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Research paper

Evaluation of Productivity Rate and The Quality of Several Genotypes of Jatropha curcas Linn. Seeds at First and Second Year in East Java and West Nusa Tenggara, Indonesia

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Abstract

The research is aimed to obtain information regarding productivity rate and the quality of Jatropha curcas Linn. seeds within two years period in Pasuruan-East Java and Lombok-West Nusa Tenggara (NTB). The seeds used were the hybrid of JC5(SP8XSP16), JC6(SP8XSP38), JC7(SP33XHS49), JC8(SM35XSP38), and control IP3-A dan IP3-P. At the first harvest in East Java there were not any differences in the harvest duration; otherwise, there was one in West Nusa Tenggara. The highest weight of dry seeds was JC18 (52.8 g/plant) and did not significantly differ among other three hybrids. At the planting of NTB, the highest dry weight of JC5 (191.94 g/plant) did not differ significantly from JC7 and JC18. At the second harvest in East Java, the highest dry weight of JC7 (233.44 g/plant) did not differ significantly from three other hybrids and IP3P. At the experiment in NTB, the highest dry weight of JC5 (318.75 g/plant) did not differ from three other genotypes of hybrids. The JC5 treatment produced the highest number of fruit and fruit bunches whereas the highest oil rate was gained by JC18 (32.09% in East Java and 33.04% in NTB). The four examined genotypes showed higher production rate than the control. The planting in NTB indicated higher production rate than those in East Java.

Keywords: *Jatropha curcas Linn., production rate, dry-field*

1. Introduction

Indonesia is a country with abundant natural resources, one potential plant as a raw material of biodiesel is Jatropha curcas Linn which classified as euphorbiceae family (Fairless, 2007). J. curcas is a species of energy-producing plant which has a broad adaptability to grow in various types of soil and to survive for a long periods of drought and to grow well in critical land with limited supply of water and nutrient (Hasnam et al. 2007; Ikbal et al. 2010 ; Lin et al. 2003).

J. curcas seed contains 35% oil and is easy to be converted into biodiesel (Pompelli et al. 2010) which is highly prospective to be developed as biodiesel due to its adaptability to grow in dry and infertile soil. The root system can withstand ground water and function as erosion-barrier plant (Divakara et al. 2010). Jatropha's ability to grow on dry land has not been widely studied, yet several studies have revealed the Jatropha's survival ability under minimal supply of water (Achten et al. 2010; Pompelli et al. 2010). However, the problem nowadays is the absence of Jatropha's superior variety that is agronomical with Indonesian agro-climate (Hasnam et al. 2007 ; Sudarmo et al. 2007). The presence of new individual in population as a result of hybrid process can encourage the variety and diversity as a consequence of recombination, and has varied characteristic with the prime. The germplasm diversity of information holds an important role in breeding, conservation, evaluation and selection of plant (Yulaikah and Purwati, 2009)

Institute of Tobacco, Fiber, and Vegetable Oil Plants as the mandate of Ministry of Agriculture of Indonesia for vegetable oil plants development, has succeeded to identify 7 accession of J. curcas with high productivity hope (Sudarmo, et al. 2007). Also, the result of mass selection has generated (Puslitbangbun, 2009). However, those accessions in several studies are proved to require a large amount of input to support the high production rate, not to mention their resistance during prolonged drought. Hybridization of superior J. curcas to improve the drought resistance properties has been conducted and has produced several superior accession showing resistance on drought (Maftuchah et al. 2013; Maftuchah et al. 2015). This research aimed to obtain information on production rate and quality of several J. curcas Linn seeds at first and second harvesting in Pasuruan-East Java and North Lombok-NTB.

2. Materials and Methods

The research was conducted within two years using four numbers of J.curcas of several superior numbers cross results, which are: 1) JC5 (SP8XSP16), 2) JC6 (SP8XSP38), 3) JC7 (SP33XHS49), 4) JC18 (SM35XSP38) (Maftuchah et al. 2013; Maftuchah et al. 2015). Two potential genotypes had been prepared by Plantation Research and Development Center-Agriculture Department as control plants, which are IP3A and IP3P.

Seeds preparation was conducted in the garden of germplasm collection in Kalipare Village-Malang. The planting material employed are J. curcas stem cuttings with 30 cm long and diameter of 2-3 cm. Field research was conducted using a randomized block design with four repeating, each of which using 20 sample plants. The location of planting was at Kedung Pengaron Village, Pasuruan-East Java and Alok Barat Village, North Lombok District – NTB. The transplanting was conducted in rainy season. Fertilizing was only done twice, first at the beginning of rainy season and second at the end of rainy season (Puslitbangbun, 2009). Watering was done two months after field planting, and after that, there was no watering at all (only precipitated water during rainy season). An observation on the age parameter of first harvesting, bunches amount per plant, fruit amount per plant, seeds dry weight per plant, dry weight of 100 seeds and seed oil rate.

3. Results and Discussion

At first harvest in East Java, the treatment of J. curcas genotypes number affected the harvest period, while in the planting of NTB, such treatment did not affect the harvest period. The treatment of J. curcas genotypes number affected the number of fruit bunches per plant, fruits per plant, seeds dry weight per plant and oil rate either the planting in East Java or NTB (Table 1 and 2). Jatropha was bred generatively and vegetatively by stem-cutting planting. Stem-cutting plant tends to undergo flowering phase faster than the one planted from seeds, which must go through juvenile phase (Santoso et al. 2009). Other research showed that jatropha generated from vegetative breeding will go through flowering phase faster than the one seed grown (Hartman et al. 2002).

Table 1: The Average Number of Fruit Bunches, Fruits, Seeds Dry-Weight, Dry-Weight of 100 seeds, Harvest Period, and Oil Rate of Several J. curcas Genotypes at First Harvest in Kedung Pengaron, Pasuruan –East Java.

Treatment	∑ Fruit Bunches		∑ Fruits		Seeds DW (g/plant)		DW of 100 seeds (g/100 seeds)		Harvest Period (day)		Seeds Oil-Rate (% DW)	
JC5	12.75	ab	28.38	abc	46.47	a	69.94	a	133.82	a	36.28	ab
JC6	10.93	ab	26.42	abc	41.50	ab	66.46	ab	148.23	a	35.65	b
JC7	13.89	ab	49.70	a	41.07	ab	68.97	a	145.72	a	35.77	b
JC18	19.72	a	44.28	ab	52.80	a	72.61	a	137.81	a	37.37	a
IP3A	7.558	b	18.73	bc	24.88	b	60.05	b	142.78	a	32.94	c
IP3P	5.662	b	11.48	c	16.20	b	68.22	a	138.44	a	33.00	c

Description: numbers followed by the same letter in the same column have no significant effect on DMRT 5%.

Table 2: The Average Number of Fruit Bunches, Fruits, Seeds Dry-Weight, Dry-Weight of 100 seeds, Harvest Period, and Oil Rate of Several J.curcas Genotypes at First Harvest in North Lombok – West Nusa Tenggara (NTB).

Treatment	∑ Fruit Bunches		∑ Fruits		Seeds DW (g/plant)		DW of 100 seeds (g/100 seeds)		Harvest Period (day)		Seeds Oil-Rate (% DW)	
JC5	24.99	a	184.51	a	191.94	a	66.825	a	103.81	b	35.58	a
JC6	17.32	c	135.38	b	71.31	b	66.45	a	161.03	a	35.82	a
JC7	21.81	ab	188.68	a	186.00	a	64.65	a	134.71	ab	35.56	a
JC18	19.61	bc	147.31	b	190.31	a	65.03	a	114.91	b	35.61	a
IP3A	16.84	c	134.44	b	122.69	ab	62.62	a	136.30	ab	34.34	b
IP3P	16.36	c	129.40	b	121.25	ab	56.20	b	152.69	a	33.59	b

Description: numbers followed by the same letter in the same column have no significant effect on DMRT 5%.

In East Java planting, the highest seeds dry weight per plant was JC18 (52.8 g/plant) and there is no significant difference among three other hybrids. The four hybrids showed that seeds dry weight per plant is higher than the control. Meanwhile, the planting in NTB showed that the highest seeds dry weight per plant was JC5 (191.94 g/plant) and there is no significant difference with JC7 and JC18. The number of fruit bunches, fruits, and seeds dry weight per plant of all genotype at NTB planting was higher than the one in Pasuruan. (Table 1 and 2). J.curcas is an annual plant that is relatively tolerant to drought (Dwary & Pramanick, 2006). However, jatropha's production rate remains influenced by genetic potential, environment condition, and plant treatment. The number of productive J. curcas stems will determine plant productivity (Ratree, 2004). The highest oil rate in Pasuruan was JC18 (37.37% DW) and did not differ significantly from JC5 (36.28% DW). At NTB, the four genotypes showed higher oil rate than the control plants. The experiment on Jatropha's yield potency in NTB found that the potency of seeds production at first year reached 189.86 g/plant (Santoso et al. 2009). Compared to the data, the result gained from this research was a little higher for several genotypes. There is no irrigation given in this study to examine the plants' production rate in a long drought.

Table 3: The Average Number of Fruit Bunches, Fruits, Seeds Dry-Weight, Dry-Weight of 100 seeds, Harvest Period, and Oil Rate of Several J. curcas Genotypes at Second Harvest in Kedung Pengaron, Pasuruan –East Java.

0	∑ Fruit Bunches		∑ Fruits		Seeds DW (g/plant)		DW of 100 seeds (g/100 seeds)		Harvest Period (day)	
JC5	37.588	a	167.58	a	223.94	a	67.292	a	30.790	ab
JC6	40.088	a	176.44	a	230.44	a	67.708	a	27.618	bc
JC7	36.175	a	171.94	a	233.44	a	66.458	a	27.131	bc
JC18	38.213	a	167.21	a	230.06	a	66.250	a	32.097	a
IP3A	20.038	b	113.63	b	106.90	b	59.583	b	225.142	bc
IP3P	29.075	ab	160.03	a	204.10	a	61.667	b	27.322	bc

Description: numbers followed by the same letter in the same column have no significant effect on DMRT 5%.

In the second harvest in East Java, the number of fruits and fruit bunches reached by four treatments were not significant. The highest seeds dry-weight was JC7 (233.44 g/plant), which was not significantly different from three other hybrids and IP3P (Table 3). At NTB planting, the highest seeds dry-weight was JC5 (318.75 g/plant), and this did not differ significantly with three other genotypes. JC5 treatment also showed the highest amount of fruits and fruit bunches (Table 4). Meanwhile, the highest oil rate of seeds was JC18 (32.09% of dry weight in East Java and 33.04% in NTB). The four tested genotypes showed higher production rate than the control plant of IP3A and IP3P. In general, the planting of NTB generated higher production rate than the one in East Java (Table 3 and 4).

Table 4: The Average Number of Fruit Bunches, Fruits, Seeds Dry-Weight, Dry-Weight of 100 seeds, Harvest Period, and Oil Rate of Several J. curcas Genotypes at Second Harvest in North Lombok – West Nusa Tenggara

Treatment	∑ Fruit Bunches		∑ Fruits		Seeds DW (g/plant)		DW of 100 seeds (g/100 seeds)		Harvest Period (day)	
JC5	80.475	a	568.70	a	318.75	a	75.62	a	32.13	ab
JC6	64.750	a	320.05	b	305.63	a	70.83	abc	30.23	b
JC7	78.775	a	478.63	ab	267.50	a	74.06	ab	30.46	b
JC18	75.400	a	423.49	ab	288.13	a	72.08	abc	33.04	a
IP3A	70.513	a	376.74	ab	207.94	ab	67.50	c	26.13	c
IP3P	70.113	a	370.31	ab	210.63	ab	70.31	bc	29.46	b

Description: numbers followed by the same letter in the same column have no significant effect on DMRT 5%.

The higher number of J. curcas' fruits and fruit bunches tend to be followed by higher seeds dry-weight. This result consistent with previous research that showed positive correlation toward dry-weight result of J. curcas seeds and had a high heritability value such as leaf wide, the number of primary stems, secondary stems, fruit bunches and fruits. Therefore, those kinds of character can be employed as selection criteria of J. curcas plants (Maftuchah et al, 2013). At the end of this research, several numbers of superior J.curcas L. hybrids with high productivity in dry land are expected to gain, which then can be registered as intellectual property right in the form of Plant Variety Registration. In the long term, this is expected to solve strategic problem, especially in supplying J. curcas seeds with high productivity rate and resistance to prolonged drought.

4. Conclusion

At first harvest in East Java field, distinct treatment did not make a difference on harvest time, yet it made one in the planting of NTB. The treatment of J. curcas genotype gave difference on the number of fruits, fruit bunches, seeds-dry weight, dry weight of 100 seeds and seeds oil-rate, both in East Java and NTB planting. In East Java, the highest seeds dry-weight was JC18 (52.8 g/plant), and it did not differ significantly from three other hybrids. The four hybrids showed higher seeds dry-weight than the control. In NTB planting, the highest dry weight was JC5 (191.94 g/plant), and it did not differ significantly from JC7 and JC18. The number of fruits, fruit bunches, and seeds dry weight per plant of all genotypes in NTB is higher than the planting in East Java.

At second harvest in Pasuruan-East Java, the highest seeds dry-weight was JC7 (233.44 g/plant), and it did not differ significantly from three other hybrids (JC5, JC6, JC18) dan IP3P. At the experiment in NTB, the highest seeds dry-weight was JC5 (318.75 g/plant), and it did not differ significantly from three other genotypes of hybrids. The treatment on JC5 also produced the highest number of fruits and fruit bunches. The highest seeds oil rate was JC18 (32.09% of dry weight in East Java and 33.04% of dry weight in NTB). The four tested genotypes showed higher production rate than the control plant. Meanwhile, the planting location of NTB, in general, generated higher production the rate than the one in Pasuruan-East Java.

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