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Cassava (*Manihot esculenta* Crantz.) Improvement through Gamma Irradiation

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Abstract

Cassava (*Manihot esculenta* Crantz., Euphorbiaceae) is an important dietary carbohydrate source for approximately 800 million people in the tropics. Cassava breeding through conventional approaches are hampered with some limitations which resulted in a low number of superior varieties. The objective of this research was to generate several mutant lines with higher yield and starch content. According to field studies it was found that several cassava mutant lines have higher yield (root fresh weight >10-20 kg plant^{-1}). Two mutant lines has a high starch content (>39%). However, diversity on some variables are still found in M1V2 generation of cassava.

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Keywords:

Introduction

The import value of wheat based products is still on the first rank of food and agricultural products list in Indonesia, and it continues to increase year by year. In 1990 wheat flour consumption in Indonesia was 9.17kg/capita/year and almost doubled in 1999 (14.29 kg/capita/year). It is clear that wheat consumption per capita is constantly rising. This resulted in the increase of wheat import volume. In 2012, Indonesia has imported 6 million tons of wheat. Therefore, a breakthrough and efficient strategy are needed to reduce wheat import. One effort that

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can be done is to optimize and raise alternative sources of carbohydrates from tuberous crops such as cassava (*Manihot esculenta* Crantz., Euphorbiaceae). In Indonesia, from 2006-2011 the average of cassava planting area 1,199,313 ha, with production of 21,858,879 ton, and average productivity of 18 ton/ ha.

Cassava is an important dietary carbohydrate source for approximately 800 million people in the tropics [1]. Africa is the major producer of cassava worldwide, followed by Asia and Latin America, with total production around 200 million ton [2]. In the global trade of cassava, Thailand and Indonesia are the major cassava exporters; exporting mainly cassava chips, cassava pellets, cassava starch, and flour. More recently, it has gained importance as a possible fuel commodity not only in Indonesia but also in Philippines, China, Thailand, and other countries which have more advanced national bio-fuel programs.

The storage root of cassava is rich in starch (31%) [3]. Susilawati *et al*. [4] further reported that the starch content of Kasetsart variety reached 35.9% at 10 month after planting in Gunung Agung Village, Sekampung Udik sub district, Lampung Province. However, the starchy root of cassava is very poor in protein and contains linamarin/ cynogenic potential [5, 6]. Starchy root of cassava can be directly consumed if the cyanide (HCN) content ≤50 mg (kg fresh weight)$^{-1}$. Cassava for tapioca industry does not have any specific protein and HCN level requirement, since most of the HCN will be removed during processing.

With the development of cassava processing industry today, improvement of both yield and nutritional quality and reduction in cyanide content are among of agronomic characters need to be targeted in cassava breeding program. Cassava breeding through conventional approach faces some limitations, such as ploidy level, high heterozigosity, inbreeding depression, and low genetic variability caused by clonal propagation commonly applied for this plant. High genetic variability is one of important determinants in successful breeding of clonally propagated crops such as cassava. Mutation induction using gamma irradiation is one strategy to increase genetic variability. Joseph *et al*. [7] reported that gamma irradiation (Co^{60}) at the rate of 50 Gy could successfully induced mutation in cassava variety PRC-60a *in vitro*. That study reported that more than 50% mutant lines showed variability in morphology compared to the wild type plants. The objectives of this research were to generate several cassava mutant lines with higher yield and starch content. Some cassava mutant lines with higher yield and starch content, and also lower HCN content will be used for further studies, especially for multi location trials to develope the best lines as new varieties.

Materials & Methods

Stem cuttings of several mutants of M1V2 generation were planted in Cikabayan Experimental Field (240 m asl) in a planting space of 1 m x 1 m. Fertilizers were applied with the rate of 200 kg urea ha^{-1}, 150 kg SP-36 ha^{-1}, and 150 kg KCl ha^{-1}. Full rate of SP-36 was applied at the day of planting, while only 1/3 rate of urea was applied at the day of planting. At 1 month after planting (MAP), 2/3 rate of urea was applied, and full rate of KCl was applied at 2 MAP. Tuber morphological characters were observed at harvest time and scored according to IITA (*International Institute of Tropical Agriculture*) [8].