Proceeding

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Matthias A. Lechner and The Yogyahealth Collaborative Team

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THINK GLOBALLY AND ACT LOCALLY (THE ALTERNATIVE TO ENHANCE LOCAL BUSINESS PERFORMANCE, TOWARDS A GLOBAL BUSINESS)

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IN SEARCH FOR *JATROPHA CURCAS* L. GENOTYPES
SUITABLE FOR DRY LAND AREAS

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Abstract

This study aims to identify potential *Jatropha* genotypes that able to grow in
dryland areas, to be used for alternative bioenergy source such as biofuel and
biodiesel. The project was carried out at Asembagus Experimental Field
Station, Situbondo, East Java, Indonesia. Thirty six accession collections from
eastern part of Indonesia were chosen for drought trial. Cuttings, 40 cm length
and 1.5 cm in diameter were planted in 35 cm diameter pot and watered every
morning. Ten weeks later, all accessions were exposed to four water regime
treatments, i.e. 20 – 39%, 40 – 59%, 60 – 79% and 80 – 100% of field capacity
with three replicates each treatment. Plant height, number of leaves, flower
initiation time, and plant performance were observed every week until 26
weeks. Number of stomata was counted at 12 weeks after treatment. Results
show that each accession has different response to water stress. A number of
accessions have good adaptability in limited water supply, including accession
no 26 which has the best vegetative growth; accession no 8, 14, 18, 19, 30, 35
and 36 that able to produce fruit at the end of the observation time. Accession
34 was not adapted to drought.

Keywords: jarak pagar, biodiesel, biofuel, drought tolerance

1 INTRODUCTION

Fossil fuels consumption around the worlds and particularly in Indonesia is very high
(Suryana, 2007). In contrast, fossil fuels supplies are decreasing. Increasing fossil fuels
price in the International market will increase Indonesia budget since the amount of
government subsidies would increase, while reducing fuel subsidy would give significant
impact for the community, such as increase in retail prices and industrial sector would
stagnant (Hasnam, 2007). Strategic plan should be taken, including development of renewable energy as an alternative source for fuel.

In the effort to advance bioenergy in the country, Indonesian government has issued Presidential Regulation No. 5, Year 2006 about National Energy Policy. One of the targets is to reach more than 5% national bioenergy consumption in the year 2025 (Hamdi, 2006).

Green bioenergy to replace solar and crude oil can be produce from a number of renewable sources such as vegetable oil (Canola, Brassica napus) (Riley, 2004), palm oil, coconut oil, sorghum, sugar cane, and the most popular source in Indonesia currently is Jatropha curcas (Prihandana and Hendroko, 2006). The advantages of Jatropha curcas compared to other plant sources are there is no competition with other uses, such as palm oil for cooking oil (Prastowo, 2007). Producing biofuel from local plants will give benefit in reducing dependency to fossil fuel, increase income from farming sector and open up work opportunity as well as environmentally friendly (Timmas BBN, 2007).

In accordance to vision and mission on estate development and considering the prospect, commodity potency and opportunity, development of Jatropha in Indonesia was aim toward maximizing neglected land and marginal land, which are usually dry land with limited rainfall (Suryana, 2007). Therefore, it is necessary to develop Jatropha plantation that withstand and able to produce fruits with high content of oil.

Puslitbangun (Indonesian Research Centre for Estate Plants) and Balittas (Indonesian Sweeten and Fiber Crops Research Institute, ISFCRI) were given mandatory to focus on Jatropha research. This two institutes has explored genetic materials of Jatropha curcas from Indonesia, and planted at three main research station, Kebun Induk Jarak Pagar Asembagus, Situbondo, East Java (for dry climate), Kebun Induk Jarak Pagar Muktiharjo, Pati, Centre Java (for mild climate) and Kebun Induk Jarak Pagar Pakuwon, Sukabumi, West Jawa (for wet climate).

Evaluation of all the accession has resulted in three selected population with productivity around 4-5 ton per ha. However, selected population can only be achieved at a good cultural practice (Mulyani et al, 2006). Therefore, in practice, only farmers with big capital (investor) that able to reach maximal productivity of selected Jatropha accession, while ordinary farmers would not get the benefit as they only practice low input with limited rainfall (400 – 600 mm per year).

Successful breeding program will depend on validity of selection criteria being used. A number of characters that highly correlate with seed productivity of Jatropha are: proportion of male and female flowers on each inflorescence, number of inflorescence per plant, number of fruit per inflorescence, number of inflorescence per branch, number of seed per capsule and number of reproductive branch (Hasnam, 2007).

The aim of this research is to identify Jatropha germplasms that are well adapted to dry land areas. Long term goal is to obtain superior varieties to support the development of energy alternative in Indonesia.

2 METHOD

Field-pot trial to select drought tolerance accession of Jatropha curcas was carried out at Indonesian Sweeten and Fiber Crops Research Institute (ISFCRI) at Asem Bagus District, Situbondo Regency, East Java. Jatropha curcas seed from 34 accession and 2 selected clones (IP 1A and IP 2A) were planted in 35 cm diameter pot. Accession was collected from dry land areas of Eastern part of Indonesia including West Nusa Tenggara, East Nusa Tenggara, South Sulawesi and East Java. Media consists of soil and cow manure (13:1).
Both soil and cow manure was screened before mixing to obtain homogenized media texture. Jatropha cutting were used as plant materials. Same size of cutting were chosen, with ± 1.5 cm diameter and ± 40 cm height. The tip of the cutting were cover with plastic to avoid standing water that can cause fungi or bacteria infection. Watering was done every morning between 7 – 9 am. Pots were place in the open areas without shade to make sure plants obtain full sunlight to maximize growth.

Screening for drought tolerance was started when cuttings exhibited healthy grows, shown by having 2 branches and plant heigh around 90 – 110 cm, which was around 10 weeks after planting. Cuttings were exposed to 4 different levels of water stress, i.e. 80 – 100%, 60 – 79%, 40 – 59% and 20 – 39% from field capacity. Randomized completely block design were use in this experiment, with three replicates for each treatment, and two sub unit each replicate.

Soil water level on each pot was measure every morning using gypsum block. In each pot, cylindrical gypsum block, with dimension of 3 cm diameter and 5 cm length, was planted and connected with 30 cm length cable/filament. To measure media water level, cable from gypsum block was connected to gypsum meter and the water level will shows on the monitor. Based on the water level measured, water was then added as needed until the gypsum meter shows the water level according to the treatment. Water regime treatment was done for 4 months (16 weeks) during dry season. Observation was done every week, including plant height, number of primarily branches and secondary branches, number of leaves, time of first flowering, percentages/proportion of male and female flowers.

### 3 FINDINGS AND DISCUSSIONS

Results shows that there are variation observed among cultivars after four months observation on vegetatif and generatif growth. Details observation as follows:

#### 3.1 Plant height and number of leaves

Plant height at the end of observation period (26 weeks after planting, WAP), shows variation among accession. Plant height on treatment 80-100% water regime ranging from 35 cm (accession no 1 and 21) to 62 cm (accession no 7) showing accession 1 and 21 has slow growth, while accession 7 has fast growth in good water supply.

Each accession shows different response to water regime treatments. Accession no. 4, 13, 30 shows sharp decrease in plant height with decrease of water supply (Table 1). According to Sarvestani and Pirdasthi (2008), water stress significantly affect plant height. Decrease in plant height can be due to inhibition on cell elongation or inhibition to cell division due to limited water availability. Other accession such as accession no 1, 3, 17, and 26 did not affected by water stress and has the same plant height or event taller than control plants (plants that were given 100% water). The results shows those accession able to adapt on dry environment.

Observation on number of leaves also shows a similar trend with plant height. Each accession has a different response to water regime, as revealed by different number of leaves. There was a positive correlation between plant height and number of leaves, in which the taller the plants, the more leaves they have. It is presumable that accession with drought tolerance has stable plant height and a lot of leaves, has high vegetative biomass a. Lots of leaves means better photosynthesis (Germ et al., 2005)
3.2 Number of branches
Observation on number of primary and secondary branches do not show significant differences among cultivars, after treatment with drought level. Every accession has in average 3 primary branches. A number of accessions did not produce secondary branches, such as accession no 19, 20, 22 and 31. This may be due to the specific characteristics of those accessions. Accession no 2 and 33 have a lot of branch, which is a preferable characteristic for selection in *Jatropha*. The more branches on each plant, the more flowers will be produced and ultimately the more fruit will be produced.

3.3 Flowering time and proportion of male and female flowers
*Jatropha* accession produced by cutting were started to flower at 10 WAP. Flowering times varied between cultivars and between treatments. Plants on control treatments (given 80-100% water supply) in general shows the earliest flowering time compared to plants treated with lower water level. Accession no 3, 4, 6, 10, 15 and 36, water regime treatment causing plants to flower earlier compared to optimum water supply (Table 1). Earlier flowering time is a mechanism for plants to survive.

3.4 Plant vigor
Observation on plant vigor was done with scoring from 1 – 4. Score 1 shows plants are dying, score 2 shows plants are weak or slender, short and low number of leaves, score 3 means healthy plants, many branch and many leaves, score 4 shows healthy plants, tall with many branches and many leaves.

In general, *Jatropha* accession shows decreasing score with increasing water stress treatment (Table 1). This shows that *Jatropha* plants needed plenty of water to grow and develop. Accession 14 and 35 shows healthy plants grow on all water regime treatments.

### Table 1. Average plant height, number of leaves, number of branches, first flowering time and vigor score of each accession of *Jatropha curcas*, exposed to different treatment of water regime, 26 weeks after planting.

<table>
<thead>
<tr>
<th>Accession no</th>
<th>Water regime</th>
<th>Plant height (cm)</th>
<th>No. of leaves</th>
<th>No. of branch</th>
<th>Flowering time (WAP)</th>
<th>Vigor score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80-100%</td>
<td>35.2</td>
<td>18.1</td>
<td>3.0</td>
<td>18.3</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>60-79%</td>
<td>35.2</td>
<td>35.2</td>
<td>2.7</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>40-59%</td>
<td>31.3</td>
<td>31.3</td>
<td>2.3</td>
<td>Not yet</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>20-39%</td>
<td>38.8</td>
<td>38.8</td>
<td>3.0</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>80-100%</td>
<td>56.8</td>
<td>29.4</td>
<td>3.3</td>
<td>17</td>
<td>4</td>
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4 CONCLUSIONS AND SUGGESTIONS

It can be concluded that *Jatropha* accessions have varied response to water stress. Accession 8, 14, 18, 19, 30, 35 and 36 has good vigour. Accession no 34 is very sensitive to water regime and cannot withstand water stress. Accession 26 has the best vegetative growth. Accession 2 and 33 has many branches with potential on producing many fruits. Accession 2, 26 and 33 could be used as parent line for breeding for drought tolerance plants.

To evaluate performance of accession selected from current pot trials, it can be suggested to do a field trial in dryland region in Indonesia such as north part of Bali, West Nusa Tenggara and East Nusa Tenggara.

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