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SOME FACTORS AFFECTING SEED VIABILITY OF Leucaena leucocephala (Lmk. de Witt.)

Beberapa Faktor yang Mempengaruhi Viabilitas Benih Leucaena leucocephala (Lmk. de Witt.)

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ABSTRAK

Penelitian ini bertujuan untuk menentukan : (1) waktu pemanenan polong yang tepat, (2) metode ekstraksi benih dengan pengeringan, (3) jamur pathogen yang menyerang benih L. leucocephala

Waktu pemanenan polong yang tepat adalah 62 hari setelah terbentuknya kuncup bunga. Pada waktu ini tercapai daya kecambah benih paling tinggi yaitu 97,25%.

Pengeringan dengan penghembusan udara tanpa pemanasan menghasilkan jumlah polong terbuka paling rendah dibandingkan dengan pengeringan dengan embusan udara panas, baik dengan menggunakan alat pengering tipe batch ataupun tipe wagon. Pengeringan dengan penghembusan udara, jumlah polong terbuka : 20% dari polong no.9; 21% dari polong no.10; dan 41% dari polong no.11 dengan daya berkecambah benihnya relative paling tinggi dibandingkan dengan kedua pengeringan lainnya yaitu berturut-turut 87,13%, 44,25% dan 19,75%. Akan tetapi, daya berkecambah benih dari metode ekstraksi benih dengan penghembusan udara tanpa pemanasan masih lebih rendah daripada kontrol.

Jamur pathogen yang menyerang benih adalah Aspergillus sp., Alternaria sp., Pythium sp., dan satu jenis tidak teridentifikasi.

INTRODUCTION

Leucaena leucocaphela (Lmk. de Witt.) (kemlandingan) is a tree, which has an important role both as forest plant and cultivated crops. In Indonesia, L. leucocephala has been known for along time and is used for intercrops at teak plantation or as shade plants and green manure producers in plantation (in Martadiredja, 1971). This species is also very useful as plants for erosion prevention (Martadiredja, 1971; Benge, 1976), alang-alang eradication (Knoop, 1910; Mathews, 1974, Benge, 1976) and soil amendments (Martadiredja, 1971).

One problem in management of L. leucocephala crop was difficulty in procurement of high quality seed in sufficiently amount.

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Several things have not been known yet, for instance those concerning proper schedule of pod harvesting and seed extraction method. Various fungi can develop in the seeds during storage, and this can result in rapid decline of seed viability (Soepandi, 1975)

For the purpose of solving these problems, several factors those affect seed viability of L. leucocephala has been studied. The objective of study were to determine :

(1) Proper schedule for pods harvesting.
(2) Seed extraction method from various ages of pod by drying method.
(3) Fungal pathogen, which attack seed.

Hopefully the research results can be used for developing method of handling seeds of this species, so that good quality seeds are available for planting L. leucocephala.

METHODS

Schedule for pod harvesting

Seeds were obtained from pods with various level of maturity, occurring in the seed tree which grew in IPB Campus of Darmaga. Pods were collected from four seed trees. Each pod was numbered indicating its level of maturity.

Pod development stages of no.9, no.10, no.11, and no.12 were those of mature (ripe) pods. Seeds from pods of those level of maturity were measured of their moisture content, and tested for their germination capacity by using between paper tests with rice straw paper as germination medium.

Extraction

Seeds from various stages of pod maturity (pods no.11, no.10, and no.9) were extracted by drying. Drying was conducted by blowing heated air, with drying equipment of batch type and wagon type. Drying duration was 24 hours. Every 3 hours, percentages of open pods were determined. In the end of the drying period, all seeds were tested for their germination capacity. Beside that, germination tests were also conducted for seeds from control treatment. Control was seed extraction by hand (manual).

Identification of pathogenic fungi

Pathogenic fungi, which were commonly occurring in seeds of the four level of seed maturity, were studied. Identification was conducted on seeds, which were stored for 0 week (right after extraction), one week, two weeks, and three weeks.

RESULTS AND DISCUSSIONS

Schedule of pod harvesting

According to preliminary experiment, pod no.9 had fulfilled the criteria of physiological maturity. Observation results showed that seeds reached maturity level of no.9 after 62 days since the formation of flower bud.

Relationship between seed maturity level no.6 up to that no.12, a seed germination capacity and seed moisture content can be seen in Figure 1.

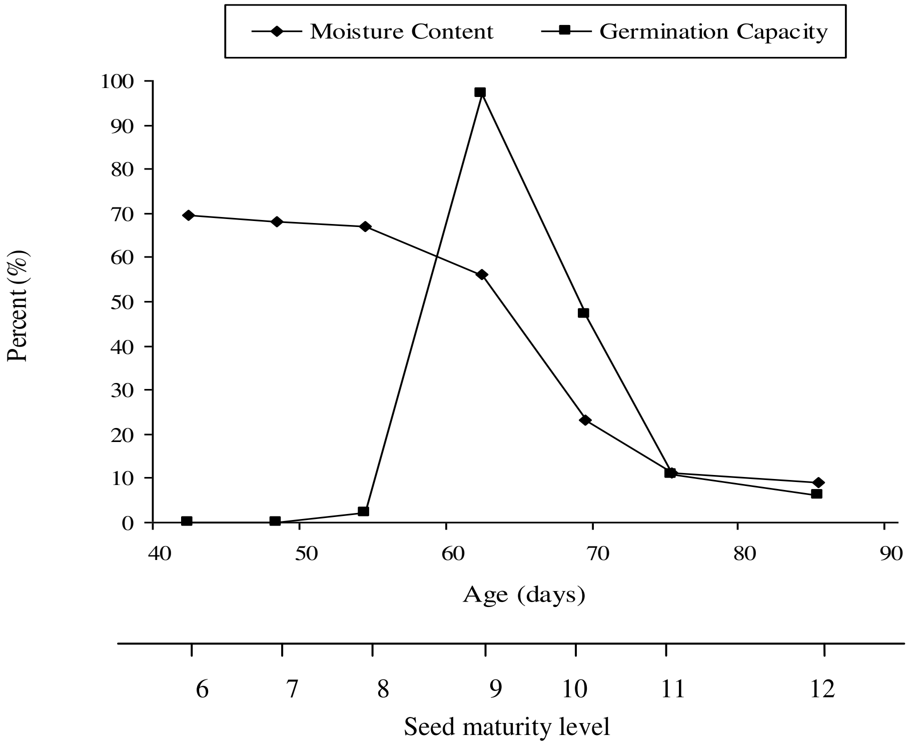

Figure 1. Relationship between seed maturity level and germination capacity, and seed moisture content

Seed germination capacity increased drastically with increasing age up to physiological maturity (seed lot no.9; age 62 days). Afterwards, seed germination capacity decreased. There was a tendency that after the seed reached 62 days of age, seed germination capacity decreased in accordance with decrease in seed moisture content.

Before the seed reached 62 days of age, seed germination capacity increased, while moisture content decreased.

Seeds of L. leucocephala from pod maturity level of no.9, 62 days old, had fulfilled the criteria of physiological maturity. The occurrence of physiological maturity is the most appropriate time for pod harvesting of various plant species, because after this time there will be deterioration of seed quality (Suseno 1974/1975). For L. leucocephala, after the seed reached physiological maturity, namely 62 days after formation of flower. The color of the pods was yellow with black or brown spots. The pod had fresh and succulent seeds. The succulent seeds had color ranging from yellow to brown. On the basis of color change, pod no.9 could be identified in the field, so that seeds with the best quality could be harvested in time. The use of color change as indicator of maturity level of fruit had been known for other species (Toumey and Korstian, 1960). However, this phenomenon is not always reliable (Leloup, 1955).

Seed moisture content could also be used for determining the appropriate schedule of pod harvesting. It turned out that moisture content of physiologically mature seeds was 56.02 %. After the pods reached physiological maturity, seed moisture content decreased drastically.

The effect of moisture content on seed germination capacity was exerted through physiological process of seeds. Sufficient amount of water is of paramount importance for seed cells in order that absorption process, formation of pod, translocation of food, assimilation and respiration could occur properly (Annonymous, 1984).

Extraction method

The use of drying equipment of batch type without heater had the lowest percentage of open pods (20 % for pod no.9, 21 % for pod no.10, and 41 % for pod no.11), but with highest germination capacity (87.13 % for seed lot no.9, 44.25 % for seed lot no.10, and 19.75 % for seed lot no.11). On the other hand, the use of drying equipment of wagon type had intermediate percentage of open pods (30 % for pod no.9, 22 % for pod no.10, and 43 % for pod no.11) with lowest germination capacity (20.25 % for seed lot no.9, 1.88 % for seed lot no.10, and 1.25 % for seed lot no.11). The use of drying equipment of batch type had the highest percentage of open pods (29 % for pod no.9, 38 % for pod no.10, and 61 % for pod no.11) but with intermediate level of germination capacity (19.63 % for seed lot no.9, 4.38 % for seed lot no.10, and 3.5 % for seed lot no.11).

Results of Honestly Significant Deference test of germination capacity for each level of seed maturity from various extraction methods showed that there were highly significant difference between seeds extracted by using drying equipment of batch type without heater and those extraction by using drying equipment of batch type, wagon type, or control. Except for germination capacity of seed lot no.9 and no.10, there were no significant difference between seeds extracted by using drying equipment of batch type without heater and those of control. For seed lot no.9, no.10 or no.11, there were no significant differences between seeds extracted by using drying equipment of batch type and those of wagon type (Table 1).

Table 1. Difference in germination capacity of seed lot no.9, no.10, and no.11, between those extracted by drying equipment of batch type (d_1), batch type without heater (d_2), wagon type (d_3), or control (d_0)

Treatment	Mean Value (arc sin √%)	Value difference with			
		d_0	d_1	d_2	
For seed lot no. 9					
D_0	76.55	-	-	-	HSD 0.05 =
D_1	26.73	50.32^{**}	-	-	11.97
D_2	70.52	6.03	44.29^{**}	-	HSD 0.01 =
D_3	26.30	50.25^{**}	0.07	44.22^{**}	16.68
For seed lot no. 10					
D_0	41.83	-	-	-	HSD 0.05 =
D_1	11.95	29.88^{**}	-	-	4.41
d_2	41.70	0.13	29.75^{**}	-	HSD 0.01 =
d_3	7.86	33.97^{**}	4.09	33.84^{**}	5.78
For seed lot no. 11					
d_0	18.19	-	-	-	HSD 0.05 =
d_1	11.06	7.13^{*}	-	-	5.59
d_2	26.38	8.19^{**}	15.32^{**}	-	HSD 0.01 =
d_3	5.47	12.73^{**}	5.59	20.91^{**}	7.81

* : Significant at HSD (Honestly Significant Difference) 0.05

** : Highly significant at HSD 0.01

Figure 2 showed cumulative percentage of open pods after storage of 1 x 3 hours, 2 x 3 hours, 3 x 3 hours, 4 x 3 hours, 5 x 3 hours, 6 x 3 hours, 7 x 3 hours, or 8 x 3 hours, in drying equipment of batch type, batch type equipment without heater and wagon type.

Percentage of open pods from levels of maturity of no.10 and no.11, extracted by drying equipment of batch type, were higher than those of other treatment, whereas for pods maturity no.9, the percentage of open pods from this equipment was lower than that of wagon type. Percentage of open pods from all levels of maturity extracted by drying equipment of batch type without heater was the lowest.

There was a tendency that cumulative percentage of open pods increased drastically up to extraction duration of 4 x 3 hours. Afterwards, the percentage of increase was lower. Even, the use of extraction by drying equipment of batch type without heater, showed that percentage increase of open pods after extraction duration of 5 x 3 hours, was not significant. For drying equipment of batch type after extraction of 6 x 3 hours, and for drying equipment of wagon type after duration of 6 to 7 x 3 hours, addition of open pods was not significant. This trend occurred more obviously for younger pods.

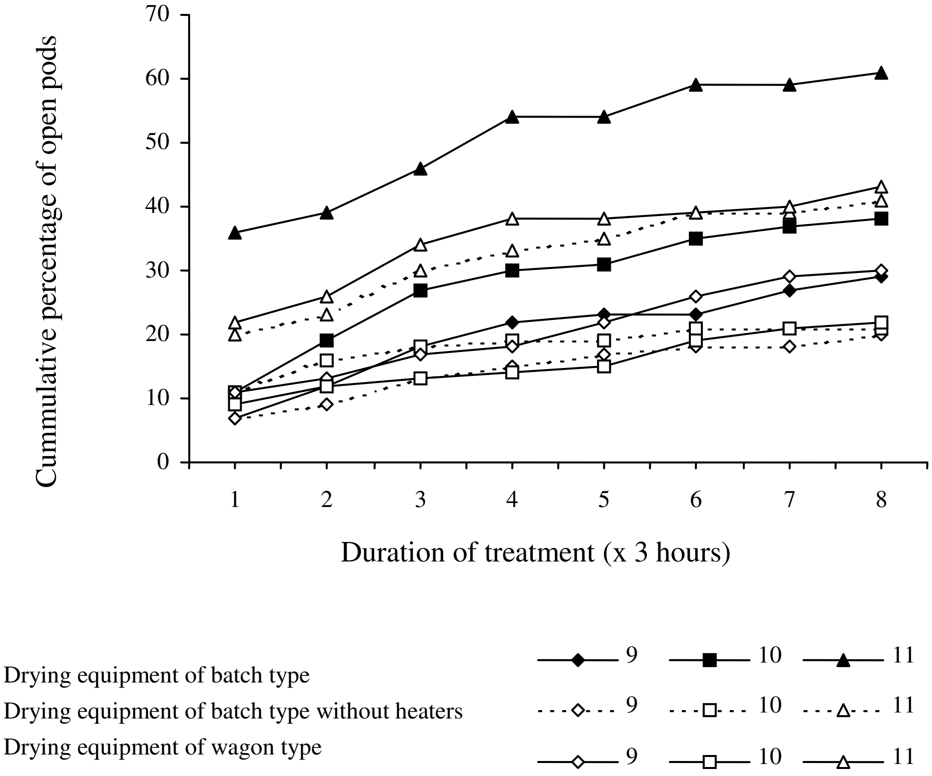

Figure 2. Cumulative percentage of open pods from various levels of maturity, after various levels of storage duration in various type of drying equipment

Figure 3 showed the relationship between various levels of maturity and seed germination capacity from various extraction methods.

In order that seed extraction is properly conducted, temperature and relative humidity during fruit drying should be regulated, and this is commonly practiced during seed extraction from pine cones (Anonymous, 1984)).

Seed extraction by drying reduced the seed moisture content to varying levels, depending on equipment used. The decrease in moisture content could damage the seed (Robert, 1972) and the seeds could not germinate anymore (Anonymous, 1984) or the germination capacity was lost, especially for dormant seeds (Jones, 1920 in Kramer and Kozlowski, 1960).

High temperature could also damage the seeds (Suseno, 1974/1975). This was probably the cause on why the germination capacity of seeds extracted by drying, was lower than those of control seeds (Figure 3). The lower the relative humidity and the higher the temperature within the extraction device, the lower would be the seed moisture content, and the resulted in lower germination capacity.

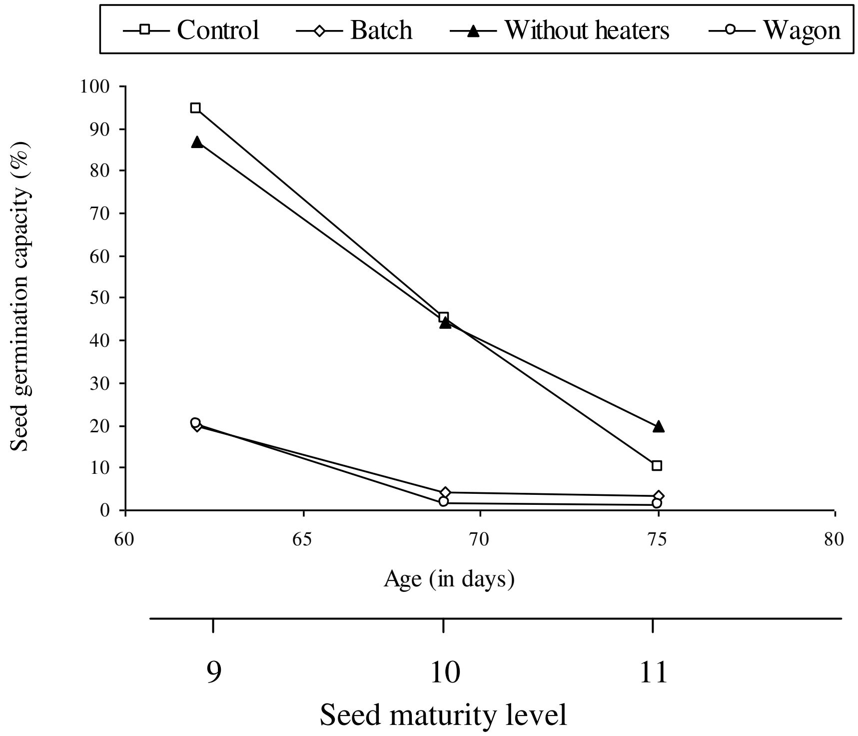

Figure 3. Relation between various levels of seed maturity with seed germination capacity from various extraction methods

Germination capacity of seed lot no.11, as a product of extraction method with drying equipment of batch type without heater, was higher than those of control. Those was probably due to seed moisture content, which was sufficiently high, and the temperature in the drying equipment was suitable for the seeds, so that the germination capacity became higher (Suseno, 1974/1975).

Pathogenic Fungi In The Seed

Pathogenic fungi, which attacked seed of L, leucocephala from various levels of seed maturity after storage for various duration, are depicted in Table 2. During storage, seeds from various levels of maturity became drier. Important consideration, which should be taken in seeds storage, in relation with attack by pathogenic fungi, was relative humidity, and storage temperature (Robert, 1972; Christensen and Kaufmann, 1968).

Table 2. Pathogenic fungi in seeds of L. leucocephala

Storage Duration (weeks)	Maturity Level (number)	Moisture Content (%)	Percentage		Pathogenic Fungi
			Germination	Attacked	
0	9	50.30	93	2.50	Aspergillus sp., Penicillium sp., Colletotrichum sp., Spesies x
	10	15.83	48.25	20.00	Aspergillus sp., Colletotrichum sp., Pythium sp.
	11	9.70	5.00	3.00	Aspergillus sp., Pythium sp.
	12	7.85	5.00	1.00	Aspergillus sp., Pythium sp.
1	9	37.45	52.00	40.00	Aspergillus sp., Penicillium sp., Colletotrichum sp., Spesies x
	10	14.30	47.00	22.00	Aspergillus sp., Colletotrichum sp., Pythium sp.
	11	9.60	3.00	2.00	Aspergillus sp., Penicillium sp.
	12	7.85	1.00	0.00	-
2	9	20.12	19.00	62.30	Aspergillus sp., Penicillium sp., Colletotrichum sp., Pythium sp., Alternaria sp., Spesies x
	10	12.55	41.00	10.00	Aspergillus sp., Penicillium sp., Pythium sp., Alternaria sp.
	11	9.50	1.00	0.00	-
	12	7.85	0.00	0.00	-
3	9 17.67		8.00	70.00	Aspergillus sp., Penicillium sp., Colletotrichum sp., Pythium sp., Alternaria sp., Fusarium sp., Spesies x
	10 9.20		37.00	10.00	Aspergillus sp., Penicillium sp.
	11 8.73		1.00	0.00	-
	12 7.80		0.00	0.00	-

Note : species x = unidentified

Species of storage fungi was found mostly on youngest seed, and was less on older seeds. This had something to do with seed moisture content. The older the seed, the lower was its moisture content. Higher moisture content of seed is more suitable for development of various fungi.

The longer the duration of storage, the greater was the number of storage fungi species, which develop, especially on younger seeds (seed lot no.9 and 10). On older seeds (seed lot no.11 and 12), the number of fungi species, decreased. This was probably due to decreasing seed moisture content at all levels of maturity, in line with storage duration. It appeared that, moisture content of seed lot no.9 was suitable for development of various fungi species, during storage period. The longer the storage duration, the longer was the exposure of the seeds toward contamination so that more fungi species could develop (Roberts, 1972).

The presence of storage fungi at stored seeds, right after extraction, was supposed to be derived from contamination before seed extraction was conducted. This appeared more clearly at pods which became rotten due to attack by fungi when they were still at trees.

Aspergillus sp. and Penicillium sp. were two species, which commonly attacked seeds in storage. These two fungi species could deteriorate seed quality (Christensen and Kaufmann, 1969).

Field fungi Fusarium sp. appeared only after the seeds had stored for three weeks, whereas that of Alternaria sp. after two weeks. This was probably due to contamination during storage. These fungi appeared of the moisture content reached 20-22 %. (Christensen, 1972) suggested that Fusarium sp. caused damage on the embryo, whereas that of Alternaria on other parts of the seeds, outside embryo.

The decreasing germination capacity of seeds during storage was due to seeds physiological activity, as well as to pathogenic fungi, which damage the seeds. Fungi affect seed directly by taking out energy and indirectly by producing toxic substances for the seeds through metabolic process. Beside that, fungi also produced more water, which made the seeds more conducive for further fungi development.

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