The Usage of Gibberellin-Rich Seed-Waste for Vegetable Growth Enhancement: A Case Study of Rambutan Seed

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Abstract

This research aims to study the feasibility of plant growth enhancement by Extracted Gibberellic Compounds (EGCs) of rambutan seed-waste, with 3 extracted solvents: 80% methanol, 80% ethanol and rice whisky, and at the considered ratios (wt./vol.) of rambutan seeds (grams) and extracted solvent (milliliters) of 1:1, 1:2 and 1:3. The growth enhancement was identified through the Lettuce Hypocotyl Bioassays (LHB) method. Among the 5 species of lettuce (Grand rapids, Red cos, Red oak, Red coral, and green oak) for bioassays, the Green Oak lettuce was finally determined to be the representative lettuce for LHB. The 2.1 % of diluted EGC (methanol solvent, ratio 1:1) performed better as a growth enhancer than the other EGA. Moreover, the same EGC type revealed a non-significant difference of growth enhancement with standard GA3 at 0.1 ppm. (p > 0.05). Therefore, the 2.1% EGC (methanol, 1:1) had gibberellic acid equivalent (GAE) to 0.1 ppm standard GA3. In application to Water Morning Glory growth enhancement, the introduction of EGC (Methanol,1:1) with the dilution ratio 1:1 with water performed significantly different (p<0.05) in height and no-significant difference (p>0.05) in fresh weight with the control (water).

Keywords: Extracted Gibberellic Compounds(EGCs)/Rambutan seed/Gibberellic acid equivalent/ Lettuce Hypocotyl Bioassays /Water Morning Glory

1. Introduction

Currently, land is becoming a more and scarcer resource, particularly for agricultural production, therefore, competition for available land for different uses is creating more conflicts and complexities (FAO, 1997). As of now, the farming systems development (FSD) is considered to be a potential strategy for improving food security. In particular, the usage of plant growth regulators (PGRs), defined as “a substance used for controlling or modifying plant growth processes without appreciable phytoxic effects at the dosage applied” (Lessenger, 2006; Moore, 1998). PGRs are mainly composed of variations of gibberellic acid (GAs), ethylene, auxin, abscisic acid, gibberellins, cytokinins, jasmonates, brassinosteroids and salicylates. But the most widely used is gibberellic acid (GA3). However, it has to be extracted from cultured fungi, which consequently makes it quite expensive. So, the local farmer and gardener cannot access this improvement for their food production system. However, several studies have reported the gibberellic-like substances (GLS) are available in seeds, tips and roots at various amounts and growing stages (Ortega-Baes, 2007; Çetinbaş, 2006; Niran, 1993; Bachelard, 1968).

Rambutan (Nephelium lappaceum Linn.) is a seasonal fruit native to Southeast Asian countries. Thailand has become the leading producer and exporter of Rambutan. This fruit is generally consumed fresh, and sometimes is industrially processed to obtain juice, jams, jellies and marmalades, as well as with a chunk of pineapple and canned in syrup. In the preparation process, the rambutan fruits are deseeded during processing and these seeds (~ 4-9 g/100 g) are considered as a waste by-product (Wannee, 2011). Furthermore, there are reports that plants in the Sapindaceae family and related genus, such as rambutan and longan seeds, possess a relatively high amount of GLS (Sunee & Aussanee, 2009). However, whether or not this GLS will be available for local usage depends on the extraction process, which needs locally available solvents to become a viable option. Thus, this study will consider edible ethanol (40 degree rice whisky) in association with such novel solvents as methanol, ethanol (Jones,1968; Assen,1960) and investigate whether these EGCs or GLS from rambutan seeds with the aforementioned solvents can enhance plants and vegetables growth or not. Hence, in the study it was applied to water morning glory. Can it enhance the growth and quality of the product such as: uniform length, fleshy weight, as well as reducing the harvesting time?

2. Methodology

To approach the research questions, whether the gibberellic-rich seed waste is feasible for plant and vegetable growth enhancement or not, three main objectives were setup as illustrated by the conceptual framework in Fig. 1. They include i) the effectiveness of EGCs from Rambutan seeds when compared with standard gibberellic acid, ii) the growth enhancement of plants and such as as water morning glory (WMG).

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