SEED YIELDS OF *Agathis loranthifolia* IN AN AGROFORESTRY STAND OF GUNUNG WALAT EDUCATIONAL FOREST, SUKABUMI

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Introduction

Indonesia has experienced great losses of biodiversity, land productivity, ecological and economical functions of forests as results of uncontrolled wood harvesting, illegal logging, and forest encroachment as well as forest fire (Fakultas Kehutanan IPB, 2000). Rehabilitation of degraded forest lands through agroforestry including development of community forests has become a promising alternative to other modes of forest rehabilitation (Departemen Kehutanan, 2001).

This resulted in increasing demand for seeds. According to Ministry of Forestry (2001), the annual needs of high quantity seeds are estimated as much as 2,395 tons that can be used for planting 1,890,000 ha.

Forest seed is an essential element for forest establishment because its permanent effect throughout plant life. There are lots of evidences that the use of seed of good quality will give better and more productive plantations.

Faculty of Forestry IPB as one of active institution working on this field has established a university forest in the district of Sukabumi, West Java. This plantation forest is dominated by Damar (*Agathis loranthifolia*) which is multipurpose tree species amongst other for construction wood, pulp, plywood, copal (resin), furniture etc. (Sutisna et al., 1998; Naiola, 1986). Damar is distinctive, highly sought and exploited for their valuable timber and copal. Large stands of this species have been completely extracted throughout much of its range. Plantation of this species is now established, especially in Java. An example of successful plantation can be found in Mountain Walat Educational Forest (GWEF) of Bogor Agricultural Institute which is located in the district of Sukabumi, West Java. In this forest, Damar is managed either in pure- or agroforestry stands. Seeds and wildlings of Damar are often collected from both stands in order to meet the demand for planting stock materials elsewhere. There is however no available information regarding the influence of stand structure and density on seed yield.

Research on the seed aspects of Damar has been carried out with aims to determine the seed yields of Damar with respects to the type of stand (agro-forest or pure).

Methodology

Sampling procedure

Cones were sampled from ten mother trees of each stand type: i) agro-forest (n= 100 trees/ha) and ii) pure stand (n=400 trees/ha). Mother trees were chose randomly in the stand but using following characteristics as field guide such as stem straightness, health and cone production. Mature cones, collected by a local climber, are recognized form their dark-green colour, smooth and brown colour at the edge of the cone scales (Departemen Kehutanan, 1989). Procedure of sampling for cone analysis is shown in Figure 1.

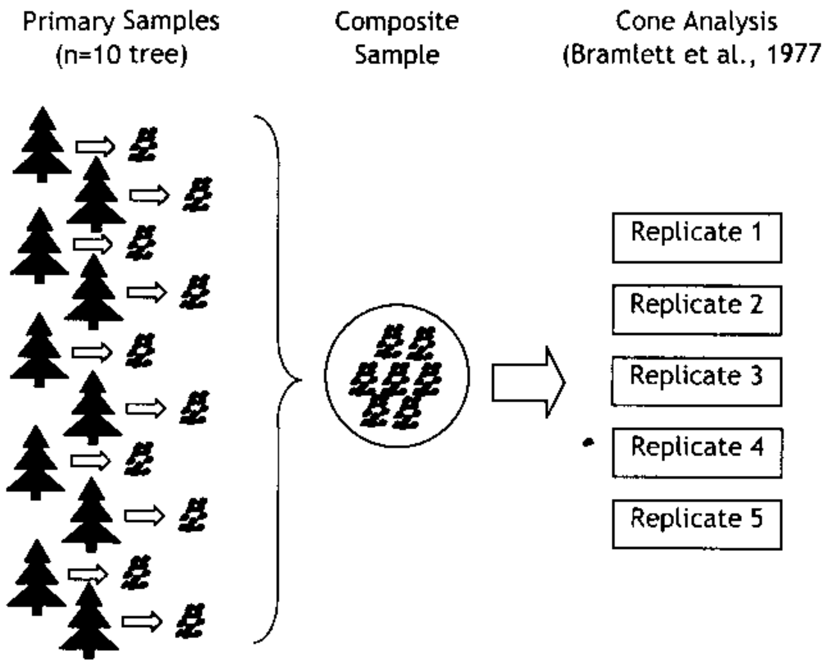

Figure 1. Procedures of sampling for cone analysis in each stand (agroforest or pure stand)

Cone and Seed Analysis

Cone analysis carried out based on a procedure developed for Southern pines (Bramlett et al., 1977) in which some cones variables such as diameter, length, weight and numbers of seed per cone were measured. Following cone analysis, seed was analysed according to procedure published by Indonesian Ministry of Forestry (2002), which is partly adopted from International Seed Testing Association (ISTA) standards for seed quality assessment. The measures are as follows: i) seed purity, ii) seed weight, iii) moisture content and iv) germination.

Statistical Analysis

Experiments were carried out using randomized complete design and data of cone and seed parameters were analysed using statistical package Minitab Version 11.

Results and Discussion

Overall results of cone and seed analysis are presented in Table 1. There were differences due to type of stand in terms of cone diameter, number of seed per cone as well as percent empty seed per cone, while cone length was not significantly different. In general, cones collected from agro forestry stand had better cone physical characteristics than that of pure stand.

Table 1. Summary of results of cone and seed analysis in two different *A. loranthifolia* stands.

No	Characteristics	Type of Stand		*p*-value
		Agroforestry	Pure	
Average Cone Quality				
1	Diameter (cm)	6.7	6.4	0.027**
2	Length (cm)	7.1	6.8	0.157^{ns}
3	No. Seed/Cone	31.58	22.88	0.081*
4	% Empty Seed/cone	13.48	8.72	0.000***
Average Seed Quality				
1	Purity (%)	98.24	97.23	-
2	Moisture Content (%)	18.90	26.50	-
3	Weight of 1000 seeds (g)	19.36	14.60	-
4	Germination (%)	51.80	41.60	0.000***

Seed quality of both stands appeared to have significant differences in terms of moisture content, seed weight and germination, while seed purity showed almost the same scores. In general, agroforestry stand gave better germination that that of pure stand, lower seed moisture content and smaller seed size or seed weight.

Better cone and seed quality produced in agroforestry stand is as a result of lower density, i.e. around 100 trees/ha. In this density, two significant advantages for seed production were observed. First, lower density allows a mother tree to developed broader crown that in turn leads to production of more pollen. As a result, pollination event within the stand is enhanced due to abundant pollen clouds. Second, mother trees receive more lights and this can lead to loss more moisture which in turn reduces the seed moisture content. Seed moisture content always fluctuates and depends on environment (light, temperature and moisture) which at the end reaches equilibrium with its environment conditions. With respects to seed of Damar, i.e. recalcitrant, moisture content is an important factor affecting its viability and health (Kuswanto, 1977). These results would imply that agroforestry stands in Gunung Walat University Forest can function also as seed production area of A. *lorathifolia* provided that the average quality of trees meet the criteria and appropriate management is practiced.

Conclusions

Type of stand influenced cone and seed quality in particular affecting number of seed per cone, seed moisture content, seed weight and seed germination. In general, agroforestry stand gave better seed yields and quality that means feasibility of the stand for seed production.

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