, 450 Gy, 600 Gy and 750 Gy, and mangosteen (n=75) gamma-irradiated at 0 Gy, 10 Gy, 20 Gy, 30 Gy, and 40 Gy were germinated in perlite plots. The plants' primary root lengths were measured. Image analysis using *Fractal Dimensions* software was conducted to determine the fractal dimensions, D, of the plant roots.

Findings for mangosteen reveal that as the gamma-irradiation dose increases, the primary root length decreases and the root D increases. Roots irradiated at 40 Gy showed the highest average D at 1.657. This implies greater root branching complexity which results to better plant nutrient exploitation efficiency. For cashew roots, D did not vary significantly with increasing gamma-irradiation dose. However, cashew seeds irradiated at 150 Gy exhibited the highest germination rate, highest average primary root length, and an average D of 1.613. General trends also reveal that cashew roots' D increased with time.

This study demonstrates that fractal dimension can be a useful tool in characterizing the complex branching characteristics of root systems. This may pave the way for further applications of fractals in other areas of research. The findings from this research study can also be used to improve the agriculture of cashew and mangosteen which are two of the world's most economically-valued fruits.