# B.1-9-Yield of Jatropha curcas L. accessions of West Nusa Tenggara during

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**Research Article**

# Yield of *Jatropha curcas* L. accessions of West Nusa Tenggara during five a year production cycle on a degraded agricultural land

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**Abstract:** Competition between food crops and bioenergy crops in using agricultural lands should be avoided. Bioenergy crops such as *Jatropha*, should be grown on underutilized or degraded agricultural lands only to improve the land productivity and land coverage. Yield potential of five *Jatropha curcas* L. accessions of West Nusa Tenggara, Indonesia was evaluated on a degraded agriculture land at district of Kayangan, North Lombok, Indonesia. The experiment was conducted using a Randomized Complete Block Design with three blocks, and 24 plants per plot of each accession for five years. Yield components showed significant differences among accessions. Better yield performance was showed by West Lombok, Sumbawa, and Bima accessions e.g. 6.004 kg/ha, 5.885 kg/ha and 5.548 kg/ha at five years of age respectively. However, the yearly yield improvement was reduced after the plant reached three years of age and it was not followed by a geometrical progression based on dichotomy brancing system of the *Jatropha*. The high yielding accessions have a good potential to be grown on degraded agricultural lands to produce bioenergy as well as to reduce soil erosion.

***Keywords** : bioenergy, branching, dichotomy, oil content, seed weight*

## Introduction

*Jatropha curcas* L. or jatropha has been described as a drought tolerant plant and capable of growing in marginal and poor soil and also has potential for cultivation under semi-arid conditions without competing with food crops for land use (Fairless, 2007; Divakara *et al*., 2010). The economic feasibility of biodiesel production from jatropha oil has been accepted worldwide as a solution for the problem of environmental degradation, energy security, restricting imports, rural employment and attaining better agricultural income (Samodi *et al*., 2012). Even so, jatropha should not be grown on agricultural lands to compete with food crops. Growing jatropha on degraded land or underutilized land to land productivity and land coverage is suggested (Pandey *et al*. 2012). Jatropha as a potential biodiesel crop has recently been introduced to Indonesia. Although this species grows abundantly in the wild and abandoned lands, its seed and oil productivity under tropical climate is not known (Ovando *et al*., 2011; Rafii *et al*., 2012). Presently, production of *Jatropha* is limited by non availability of quality planting materials and agrotechniques. The species has adapted itself to a wide range of environmental and ecological condition and there exists considerable genetic variability. Breeding of high yielding variety is not possible without knowing yield potential of the available genotypes. Hence, the present investigation was undertaken to asses the performance of several *J. curcas* accessions within West Nusa Tenggara province during the first five-year production cycle on dry lands.

## Materials and Methods

### *Plant material and their preparation*

Plant materials were collected during Mei-Juni 2006 from West Nusa Tenggara region where *J. curcas* is grown as garden fences. Seeds were collected from representative trees showing good growth and development. Capsule with yellow colour (ripe stage) was harvested and the seed was air dried for two days before sowing in a nursery.

***Experimental site condition***

Seedling preparation and field experiment were done at Amor-Amor Village, District of Kayangan, North Lombok, West Nusa Tenggara, Indonesia located at 25 m above sea level. The field investigation was initiated during September 2006 to November 2011. Two and half-month-old seedling raised in polybags were planted in the field experiment to evaluate the performance of each accession in a Randomized Block Design with three replications. The plot size was 8 x 12 m and number of plants per plot was 24 with 2 x 2 m spacing. All the twenty-four plants in each plot constituted the measurement unit. The soil was sandy loam Entisols and composed of sand (69%), silt (25%), and clay (5%), with 1.8% organic carbon, 0.2% total N, the pH 5.9-6.3, and cation exchange capacity of the soil measured 7.2-10.4 cmol.kg$^{-1}$.

***Agronomic practices***

Fertilizer was applied at time of planting 5,000 kg manure/ha (2 kg/tree) and 25 kg Urea/ha (10 g/tree), 150 kg SP-36 /ha (60 g /tree), and 30 kg KCl /ha (12 g /tree). Second Urea application (25 kg Urea/ha (10 g /tree) was applied one month after planting. At four and five years old, the plants were given 50 kg Urea/ ha, 175 kg SP-36 /ha, and 45 kg KCl /ha Urea, SP-36, and KCl were applied in fourth to fifth year at the beginning of the rainy season (November). Weeding was done in radius one meter from the stem base. Unproductive shoots were pruned regularly every two weeks. Irrigation was applied weekly up to one month after planting and thereafter, no irrigation was applied.

***Observation and data analysis***

Number of capsules per inflorescence and per tree, weight of seeds per plant and per plot, and seed oil content were recorded. Extraction of seed oil was carried out following the Soxchlet Extraction Method modified by Sudarmadji *et al*. (1997) in which the seed kernels were separated and powdered. Seed kernels (3 g) were groundmechanically and defatted in a soxhlet apparatus using hexane for 6 h. Solvent was removed by vacuum evaporation and then exposed to heat in a drying oven at 50°C for 39 h. The amount of oil recovered was calculated as percentage of total oil. Each extraction was run in triplicate and the final value was the average of samples of each genotype treatments. Data were subjected to analysis of variance and the mean along with standard deviation were computed for each of quantitative traits using Minitab-14 statistical program.

## Results and Discussion

The maximum and minimum temperature, rainfall, and relative humidity during the cropping periode are presented in Table 1. The data shows that rainfall declined during the period of six years. Since 2009, rainfall was distributed only in 4 months, its mean that the rainfall was lower than the three previous years.

Table 1. Climate conditions of the experimental site during 2006–2011

| Climate Component | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| Rainfall (mm) | 965 | 716 | 699 | 642 | 685 | 659 |
| Rainy month | 5 | 5 | 5 | 4 | 4 | 4 |
| Rainy day | 56 | 59 | 57 | 48 | 52 | 50 |
| Air temperature ($^{O}$C) min. | 24.7 | 25 | 25.8 | 25.4 | 25.6 | 25.9 |
| Air temperature ($^{O}$C) max. | 31 | 32 | 32.5 | 32.7 | 32.8 | 33.1 |
| Relative humidity (%) | 90 | 91 | 89 | 89.4 | 88.2 | 89.1 |

In general, seed sources of *J. curcas* West Nusa Tenggara accessions did not vary significantly with respect to vegetative morphological characteristics. We however found marginal differences for number of branches and number of productive branches (data not shown). On yield components, differences among accessions were sign for number of capsules per inflorescence (Figure 1), number of capsules per tree (Figure 2), seed dry weight per tree (Figure 3), seed dry weight per plot (Figure 4), and seed dry weight per hectare (Figure 5). No significant differences among accessions was observed for seed kernel oil ontent (Table 2) during the 5-year of production cycle except on fences population.

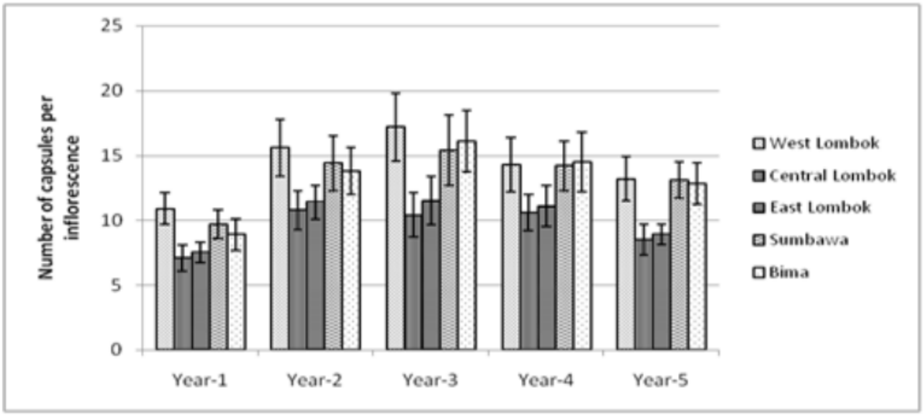


Figure 1. Number of capsule per inflorescence of West Nusa Tenggara accessions at the first five years of cultivation

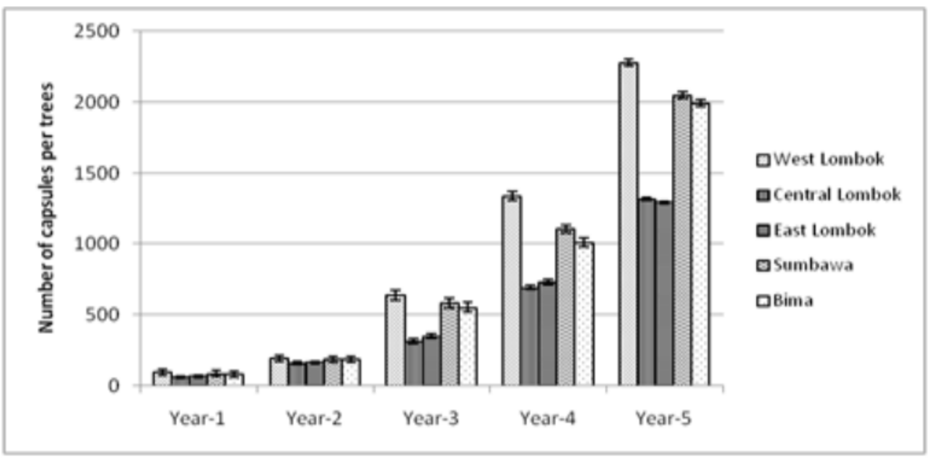


Figure 2. Number of capsule per tree of West Nusa Tenggara accessions at the first five years of cultivation

Figure 1 shows number of capsules per inflorescence was different between the accessions since year one up to 5 years old of plant age. The number of capsules produced per inflorescence for accession of West Lombok, Sumbawa, and Bima were higher than East Lombok and Central Lombok accessions. However, different ripening time of capsules on the same inflorescence was found in West Lombok, Sumbawa, and Bima. Along with increasing plant age (4-5 years), the number of capsules per inflorescence was decreased. Figure 2 shows the number of capsules per plant continues to increase along with plant age.Accession of West Lombok, Sumbawa, and Bima had number of capsules per plant higher than the two other accessions.

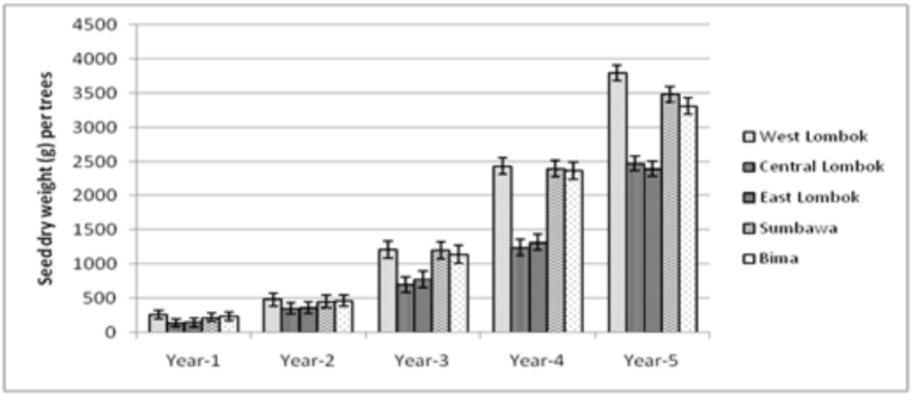


Figure 3. Seed dry weight per tree of West Nusa Tenggara accessions at the first five years of cultivation.

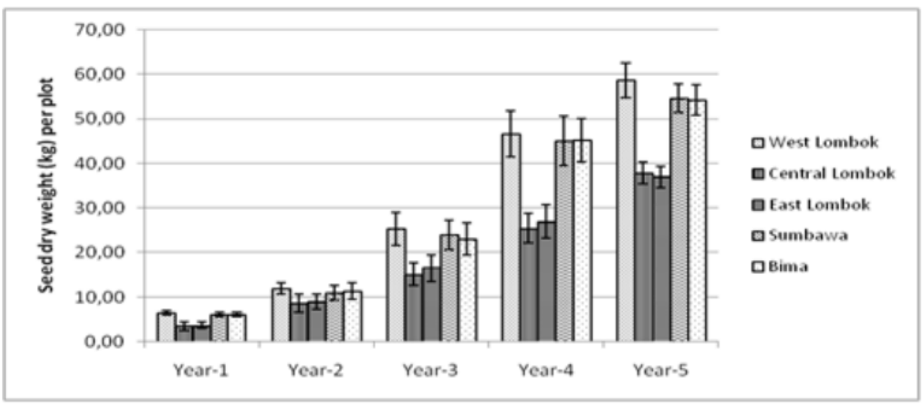


Figure 4. Seed dry weight per plot of West Nusa Tenggara accessions at the first five years of cultivation.

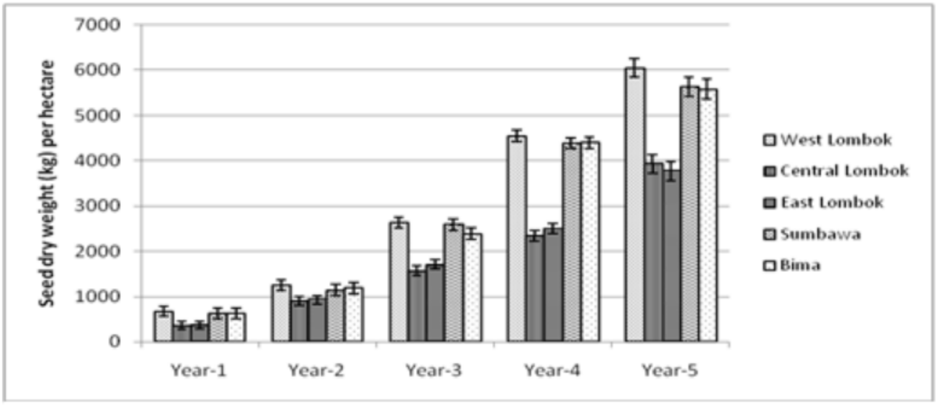


Figure 5. Seed dry weight per hectare of West Nusa Tenggara accessions at the first five years of cultivation.

A consequence of the difference in the number of capsules per inflorescence and the number of capsules per plant, then there were significantly different in seed dry weight per plant (Figure 3), seed dry weight per plot (Figure 4), and the projected seed dry weight per hectare (Figure 5). Since the first year of cultivation, total dry seed weight was highest in West Lombok accession followed by Bima and Sumbawa, and were significantly different to Central Lombok and East Lombok accessions.

The yield potential, with respect to dry seed weight per plot and per hectare (Figure 4 and Figure 5) followed a similar trend as was in the case of dry seed weight per tree (Figure 3). Therefore, two accessions (Central Lombok and East Lombok) showed a lower yield potential than the other three accessions (West Lombok, Sumbawa, and Bima). The highest yield, ranged from 1,145.55 to 1,213.61 kg/ha was recorded in the second year of cultivation, while in the third, fourth, and fifth year of cultivation, the highest yield was ranged from 2,389 to 2,632 kg/ha; 4,686 to 4,847 kg/ha; and 5,484 to 6,004 kg/ha, respectively.

Seed source of *Jatropha* harvested during the exploration varied significantly in respect of oil content in kernel (Table 2). Data shows that kernel oil content was the highest in Sumbawa accession and was the lowest in East Lombok one. However, kernel oil content was not significantly different in seeds obtained from trees cultivated during a periode of 5 years.

As no significant difference of oil content was observed in kernel (Table 2), however, due to significant difference in yield of seed per hectare (Figure 5), the production (yield) of oil per hectare was significantly different (data not shown). The oil yield of the three accessions (West Lombok, Sumbawa, and Bima) was found to be higher than those of the two other accessions

The environment condition from where the accessions were collected in West Nusa Tenggara Province varied with respect to altitude and rainfall (Table 1). Variation of *Jatropha* resource in dry seed yield and 100 seed weight was mainly due to the fact that these accessions grew over a wide range of environmental and climatic condition. The population might have experienced marked selection pressure. Various range of yield were reported i.e. 0.4 t/ha (Jones and Miller, 1992) or 2.5-3.5 t/ha(Henning, 1996) in the first year and 0.4-12 t/ha (Lele, 2005) in the second year. In the present study the dry seed yield was in between of those reports.

After one-year planting, the best West Nusa Tenggara accession produced 551.08-674.72 kg. $ha^{-1}$ seed then after two-year planting produced 1,145.55-1,213.61 kg/ha seed. The yield was lower than that reported by Henning (1996) and Lele (2005) but higher than report of Jones and Miller (1992).

The variability in dry seed yield along with variability in growth performance especially on number of branches (data not shown) and number of capsules per inflorescence indicates that higher yield may be obtained by manipulation of cultural practice including pruning-training, plant spacing, and fertilizer dosage. As, Abdel-Gadir *et al*. (2009) state that low numbers of famale flower, less branching, and inadequate pollination are the major factors that limit seed production and oil of

*Jatropha curcas*. Santoso *et al*. (2011a) also report that East Lombok genotype followed by Sumbawa and Bima were found as higher genetic potential for female flower formation other that existing *Jatropha* local West Nusa Tenggara. Therefore, the West Lombok, Sumbawa, and Bima ecotypes were found superior to the Central Lombok and East Lombok genotypes.

Table 2. Seed kernel oil content of West Nusa Tenggara accessions at the first five years of cultivation

| **Accessions** | **Seed kernel oil content (% - w/w)** | | | | | |
|---|---|---|---|---|---|---|
| | **Fences population** | **Year-1** | **Year-2** | **Year-3** | **Year-4** | **Year-5** |
| | | | ......... % (w/w)......... | | | |
| West Lombok | 33.7 ab | 36.4 | 36.9 | 35.9 | 36.3 | 35.6 |
| Central Lombok | 34.3 ab | 36.2 | 35.1 | 35.5 | 35.6 | 35.3 |
| East Lombok | 30.8 a | 35.1 | 35.4 | 35.3 | 35.7 | 35.1 |
| Sumbawa | 34.9 b | 36.1 | 36.8 | 36.2 | 36.1 | 35.7 |
| Bima | 33.1 ab | 35.8 | 36.6 | 35.6 | 36.2 | 35.5 |
| HSD 5% | 4.03 | Ns | ns | ns | ns | ns |

Explanation : Oil content based on seed kernel. Mean within the same column with the same letters are not significantly different according to Honestly Significant Difference test at 5%. ns = not significant

Previous studies have reported that the oil content ranged between 43-60 percent oil (Jones and Miller, 1992; Makkar *et al*., 1997). Kernel oil content for India was 58.1% (Ginwal *et al*., 2005), Nigeria 47.3 to 66.4% (Adebowale and Adedire, 2006), Nicaragua 52.9 to 57.4% (Foidl *et al*., 1996), China 51.3 to 61.2% (Ye *et al*., 2009), and Malaysia 63.2% (Emil *et al*., 2009). In this experiment the oil content ranged between 35.1-36.9 percent in kernel base. At the first seed oil analysis it was found that oil kernel content varied significantly between accessions. The difference was primarily due to seed source collected from different regions with relatively varied in their growing habitat especially with respect to rainfall and altitude. The accessions used in this study grew in the area with annual rainfall ranging from 550 mm to 1,500 mm and altitude from 25 m to 100 m above sea level. Accession grew at drier condition has higher seed oil content compared to seed from accession grown at wetter habitat. Similar argument has been reported by Jones and Miller (1992). On the other hand, sunflower planted in less sunlight condition produced lower seed oil content compared to crop planted in bright and higher temperature condition (Leon *et al*., 2003).

During the 5-years cultivation with regular plant spacing, fertilizer, thinning, weeding, and pest control, seed oil content was not significantly different between accessions. However, seed oil content was higher than the seed of that same accession but obtained from natural population/fence population. Leon *et al*. (2003) state that yield component such seed oil content and seed weight could be modified by environment or cultural practice. Planting distance also affected number of seed and oil content of sunflower (Aquirrezabal *et al*., 2003).

The result of *J. curcas* NTB accessions reported in this study was relatively lower than some reports (Henning, 1996; Lele, 2005) but also higher than a few other reports (Jones and Miller, 1992). This may be attribute to the planting standing trees not as superior variety, it was wild genotype, and also due to the relatively short duration of production cycle when *Jatropha* began to establish in a good cultural practice and relatively good growing condition. However, this present study gives first information on *Jatropha* production on dry land especially in West Nusa Tenggara province, Indonesia. It also may serve to estimate on yield reasonably. Jongschaap (2008) state that to obtain good yield of *Jatropha*, the crop needs input. It is unwise to expect high yield of *Jatropha* in degraded or critical land without any input and conservation measure including genetical development.

Our research shows that during five years production cycle, yearly yield improvement of all accessions tested was about 1-2.5 times than the previous year and did not follow the geometrical progression based on dichotomy branching pattern on Jatropha. Santoso *et al*. (2011b) also found that in West Lombok genotypes which trees planting from seed, stem cut, and seed followed by pruning, showed yearly yield improvement did not follow the geometrical pattern. Eventhough, Wang and Ding (2012) state that inflorescence of *Jatropoha curcas* germinated from top of branch, with the upper end of the branch stopping upward because of the formation of inflorescence, then, after a span of time, 1-3 (ussually 2) lateral buds under inflorescence germinated. It happened 2-3 times during a year, so that, yearly yield improvement could be 4-5 time than the previous year. However, the fact that not all the branching occurs to form two branches (dichotomy). In the dry season, most of the branches are formed only one. Other phenomena was along with increasing plant age (4-5 years) the more dense canopy formed branching with small and short branches. Those of short branches not supported by enought leaves so that the number of capsules produced per inflorescence become lower than when the plants was 2-3 years old. For that reason, pruning is neededе to produce a succession of young shoots and branches every year on mainly permanent and mature branches so that the cropping element is kept young and also productive with higher number of capsules per inflorescence. As Gill and Bal (2006) state, that the aim of the renewal pruning is to keep the bush young with an adequate supply of one-year-old wood to ensure a good flowering then fruiting. Therefore, as the crop ages, one third to a quarter of the oldest stem or branches should be removed to encourages strong new growth.

## Conclusion

In conclusion, it is quite clear that West Lombok, Sumbawa, and Bima were accessions showed high yield performance as compared to Central Lombok and East Lombok, with yearly yield improvement was not follow the geometrical progression based on dichotomy brancing system on Jatropha. These accessions have a good potential to be grown on degraded agricultural lands to produce bioenergy as well as to reduce soil erosion.

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## References

Abdel-Gadir, H.A., Johnson, S.D. and Van Staden, J. 2009. Pollinator effectiveness, breeding system, and tests for in breeding depression in the biofuel seed crop, *J. curcas*. *Journal of Horticultural Science and Biotechnology* 84:319-324.

Adebowale K.O. and Adedire, C.O. 2006. Chemical composition and insectidal properties of the under utilized *Jatropha curcas* seed oil. *African Journal of Biotechnology* 5: 901-906.

Aguirrezabal, L.A N., Lavaud, Y., Dosio, G.A.A., Izquierdo, N.G., Andrade, F.H. and Gonzalez, L.M. 2003. Intercepted solar radiation during seed filling determines sunflower weight per seed and oil concentration. *Crop Science* 43:152-161.

Divakara, B.N., Upadhyasa, N.D., Wani, S.P. and Gowda, C.L.L. 2010. Biology and genetic improvement of *Jatropha curcas* L: a review. *Applied Energy*. 87: 732-742.

Emil A., Zahira, Y., Siti, K.K., Manal, I. and Jumat, S. 2009. Characteristic and composition of *Jatropha curcas* oil seed from Malaysia and its potential as biodiesel feedstock. *European Journal of Scientific Research* 29: 396-403.h

Fairless, D. 2007. Biofuel: the little shrub that could-maybe. *Nature*. 449: 652-655.

Foidl N., Foidl, G., Sanchez, M., Mittelbach, M. and Heckel S. 1996. *Jatropha curcas* L. as a source for the production of biofuel in Nicaragua. *Bioresource Technology*. 58: 77-82

Gill, K.S. and Bal, J.S. 2006. Influence of pruning severity and time on yield and fruit quality of bry cv. Umran. *Indian Journal of Horticulture* 63:162-165.

Ginwal, H.S., Rawat, P.S. and Srivastava, R.L. 2005. Seed source variation in morphology, germination, and seedling growth of *Jatropha curcas* Linn. In Central India. *Silvae Genetica* 54:76-80.

Henning, R. 1996. Combating Desertification : The Jatropha Project of Mali, West Africa. Aridland No.40, Fall/Winter 1996. The CCD, Part I : Africa and The Mediterranean. http://ag.arizona.edu/OALS/ALN/aln40/jatropha.html [Januari 2006].

Jones, N. and Miller, J.H. 1992. *Jatropa curcas*. A Multipurpose Spesies for Problematic Sites. The World Banks Report. Asia Technical Department. Agriculture Division. 11p.

Jongschaap, R.E.E. 2008. A to Z of *Jatropha curcas* L. Claims and Facts on *Jatropha curcas* L. Wageningen UR – Plant Research International, Wageningen, The Netherlands. www.jatropha.wur.nl [Desember 2008].

Lele, S. 2005. The cultivation of *Jatropha curcas*. Strategies and institutional mechanisms for large scale cultivation of *Jatropha curcas* under agroforestry in the context of the proposed biofuel policy of India. www.svlele.com [Januari 2006].

Leon, A.J., Andrade, F.H. and Lee, M. 2003. Genetic analysis of seed-oil concentration across generation and environments in sunflower. *Crop Science* 43:135-140.

Makkar, H.P.S., Becker, K., Sporer, F. and Wink, M. 1997. Studies on nutritive potential and toxic constituents of different provenances of *Jatropha curcas*. *Journal of Agricultural Food Chemistry* 45:3152-3157.

Ovando-Medina I., Espinosa-Garcia, F.J., Nunez-Farlan, J.S. and Salvador-Figueroa, M. 2011. State of the art of genetic diversity research in *Jatropha curcas*. *Science Research Essays*. 6: 1709-1719.

Pandey, V.C., Singh, K., Singh, J.S., Kumar, A., Singh, B. and Singh, R.P. 2012. Jatropha curcas: A potential biofuel plant for sustainable environment development. *Renewable and Sustainable Energy Reviews* 16: 2878-2883.

Rafii, M.Y., Arolu, I.W., Omar, M.H.A. and M. and Latif, A. 2012. Genetic variation and heritability estimation in *Jatropha curcas* L. population for seed yield and vegetative traits. *Journal of Medical Plants Research* 6:2178-2183.

Samodini S.N., Gadge, S.R., Dubey, A.K. and Kadu, B.D. 2012. Economics of biodiesel production from Jatropha oil. *Journal of Agriculture Technology* 8: 657-662.

Santoso, B.B., Susanto, S., Purwoko, B.S. 2011a. The flowering of *J. curcas* L. West Nusa Tenggara ecotypes. *Journal Agronomy Indonesia* 39:210-216.

Santoso, B.B., Hariyadi, B.S. and Purwoko 2011b. Pattern on the yield improvement of *J. curcas* West Lombok ecotype during four year production cycle. *Journal of Agronomy Indonesia* 39:137-143.

Sudarmadji, S., Haryono, B. and Suhardi. 1997. Prosedur Analisa Untuk Bahan Makanan dan Pertanian. Edisi 4. Liberty, Yogyakarta.112hal.

Wang, X.and Ding, G. 2012. Reproductive biology characteristic of *Jatropha curcas* (Euphorbiaceae). *Review of Biology Tropics* (*International Journal Tropical Biology*) 60:1525-1533.

Ye, M., Li, C., Francis, G. and Harinder P.S.M. 2009. Current situation and prospects of *Jatropha curcas* as multipurpose tree in China. *Agroforestry System* 76: 487-497.

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