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Influence of agro-ecology on growth and performance of several potential mutants of cassava

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Abstract

Cassava (*Manihot esculenta*) is an important source for food, feed, and raw material for industries in Indonesia. In order to develop new high yielding and high starch content varieties, two national varieties (i.e. Adira-4 and Malang-4) and introduced variety (UJ-5) were irradiated with gamma ray to induce genetic variety. Evaluation of potential cassava mutants was needed to learn their growth and performance in two different agro ecologies, which were acid upland and optimum upland, in order to select adaptive mutants. Cuttings from sixteen mutants and three parent lines (UJ-5 (V3), Adira-4 (V4), and Malang-4 (V5)) were planted in two different locations which were Technical Implementation Unit Field Tenjo, Bogor (pH 4,8; 57 m asl) and Cikabayan Experimental field IPB, Dramaga, Bogor (pH 5,6; 200 m asl). Destructive observation was done at 4 months after planting to observe root length, tuber length, tuber diameter, and tuber mass. There was no significant difference between mutants and their parent lines on every observed variable. Number of leaves, stem diameter, tuber diameter, and tuber mass on every mutant and parent lines in acid upland were not significantly different with those planted in optimum upland. Plant height and tuber length in some mutants in acid upland were significantly higher than those planted in optimum upland. Disease incident of brown leaf spot (*Cercospora* sp.) was 90% and 47% and disease severity was 25-50% and 0-25% infected part of plant in acid upland and optimum upland respectively.

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1. Introduction

Cassava (*Manihot esculenta* Crantz) served as carbohydrate source for 800 million people in the world. In Indonesia, cassava was the third most important staple food after rice and maize. Productivity of cassava increased from 18.7 ton ha-1 to 22.8 ton ha-1 in 2009 and 2014 respectively. Even though there was an increase of cassava productivity and production, in 2014 Indonesia imported cassava of 24,558,778 ton in form of fresh and processed cassava [1]. It was evident that cassava production in Indonesia had not been able to fulfill the demand.

Cassava productivity in the last ten years was around 10 – 22 ton ha^{-1} and its potential yield was around 25 - 40 ton ha^{-1}. Several cassava genotypes even had potential yield of 100 ton fresh tuber ha^{-1} [2]. The gap between actual productivity and potential productivity was due to lack of superior seedling, under-optimum fertilization and pest and disease control, and cassava plantation on marginal land.

Marginal land in Indonesia was dominated by ultisol, which covers about 25% of total arable land in Indonesia. Ultisol was found mostly outside Java, making acid soil tolerant genotypes a crucial aspect in extensification effort.

Cassava breeding efforts was conducted to find cassava with high productivity, high starch content, and have tolerance for acid soil and high Al concentration in order to have cassava genotype that still have high yield under abiotic stress of marginal land. Preliminary effort of cassava breeding related to this research was done by Khumaida *et al.* [2] and Maharani [3] by irradiated five cassava genotypes using gamma rays to induce genetic variety to be selected. These cassava mutant lines were observed to find lines with desirable traits. This research was conducted to evaluate growth and performance of several potential M1V4 generation mutant in two different agro ecologies which were acid upland and optimum upland.

2. Methods

Stem cuttings from sixteen mutants and three parent lines (UJ-5 (V3), Adira-4 (V4), and Malang-4 (V5)) were planted in two different locations which were Technical Implementation Unit Field Tenjo, Bogor and Cikabayan Experimental field IPB, Dramaga, Bogor, West Java. Tenjo field had pH 4.8 soil and located at 57 m asl (above sea level), whereas Cikabayan field had pH 5.6 soil and located at 240 m asl. Fig. 1 showed maps of two locations. At each location, experimental design used was single factor completely randomized block design with five replications. Data from both locations was analyzed and if both data error was not significantly different, then data was analyzed as two factors, which were genotypes and locations.

Land preparation was done by making beds and application of manure of 5 ton ha^{-1} two weeks before planting. Cassava cuttings with size of ±20 cm (5 nodes) were planted with planting space of 1 m x 1 m. At two weeks after planting (WAP), fertilizer of 300 kg ha^{-1} NPK (16-16-16) was applied. Second fertilizer application was given at 3 months after planting of 100 kg ha^{-1} urea and 50 kg ha^{-1} KCl.

Observation was conducted on growth parameter such as plant height, number of leaves, and stem diameter. Destructive observation was done at 4 months after planting to observe root length, tuber length, tuber diameter, and tuber mass.

3. Results

At the beginning of this experiment, Tenjo Field received moderate rain 85-115 mm per month, however Cikabayan received 116-150 mm per month. From 4 months after planting (MAP), both locations experienced moderate dry spell with 11 – 20 days without rain [4].

Genotypes planted at Cikabayan showed better growth than those planted at Tenjo in early growth (2 WAP). At 4 – 14 WAP, cassava planted at Tenjo had higher plant height than those panted at Cikabayan, as well as on number of leaves and stem diameter from 10-14 WAP (Table 1). Destructive observation results did not showed significant effect on root length between cassava planted at Tenjo and Cikabayan. On variable tuber length, diameter and mass, cassava planted at Tenjo had significantly higher value than those planted at Cikabayan (Table 2).