belum-B.1-34-Yield Performances of Jatropha curcas L. Originating from multy-entrenched seedling

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Yield Performances of *Jatropha curcas* L. Originating from Multi-entrenched Seedlings through Two Year Production Cycles

Yield Performances of *Jatropha curcas* L. Originating from Multi-entrenched Seedlings through Two Year Production Cycles

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Abstract. *Jatropha curcas* L. is a terminal flowering plant. The use of planting material from the beginning which has many branches (multi-entrenched seedlings) will certainly have the opportunity to provide higher yields, compared to single-stemmed seedlings. Three-month-old multi-entrenched seedlings (b1 = single-stemmed seedlings, b2 = seeds with two branches, b3 = seeds with three branches, and b4 = seeds with four branches) raised in polybags were planted in the field to evaluate the performance of these multi-entrenched seedlings in a Randomized Block Design with three replications, and each treatment consisted of five tree units. The result shows that the use of branched seedlings has a significant effect on the yield of Jatropha started in the first year of cultivation. Seedlings with two entrises were very well multi-entrenched seedlings used, offered seed yield about 408.2 g per tree in the first year, and 1,118.4 g in the second year of cultivation.

Keywords: branching; flowering; fruiting; grafting; pruning

1 Introduction

Jatropha curcas L. is one of the plant sources of bio-oil which can be processed into substitute fuel for petroleum. This is since these plants have quite high oil content which reaches 30-40%, so the development of Jatropha as a raw material for biodiesel has a huge potential [1]. In addition to producing oil with high productivity, Jatropha can adapt and grow well on dry land. West Nusa Tenggara is one potential province in Indonesia having extensive dryland areas, to develop Jatropha. However, the development is still limited, due to the unavailability of types or varieties having high yield.

In the agronomic aspect, the development of Jatropha in dryland still faces several obstacles, one of which is the provision of superior seedlings. The variety needed to overcome these obstacles should be able to adapt and produce well on dry land or marginal land. In relation to the nature of the Jatropha which is flowering and bearing fruit at the end of each branch, the more branches will be the more chances the tree to produce flowers and then fruit [2]. Therefore, the supply or use of planting material from the beginning which has many branches (multi-entrenched seedlings) will certainly have the

opportunity to provide higher yields, compared to single-stemmed seedlings. Santoso [3] states that pruning from the beginning or shortly after transplanting will increase yield due to the larger number of branches compared to plants that are not pruned. Of course, using multi-entrenched seedlings, branching from the beginning is guaranteed. Furthermore, the study of Iksan [4] shows that to produce multi-branching in Jatropha seedlings can be formed quickly through grafting, hence it was produced seedlings with 2-4 branches. Hence, the present investigation was undertaken to asses the yield performance of Jatropha tree generating from multi-branching seedling or multi-entrenched seedlings during two years of production cycles.

2 Method

2.1.Experiment side and condition

The field experiment was initiated from September 2006 to December 2011 at Amor-Amor Village, District of Kayangan, North Lombok, West Nusa Tenggara, Indonesia located at 8O16'15.02''S 116O17'34.02''T, 25-75 m above sea level. 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 of 5.9-6.3, and cation exchange capacity of the soil measured 7.2-10.4 cmol.kg-1. During the experiment, the surrounding environment had a minimum temperature ranging from 24-25OC and the maximum temperature ranged from 31-34OC. The minimum humidity ranges from 70-82% and the maximum ranges from 90-95%, and the number of rainy days is 6-10 days per month with moderate intensity.

2.2. Seedling preparation

Seedling preparation as rootstock using West Lombok genotype. The shoot buds (entris) was used branch shoots of IP-1 genotype, originating from West Lombok. Multi entrieses grafting (1-4 entrieses) was performed on 2 months old seedlings. The multi-entrenched seedlings than was maintained for 3 months. Healthy and good growing multi-entrenched seedling are ready for use in this study.

2.3. Experiment design

Three-month-old multi-entrenched seedling raised in polybags were planted in the field experiment to evaluate the performance in a Randomized Block Design with three replications. Each treatment consisted of five tree units, so there were 60 tree experimental units in this study. The treatment was the branches (entheses) number on the seedlings, namely: b1 = un-grafted seedling (single-stemmed seedlings), and multi-entrenched seedlings, i.e. b2 = seeds with two branches, b3 = seeds with three branches, and b4 = seeds with four branches. All trees were planted with a spacing of 2 x 1.5 m as a measurement unit.

2.4. Agronomic practices

Fertilizer was applied at time of planting, i.e. 5,000 kg manure.ha-1 (2 kg.tree-1) and 25 kg Urea.ha-1 (10 g.tree-1), 150 kg SP-36.ha-1 (60 g.tree-1), and 30 kg KCl.ha-1 (12 g.tree-1). The second Urea application (25 kg Urea.ha-1 (10 g.tree-1) was applied at three months after planting. At the two years old, the trees were given 50 kg Urea.ha-1, 175 kg SP-36.ha-1, and 45 kg KCl.ha-1 at the beginning of the rainy season (late of October). Weeding was done in radius one meter from the stem base. Irrigation was applied weekly up to two months after planting, and thereafter, no irrigation was applied.

2.5. Observation and data analysis

Number of branch, number of capsules per inflorescence and per tree, the weight of seeds per plant, and seed oil content were recorded. The extraction of seed oil was carried out following the Soxchlet Extraction Method with hexanesolvent. 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.

3 Result and Discussion

The use of branched seedlings has a significant effect (P≤0.05) on the yield starting in the first year of the production cycle. Pruning in Jatropha cultivation aims to increase the number of branches that are positively correlated with increasing yield. However, [3] stated that the pruning of Jatropha at time of after transplanting cause of low yield in that year, and will provide higher yield in the following year. It means that there is a delay in the acquisition of results. In this study, the phenomenon of no decrease in yield at the first and also second year of the production cycle was obtained, even there was an increase in yield from the first year to the second year. This was due to the amount of branching in a certain amount existed in the starting planting material, branches seedling has higher yield potential than the single-stemmed seedlings.

Table 1 describes the number of branches and the number of Jatropha inflorescence at one and two years old of multi-entrenched seedlings. The number of branches varies. The larger number of branches of the tree comes from the seedlings with 2-4 branches and the single-trunked seedlings. This variation of branching also causes not all of the branching formed produce productive inflorescence. In the first year, seedlings with four branches had the same amount of inflorescence as the plants originating from single-stemmed seedlings. In the second year, however, all the plants originating from multi-entrenched seedlings have more productive inflorescence than that from single-stemmed seedlings.

The difference in the number of branches formed with the number of formed inflorescence and productive inflorescence found in this study is consistent with what Heller [5] said that the number of branches as well as productive inflorescence is not always the same as the number of branches formed.

The number of capsules per inflorescence was not influenced by multi-entrenched seedlings but the number of capsules per plant was significantly influenced by multi-entrenched seedlings (Table 2). The number of capsules per inflorescence was dominantly caused by a genetic factor, but with differences in the number of productive inflorescence per plant (Table 1), it will cause a difference in the number of capsules per plant both among multi-entrenched seedlings and for single-stemmed seedlings. The use of multi-entrenched seeds causes differences in the number of productive inflorescences, so the production variables, such as seed dry weight per plant also had a significant effect (Table 3).

Table 1. Number of branches, total inflorescence formed, and number of productive inflorescence

Branch number on seedling	**Number of branches**				**total inflorescence formed**		**number of productive inflorescence**	
	1st year		**2nd year**		**1st year**	**2nd year**	**1st year**	**2nd year**
	prm	**scd**	**scd**	**ter**				
No branch	4.2	3.2	6.5a	11.2a	6.3a	17.2a	5.8a	16.5a
Two branches (entris)	6.7	4.2	10.4b	18.6b	9.4b	24.6b	8.5b	23.3b
Three branches (entris)	6.8	5.3	11.8b	19.3b	10.7b	25.8b	9.3b	24.1b
Four branches (entris)	6.2	4.0	10.7b	17.9b	8.8ab	23.3b	7.6ab	21.6b
HSD 5 %	ns	ns	3.15	5.33	2.72	5.36	2.23	4.74

Explanation: mean within the same column with the same letters are not significantly different according to Honestly Significant

Difference test at 5%. ns = not significant. prm = primary. scd = secondary. ter = tertiary.

Table 2. Number of capsules per inflorescence and number of capsules per trees

Branch number on seedling	number of capsules per inflorescence		number of capsules per trees	
	1st year	2nd year	1st year	2nd year
No branch	9.4	10.3	54.5a	169.9a
Two branches (entris)	9.3	12.4	75.6b	238.7b
Three branches (entris)	10.2	11.6	94.9c	279.6c
Four branches (entris)	9.5	11.1	73.2b	229.5b
	ns	ns	11.45	13.75

Explanation: mean within the same column with the same letters are not significantly different according to Honestly Significant Difference test at 5%. ns = not significant.

Table 3. Dry weight of seeds per trees and seed kernel oil content

Branch number on seedling	**seeds dry weight (g) per trees**		**seed kernel oil content (% - w/w)**	
	1st year	**2nd year**	**1st year**	**2nd year**
No branch	234.4a	676.7a	35.5	35.9
Two branches (entris)	325.1b	954.8b	35.8	36.2
Three branches (entris)	408.2c	1.118.4c	36.1	36.3
Four branches (entris)	314.8ab	918.9b	35.6	36.1
BNT 5%	85.12	124.25	ns	ns

Explanation: mean within the same column with the same letters are not significantly different according to Honestly Significant Difference test at 5%. ns = not significant.

The tree canopy arrangement to produce good yields was completed through pruning [6], which would stimulate productive branching so that the capsules and seeds obtained in the tree would be more abundant. In this study, the canopy arrangement referred to an early canopy arrangement by using multi-entrenched seedling material. The results showed that there were differences in the dry seed yield per plant from plants originating from multi-entrenched seedlings during two years production cycle.

This study also shows that there was a positive correlation between the number of branches and the yield. The results of this study were in line with [7], and [8]. Arrangement of the canopy through the directive of branches number will increase photosynthesis due to an increase in chlorophyll content which is naturally produced due to better plant growth [9]. Furthermore, more productive branching formed due to the assimilation because of the increase in the rate of photosynthesis due to the canopy which allows more and efficient capture of sunlight [10]. In this study, it appears that the trees originating from single-stemmed seedlings during the two-year production cycle have a higher performance with thin canopies, while the trees from multi-entrenched seedlings appear to be lower with wider canopy. The low canopy was highly expected due to easier harvesting the capsul next.

At the same time, however, the difference in the number of branches that illustrates the difference in canopy between plants originating from multi-entrenched seedlings with single-stemmed seedlings did not cause differences in the seed oil content (Table 3). The oil content was more as a genetic factor that could not be modified through plant branching arrangements. The increase in oil yield would certainly be obtained by increasing the yield of seeds obtained due to increased branching.

4 Conclusion

The use of branched seedlings of Jatropha has a significant effect on the yield during two years production cycle started in the first year of cultivation. Seedlings with two branches (entries) were very well multi-entrenched seedlings used, offered seed yield 408.2 g tree-1 in the first year and 1,118.4 g in the second year of cultivation.

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