Potential of Plant Extracts as Growth Exogenous Regulators of Potato Seeds

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Abstract: Potato production in Indonesia has been declining while demand for potatoes remains increasing. One main reason of the decline is the lack of availability for good potato seedling. To optimize the growth of potato seedling, some plant extracts as exogenous growth regulators may be used. This experiment was aimed to select the best plant extract as exogenous growth regulator for potato seedling growth and study the underlying physiological process. Seven plant extracts as exogenous growth regulators for potato seedling were used as treatments namely: water as a control, corn grain (Zea mays L.), onion (Allium ascalonicum L.), coconut water (Cocos nucifera L), snaps (Phaseolus vulgaris L), banana (Musa paradisiaca L.) and mung bean sprouts (Vigna radiata). The experiment was set in the form of randomized complete block design with three replications. Result revealed that one month after sowing, corn grain extract gave the best quality on the potato seedling growth based on percentage of live seedling (100%), seedling height (15.87 cm), number of leaves (9.40 leaves) and root length of the seedlings (13.39 cm). On the other hand, water treatment (control) showed the lowest growth quality on potato seedling indicated in all parameters as follow: percentage of life of potatoes seedling (74.44%), seedling height (3.66 cm), amount of leaves (4.27 leaves) and length of root (4.83 cm).

Keywords: Plant extracts; growth regulators; potato seedling

1. Introduction

Even though demand for potatoes in Indonesia is increasing, potato production has declined due to lack of good quality seedling. To overcome this problem, plant growth regulators that exogenously applied may be used.Growth regulators are organic compounds but not nutrient needed in the least amount which can support, inhibit, and may alter physiological processes of plants. Growth regulators can be used to improve the quality of potato seedling. Nowadays, growth regulators commonly used are synthetic growth regulators that are relatively expensive and sometimes have scarcely availability. Alternatively, some plant extracts that contain bioactive compound can be explored to be used as plant growth regulators. This is applicable for Indonesia considering the great diversity of plant species available. Besides, the price of growth regulators is expensive and rare in the market is also a reason.

Some plants extracts as: onion (*Allium ascalonicum* L.), coconut water (*Cocos nucifera* L), snaps (*Phaseolus vulgaris* L), banana (*Musa paradisiaca* L.), mung bean sprouts (*Vigna radiata*), corn grain (*Zea mays* L.) are expected to contain bioactive compound to be used as plant growth regulators. Sandra (2011) suggested that mung bean sprouts (*Vigna radiata*), bananas (*Musa paradisiacal* L.), onions (*Allium ascalonicum* L.) contain auxin; snaps (*Phaseolus vulgaris* L) contain cytokinins; coconut water (*Cocos nucifera* L.) contains auxin, cytokinins and gibberellins, whereas corn grain (*Zea mays* L.) contains giberellin (Anonymous, 2011) and cytokinin (Lethan and Miller, 1963 in Wijaya (2002). Zamroni and Darini (2009) studied effects of coconut water on growth of chilli (*Capsicum annuum* L.). Results showed the use of 25% coconut water (*Cocos nucifera* L.) significantly affected. Mahanani (2003) investigated the effect of various sources of natural plant growth regulator and frequency of application of the growth and yield potato (*Solanum tuberosum* L.) Granola varieties. In this research were used coconut water (*Cocos nucifera* L.), mung bean sprouts (*Vigna radiata*), soy bean sprouts (*Glycine max*) and cow urine. The result showed the Application of mungbean sprouts (*Vigna radiata*) extract on potato variety (Granola) twice gave the best growth and yield compared with control (Mahanani, 2003).

Work of Arditti and Ernts (1992) showed auxin and gibberellins were contained in banana. Similarly, use of maize seed extract corn extract as growth regulator has been investigated by Hartati (2009) to study its effect on orchid plantlets and the results showed that the extract application significantly affected early root emergence and the number of roots produced. Although research on the use of plant growth regulators naturally in plants has been done, but its use is limited to the production of crops, instead of improving the quality of cuttings. In addition, the type of plants used as plant growth regulators is still limited. Thus research needs to be done on a wider variety of crops to determine the concentration of growth regulators containing compounds and see its effect on the growth of plant cuttings.

2. Materials and Methods

The research was designed using randomized complete block design with

three replicates. Seven treatments of plant extracts as exogenous growth regulators were used, namely: water as control, coconut water, onions, banana, corn grain, snaps and mungbean sprouts. Each treatment was repeated three times resulted in 21 experimental units. Each experimental unit consisted of 30 seedlings, so overall there were 630 seedlings. For each experimental unit, 9 seedlings were observed as samples, so that the total number of 189 seedlings samples. Honestly significant difference (HSD) test at level 5% was used to determine difference between treatments.

The experiment was started by planting sprouted potato tubers G0 into growing media made with a mixture of rice husk and soil (1 : 2) with plant spacing of 5 x 5 cm. Seedling cutting procedure was conducted when the seedlings were about 10 cm high with 2 leaves and 2 nodes. Cuttings were then planted in polybags filled with growing media..

Each source of natural plant growth regulators (banana, coconut milk, mung bean sprouts, onions, corn, snaps) mixed with distilled water in the ratio 1:1, blended and then added to 30 g of sugar per kg of material. After then fermented up to 15 days. Separation of liquids and solids part of the extract was carried out by centrifugation at 8000 rotation per minute (rpm) for 10 minutes. Liquid extract which is a natural plant growth regulator was put in a sealed bottle protected against light and stored in refrigerator. The liquid extract (5 ppm) was applied to potato seedling by spraying once a week as much as 50 ml per plant.

3. Results and Discussion

Growth regulator is a supporting factor in the cultivation of plants that can make a major contribution to the success of farming with its role as controlling growth, development, and movement of plants. Application of plant extracts as plant regulator on potato seedling gave effect significantly because of plant extract containing organic compounds needed in small amounts, but was instrumental in supporting, inhibiting and changing physiological processes of plants. This is consistent with the statement by Wattimena (1988) that the growth regulator is a set of organic compounds not nutrients, naturally occurring or man-made, which in some measure very small (under one millimoles per liter or just one micromol per liter) to encourage, inhibit, or alter the growth, development, and movement (taksis) plants. Furthermore,

Growth and quality of potato seedlings generally improved by the application of plants extracts as natural growth regulators. Kusumo (1984) stated that the application of growth regulators either synthetic (exogenous) and natural had a potential to speed up the growth process in plants. Different plant extracts contain different compounds and consentration that can act as growth regulator and give varied response on the growth of potato seedlings.

Table 1 showed that the extract of corn grain resulted in the highest percentage of living potato seedling (100%). Table 1 also indicated that all of the extract had no significant difference, but were different significantly with the control (water)

Table 1. Percentage of life, height average, average leaves number and root length of potatoes seedling at the age of one month after sowing at various treatment of plants extract as plant growth regulators

Treatment	Average			
	Percentage of life	Height of seedling (cm)	Number of leaves (leaves)	Root length (cm)
Corn grain	100,00 [a]	15,87 [a]	9,40 [a]	13,39 [a]
Banana	95,56 [ab]	12,60 [ab]	7,80 [a]	9,89 [ab]
Mung bean sprouts	92,22 [ab]	10,33 [bc]	8,20 [a]	10,22 [ab]
Snaps	90,00 [ab]	12,57 [ab]	8,47 [a]	9,39 [b]
Coconut water	88,89 [ab]	10,53 [bc]	7.87 [a]	11,22 [ab]
Onion	86,67 [ab]	3,67 [d]	4,87 [b]	8,67 [bc]
Water (control)	74,44 [b]	3,60 [d]	4,27 [b]	4,83 [d]
Value HSD 0.05	21,50	4,17	2,57	3,67

*) Different letters indicate differences at the level of 5%

($p \leq 0.05$). Tallest seedling resulted from the application of corn extract treatment which is significantly different from extract treatments e.g. mung bean sprouts, coconut water, onions and water as a control; but no significant difference with the extract treatment of snaps and banana. (Table 1). Other treatments e.g. extract of banana, snaps, coconut water and mungbean sprouts resulted in shorter seedlings compared to corn extract and differed significantly from seedlings treated with onions extract and water. No significant differences between onion extract treatment and water.

Application of corn grain extract as growth regulator resulted in the highest number of leaves that significantly different from the water and onion extract treatments. However, the treatment result was not significantly different from other treatments (Tabel 1). Table 1 shows that the longest root seedlings obtained in seedling treated with extracts of corn grain and significantly differed with other extract treatments i.e. snaps, onion and water, but had no significant difference with the extract of coconut water, mung bean sprouts and bananas. The shortest root seedlings obtained in seedling treated by water.

Different plants extracts contain varied types of growth regulators therefore have different effect on the improvement of the potato seedlings growth, hence quality of the plant resulted from. According to Sandra (2011) bioactive compound such as auxin, cytokinin and gibberellins could be extracted from coconut water and corn grain while auxin is found in mung bean sprouts, banana and onion extracts. In addition, cytokinin was found in snaps extract. These plants extract have potential to be used as exogenous growth regulator as shown in this study.

Application of exogenous growth regulators from plant extracts can stimulate growth which is mostly related to the mechanism played by the growth regulators. Increased growth such as longer shoot and root or higher leaf numbers by adding corn grain extract is a result of the gibberellins

contained in the grain. The study on maize grain extract conducted by Hartati (2009) showed that the effect of maize grain extract application as a natural plant growth regulator was significant at the time of root emergence and number of roots produced. Research by Arpiwi (2007) concluded that gibberellins accelerated the emergence of potato shoots above the soil surface. Bisides that gibberellins increased the number of stems, number of tubers and yield per plant. Hayashi (1961) in Arteca (1996) reported that administration of gibberellin (GA3) through the leaves may increase growth due to an increase in the effective leaf area hence photosynthesis increases. Other than giberellins, extract of corn grain also consisted of cytokinin. Cytokinin was also reported as one of important factors for the regulation of root growth, especially cell differentiation in elongation zone (Dello et al., 2007). Cytokinin is formed from the amino acid tryptophan which acts to stimulate stem elongation, leaf growth, and influence the development of potato roots. Tryptophan is an auxin-forming compound (Abidin, 1983). According Lathan and Miller (1963) in Wijaya (2002), there are natural cytokines in the immature corn kernels called zeatin. Cytokinins are compounds that can increase cell division in plant tissues and regulate plant growth and development, as well as kinetin (6-furfurylaminopurine) (Zulkarnain, 2009).

Response of potato seedling growth varied with the types of plants used as extracts. It seems that concentration of growth regulators contained in plant extract drive the growth even though for some parameters the statistical difference shows no differences. Better growth of potato seedling treated with corn grain extract followed by coconut water extract, mung bean sprouts extract and banana extract compared to other plants extract treatment might be related to the set of growth regulators compound contained in those extracts. According to Wang dan Huang (1975) and Roca et al.(1978), accuracy of the concentration of growth regulator added (exogenous) is very important, because there will be interaction between the plant growth regulator used with endogenous substances.

4. Conclusion

The use of corn grain extract as exogenous growth regulators gave the best quality of potato seedling based on parameter of percentage of life of potato seedlings (100%), seedling height (15.87 cm), number of leaves (9.40 sheets) and length of root (13.39 cm). In addition to corn, the alternative may be chosen to obtain good growth of seed potatoes are extracts of bananas, mung bean sprouts or coconut water. On the other hand, application of water treatment as a control resulted in the lowest quality of potato seedling.

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