Advances in Biological Sciences Research, volume 14
Proceedings of the 3rd KOBI Congress, International and National Conferences (KOBICINC 2020)

Effect of Seed Source Variation on *Syzygium cumini* (L.) Skeels. Seedlings Growth in Ciamis District, West Java Province

Aris Sudomo [1*], Levina A.G.Pieter [1]

[1] *Dept. of Silviculture, Ciamis Agroforestry Technology Research and Development Center, Ciamis Regency, West Java, Indonesia*
[*] *Corresponding author. Email: arisbpkc@yahoo.com*

ABSTRACT
Syzygium cumini included in the family Myrtaceae is one type of plant that is hard to find. The benefits of *S. cumini* plants include seeds as a cure for diabetes, fruit as an antioxidant and anticancer, fruit skin as a medicine for dysentery and leaves as a reinforcement of teeth and gums. This research aimed to study the effect of seed population sources on the growth of *S. cumini* seedling. Seed exploration was carried out in 3 different *S. cumini* habitats, (1) Gunungkidul District (2) Yogyakarta District and (3) Cikampek District. CRD (Complete Random Design) was used with each population consisting of three replications (50 seeds/replication). The seed source showed significantly different results on the growth of S. *cumini* seedlings (height, diameter, number of leaves, wet weight of stem and leaves and dry weight of stem and leaves). However, the variation of seed sources did not significantly differ on survival, root wet mean, root dry weight, top-root ratio and seed quality index. Height, diameter, number of leaves, comparison starting from the greatest were Gunungkidul (30.42 cm / 2.93 mm / 21.42), Cikampek (24.64 cm / 2.82 mm / 21.06) and Yogyakarta (21.27 cm / 2.45 mm / 19.27). While The stem and leaves wet weight and stem and leaf biomass comparison from the highest were Gunungkidul (6.84 gram, 2.10 gram), Yogyakarta (4.95 gram / 1.59 gram) and Cikampek (4.24 gram / 1.47 gram). Moreover, seeds from the Gunungkidul population produced better growth than other populations. This study's recommendation is to develop rare plants of *S. cumini* species that will have the best growth by using seeds from the Gunungkidul population.

Keywords: *Population, seeds, medicine, S. cumini*

1. INTRODUCTION

Syzygium cumini Linn is known as a plant that can produce timber and fruits. Its leaves can obstruct the growth of *E. coli* and *S. Aureus*, antioxidant, anti-inflammatory, and decrease glucose in blood [1-4]. Fruit's skin contains antioxidant and anti-fungal [5-6]. Moreover, the seed extract can be used as an alternative medication for curing diabetes wounds [7-10].

S. cumini planting site requirements are: (1) ± 300 asl (above sea level), (2) loamy and clay soil with 1000 mm/year of rainfall. Fruity season of *S. cumini* is from September to the end of February on the next year. There are three variances of *S. cumini*, i.e. *S. cumini* kerikil/ white, *S. cumini* brambang, and *S. cumini* gentong [11]. Farmers/local community knowledge about some parts of the *S. cumini* plant's medicinal benefits is relatively limited, and natural germination rarely occurs. Moreover, the substitution of *S. cumini* forest plantations with other species has made it more scarce.

Based on [12], seeds propagated from local and external sources generally had better germination, viability and more vigorous than seeds collected from local remnants. This would be appropriate for productivity purposes. However, collecting local seed might be beneficial for diversity purpose. Moreover, the use of local sources reduces the risk of unwanted genotypes spreading [13].

S. cumini located in some parts of West Java, East Java and Central Java. This plant originated from India and spread throughout tropical areas from Asia to Australia. Exploration of *S. cumini* seeds is carried out in their natural distribution in Gunungkidul District, Yogyakarta District, and Cikampek Subdistrict. Selection of seeds from several provenances is needed to develop and conservation medicinal plant forest *S. cumini*. According to [12], maternal age and provenance are vital for the natural regeneration of the *Pinus thunbergii* forest. Thus, *Cordia africana* Lam's germination energy was correlated significantly with mean annual rainfall and longitude[13]. Seeds collected from different sources also varied greatly regarding seed and kernel weight, oil content in seed/kernel, in *Jatropha curcas*' growth [14]. Moreover, in a study of *A. albida*, provenance also affected a wide array of traits such as seedling growth (leaf, root and stem in the biomass total), seed weight, leaf colour, nodulation, and nutrient content [15]. The study aimed to evaluate the growth of seedlings from 3 different seed sources.

2. MATERIALS AND METHODS

2.1. Location

The research was conducted at a nursery on Ciamis Agroforestry Technology Research and Development Center, Ciamis Regency, West Java, for 11 months. The environmental conditions of the seed sources and greenhouse were shown in Table 1.

2.2 Research Material

The materials were *S. cumini* seeds from 3 provenances (1) Gembiraloka Zoo, Yogyakarta, (2) Paliyan Gunungkidul Wildlife Reserve and (3) KHDTK/ Forest area with the special purpose of Cikampek, West Java. Harvested ripe fruits were physiologically ripe fruit characterized by blackish-purple fruit (black *S. cumini* variety). The seeds were extracted by washing to remove the fruit flesh and sun-drying. Research on jamblang's generative propagation took several stages and started from plants observation until the seedlings were ready to transplant to the planting site. The stages were:

1. Flowering and fruit season observation.
2. Fruit harvesting and seed extraction
3. Germination media preparation
4. Seed germination
5. Seedling transplantation to weaning media
6. Seedling maintenance before transplantation to the planting site

2.3. Research Procedures

The fresh *S. cumini* seeds were given a pre-treatment before sowing. A mixture of soil and sand (1: 1) and a mixture of soil, manure, and sand (3:1:1) were used as germination media and weaning media, respectively. This experiment used three provenances as treatment, (1) Yogyakarta City seed population, (2) Gunungkidul seed population, and (3) Cikampek seed population. The CRD was used with three replications, and each replication consisted of 50 *S. cumini* seedlings.

2.4. Data Collection and Analysis

The observed parameter in evaluating seedling growth was the live percentage, height, diameter, number of leaves, stem and leaf wet weight, root wet weight, stem + leaf dry weight, dry leaf weight, top-root ratio, and Seedling Quality Index. Data collection was carried out at nine-month seedlings. The research data were analyzed using Analysis of Variance (ANOVA), and if it was significantly different, Duncan's test continued using 95% test level on the SPSS 18. The seedling quality index was calculated using the Dickson et al.'s (1960) formula in [17]:

$$IMB = BKT/ (T/D+BKP/BKA) \quad (1)$$

Remarks:

IMB = Seedling Quality Index ; BKT = Total Dry Weight) (g); T = *Tinggi* (Height) (cm); D = *Diameter* (cm); BKP = *Stems and leaves* Dry Weight (g); BKA = Root Dry Weight) (g)

3. RESULT AND DISCUSSION

3.1. Results

The results of this study indicated that the live percentage of *S. cumini* seedlings from the three provenances was not significantly different. Several growth parameters to describe seed quality are height, diameter, number of leaves, stem and leaves wet weight, wet weight of root, dry weight of stem and leaves, dry weight of root, top-root ratio and the quality index of the seedling. The ANOVA result showed that the seed provenance significantly affected the growth in height, diameter, number of leaves, wet weight of stem and leaves, and dry weight of stem and leaves (Table 2). However, the seed

provenance was not significantly different in the growth of wet weight of root, dry weight of root, top-root ratio and the seedling's quality index.

The Duncan's Advanced Test results showed that the Gunungkidul population's seeds produced the highest growth in height, the number of leaves, diameter, wet weight of stems and leaves, and stem + leaves dry weight (Table 3). The parameters of height, stem and leaves wet weight, and dry weight of stem and leaves of Gunungkidul seedling were significantly different from other provenances (Cikampek and Yogyakarta). Meanwhile, for diameter, the Gunungkidul provenance was not substantially different from Cikampek.

3.2. Discussion

The seed sources affect the growth of *S. cumini* seedlings. Gunung Kidul seeds produce the best growth. The seeds from Gunungkidul come from relatively young tree mother trees aged 7-10 years. The mother

Table 1. Environmental conditions at the seed sources and nursery locations

No.	Parameter	Paliyan, Gunung Kidul Wildlife Reserve	Gembira Loka Zoo of Yogyakarta	KHDTK (Forest areas) of Cikampek	Ciamis (Trial Site) [16]
1	Soil type	Latosol	Regosol	Latosol	Latosol/ grumusol
3	Altitude	100 – 300 asl	114 asl	50 asl	115 asl
4	Temperature	25º C	27,2º C	25,57º C - 27,24º C	**26 º C - 27 º C**
5	Humidity	80 % - 85 %,	84,7%	70 - 84 %.	85-89%
6	Rain fall	1.318 mm/ year	1.200 mm/ year	1.796 mm/ year	1500-4000 mm/ year
7	Age of Mother Trees	7-10 years old	± 30-35 years old	±35-40 years old	
8	Spacing of planting	3m x 3m	Mix planting/ irregular space	Mix planting/ irregular space	
9	Diameter	5 cm-11 cm	15-30 cm	20 cm-30 cm	
10	Height	5-9 m	9-15 m	11-15 m	

tree's habitat in Gunung Kidul has about 100-300 m asl of altitude, 1,318 mm/ year of rainfall and clay soil. Ciamis nursery has an altitude of 150 meters above sea level and rainfall reaching more than 1500 mm/ year. The soil mixture used for the *S. cumini* seedlings was latosol mixed with manure. This is the same as the soil conditions in Gunung Kidul, Latosol. The most suitable soil texture for growing *S. cumini* is clay. This is also the same as the condition of Gunungkidul, which is dominated by clay. Gunung Kidul has the lowest rainfall among other provenance locations causes the seeds easier to adapt to development locations with greater rainfall. This was indicated by the Gunungkidul provenance that grew better than other provenances at the development location. According to [18], in all grasses, seed provenance affected seed germination and seedling survival. Moreover, [12] stated that the mother tree did not significantly influence seed germination, but it was significant in seedling growth and biomass allocation.

According to [12], the mother tree's stand density influenced seed germination and seedling growth by maternal environmental effects, thus impacting seed establishment. Therefore, seedlings with denser stand mother tree showed relative higher stem height and slenderness. These offspring's traits were similar to the mother, indicating a maternal environmental effect [12]. [14] also found, populations of *Jatropa curcas* collected from India's central region vary in their growing habitat according to altitude, soil conditions, rainfall, and temperature.

The provenance's environmental conditions were quite the same as the environmental conditions at the development location, making the plants relatively easy to adapt. This makes the provenance of Gunungkidul well adapted to the Ciamis development site, which has similar environmental characteristics. Cikampek environmental conditions are relatively identical to Ciamis (latosol soil, temperature, humidity, rainfall) but relatively different for altitude. These conditions might cause the Cikampek provenance seedling's growth not as good as the Gunungkidul provenance. The seedlings from Yogyakarta Regency produced the lowest growth. This might due to differences in soil types presented in Table 1. [15] also found the similarity between the mother plants' altitude and the greenhouse altitude affected the seedling growth of *Acacia albida* from Zimbabwe.

The growth in height, diameter, wet weight and dry weight of the stems and leaves of the Gunungkidul seedlings proved to be better than those from other provenances. The mother tree's habitat, which is dry and relatively young, produces better growth in height and diameter. This reflects better vegetative growth at the seedling/ nursery level. However, this does not reflect the generative growth, the adaptation of planting in the field, and the produced seeds' quality. This study indicates that the young mother tree of jamblang produces more viable and vigorous seeds. This proves that the mother tree's age will positively affect the growth of the seeds produced. Old plants have decreased reproductive abilities; thus, the seeds produced have slower growth rates. However, the seed survival of the three provenances was relatively the same. This shows that provenance has more effect on seedling growth but has no significant impact on seedlings' survival rate. [12] also stated that the age of the mother tree influenced seedling growth by altering their biomass allocation.

The seeds from young mother trees in Gunung Kidul are potential for the development of the *S. cumini* stands. However, the live percentage on the field and the drugs' chemical quality indicators from each provenance have not been observed. Therefore, this study's results recommend that in the development of S. *cumini* nursery, provenance seeds of Gunungkidul and relatively young broodstock can be used. The relatively dry condition of Gunungkidul provenance has produced seeds with better seedling growth in the development area in Ciamis. [14] found that provenance positively impacts growth performance and oil yields in *Jatropha curcas*, particularly in the prevailing conditions. *S. cumini* is a plant that can reach tens of years (± 40 years). This made *S. cumini* produce seeds for a long time. The selection of young mother trees provides better seedlings growth. However, this

Table 2. The result of ANOVA the effect of population source on survival, growth of height, diameter, number of leaves, total wet weight of cutting, wet weight of stem and leaves, wet weight of root, total dry weight of cutting, dry weight of stem and leaves, dry weight of root, top-rot ratio and seedling quality index of *S. cumini* cutting at nine months old).

Parameter	F Calculation	signification
Survival rate	2,012	0,169 ns
Height	41,121	0,000 *
Diameter	7,233	0,001 *
Number of leaves	10,484	0,000 *
Wet weight of stem and leaves	8,608	0,001 *
wet weight of root	0,914	0,413 ns
The dry weight of stem and leaves	4,487	0,021 *
Dry weight of root	2,335	0,116 ns
top-root ratio	0,74	2,873 ns
The quality indexs of seedling	0,238	0,790 ns

Remark : * = Significant in 95% level and ns = insignificant in 95% level

Table 3. Duncan Test of the effect of seed source variance on height, diameter, number of leaves, wet and dry weight of stem and leaves of nine months old *S. cumini* seedlings

(Treatment / Variation Source)	Height (cm)		Diameter (mm)		Number of Leaves		the wet weight of Stem and Leaves (gram)		The dry weight of Stem and Leaves (gram)	
Yogyakarta	20,85	a	2,40	a	18,89	a	4,95	a	1,59	a
Cikampek	24,64	b	2,76	b	21,06	b	4,24	a	1,47	a
Gunungkidul	30,42	c	2,93	b	21,42	b	6,84	b	2,11	b

Remark: different letter shows a significant difference of 95% level

cannot be obtained every year. This is influenced by weather conditions and the ability of the tree to bear fruit. Along with climate change, *S. cumini* fruit does not always bear fruit throughout the year. Changing conditions in the rainy season and dry season causing the change in fruit season. Moreover, the ability to bear fruit in young trees is lower than that of old trees. The condition of old trees tends to be well established, thus, relatively resistant to climate change. However, old trees are usually less productive, both vegetatively and generatively. S. *cumini* trees at maximum age (40 years ≤) will die by themselves. According to [12], maternal identity had an essential role in their offspring' seed germination, seedling growth, and seedling biomass allocation. However, there were different effect between the stand density and age of the mother tree. The mother tree's age influenced seedling growth by converting biomass allocation. The mother tree's stand density influenced seedling establishment by maternal environmental effects on seed germination and seedling growth. Moreover, we should consider the physical environments and the maternal effects and their interaction to elucidate the natural regeneration mechanism, as stated in [12] in the coastal *P. thunbergii* forest.

A further study about S. *cumini* plant variation from Gunungkidul District is needed. Further study should include more comprehensive seed collection and plant growth in the field trials. Considering, the established field trials will help determine the traits and the genetic variability within provenances [15]. In some countries, afforestation programmes use only local germplasm. However, this might reduce the opportunity to have potential plants with desirable characteristic and higher yield [14].

4. CONCLUSION

S. cumini is a potential medicinal plant that has not been well observed. The mother trees are often found in The Paliyan Wildlife Reserve and Wonosadi Gunung Kidul customary forests. The seed provenance of Gunung Kidul with a relatively younger age of mother trees resulted in higher growth in height, diameter, and biomass of stem and leaf seeds than other provenances. This indicates that provenance influences the growth of *S. cumini* seedlings. Forest and land rehabilitation programs with *S. cumini* species need to be supported with seeds that have high generative regeneration success to increase their success rate. Therefore, young broodstocks from Gunung Kidul could be used to develop *S. cumini* stands.

REFERENCES

[1] K. Sudarmi, I.B.G. Darmayasa, I.K. Muksi, Uji fitokima dan daya hambat ekstrak daun juwet (*Syzygium cumini*) terhadap pertumbuhan *Escherichia coli* dan *Staphylococcus aureus* ATCC, Jurnal Simbiosis 2 (2017) 47–51. [In Bahasa Indonesia]

[2] F.J.S Sami, N. Kursia, S.A Gani, T.R Sidupa, Aktivitas Antioksidan dari Beberapa Ekstrak Kulit Batang Jamblang (*Syzygium cumini*) Menggunakan Metode Peredaman Radikal 2, 2-Diphenyl-1-Picrylhydrazyl (DPPH), Jurnal Farmasi UIN Alauddin Makassar 4 (2017) 130–138. [In Bahasa Indonesia]

[3] S.R. Dewi, Uji Efek Anti Inflamasi Rebusan Daun Jamblang (*Syzygium cumini*) Pada Mencit (*Mus musculus*), Media Farmasi 14 (2018) 53–59. [In Bahasa Indonesia]

[4] M.K. Raya, I.R. Ngardita, R.N Sumardi, Uji Ekstrak Daun Jamblang (*Syzgium cumini* L) Terhadap Penurunan Kadar Glukosa Darah Tikus Putih Jantan Yang Diinduksi Streptozotocin, Gema Kesehatan 10 (1) (2018) 16–22. [In Bahasa Indonesia]

[5] I.S.I Thomson, T. Anggraini, Y. Kurniawan, R. Yenrina, K. Sayuti, Effect of Jamblang (*Syzygium cumini*) Peel and Citric Acid Addition on Antioxidant Axtivity of Kolang Kaling Jam. Pakistan Journal of Nutrition 17 (3) (2018) 140–145. DOI: 10.3923/pjn.2018.140.145 [In Bahasa Indonesia]

[6] S. Chismirina, S. Rezeki, Z. Rusiawan, Konsentrasi Hambat dan Bunuh Minimum Ekstrak Buah Jamblang (*Syzygium Cumini*) Terhadap Pertumbuhan *Candida albicans*, Cakradonya Dental Journal 6 (1) (2014) 655–660. [In Bahasa Indonesia]

[7] L. Lissa. A. Ratnasari, L. Luzyawati, Uji Efektivitas Serbuk Biji Duwet (*Syzigium cumini*) Sebagai Obat Alternatif Luka Diabetes Mellitus, Gema Wiralodra 9(1) (2018) 43–51. [In Bahasa Indonesia]

[8] A. Kumar, R. Ilavarasan, M.P. Deecaraman, A. Padmanabhan, M.R. Krishan, Anti-Diabetic Activity of *Syzygium cumini* and Its Isolated Compound Against Streptozotocin-Induced Diabetic Rats, Journal of Media Plants Research 2 (9) (2013) 246–249.

[9] M. Ayyanar, P.S. Babu, *Syzygium cumini* (L). Skeels: A Review of Phytochemical Constituents And Trditional Uses, Asian Pacific Journal Tropical Biomedicine (2012) 240-246. DOI: 10.1016/S2221-1691(12)60050-1

[10] M. Ayyanar, P.S. Babu, S. Ignacimuthu, *Syzygium cumini* (L.) Skeels., A Novel Therapeutic Agent For Diabetes, Folk Medicinal and Pharmacological Evidences, Complement Therm Medicine 21 (3) (2013) 232–243.

[11] Heyne, Tumbuhan Berguna Indonesia. Diterjemahkan oleh Badan Litbang Kehutanan Indonesia. Koperasi Karayawan. Gedung Manggala Wanabakti Lantai I. Departemen Kehutanan, 1987. [In Bahasa Indonesia]

[12] P. Mao, G. Han, G Wang, Y.Yu, H. Shao, Effects of Age and Stand Density of Mother Trees on Early *Pinus thunbergii* Seedling Establishment in the Coastal Zone, China, Scientist World Journal Volume 201 (2014) 1–9.

[13] A. Loha, M. Tigabu, D. Teketay, K. Lundkvisty A. Fries, Provenance variation in seed morphometric traits, germination, and seedling growth of *Cordia africana* Lam, New Forest International Journal on the Biology, Biotechnology, and Management of Afforestation and Reforestation (32) (2006) 71–86 DOI: 10.1007/s11056-005-3872-2.

[14] H. Ginwal, P.S. Rawat, R.L. Srivastava, Seed Source Variation in Growth Performance and Oil Yield of *Jatropha curcas* Linn. in Central India, Silvae Genetica, 53 (4) (2004) 186–192.

[15] R.A. Sniezko, H.T. Stewart, Range-wide Provenance Variation in Growth and Nutrition of *Acacia albida* Seedlings Propagated in Zimbabwe, Forest Ecology Management, 27 (1989) 179–197.

[16] Anonim, Buku Putih Sanitasi Kabupaten Ciamis Ciamis, Kelompok Kerja Sanitasi Kabupaten Ciamis, 2013. [In Bahasa Indonesia]

[17] R.B.B. Kurniaty, M. Suartana, Pengaruh Media dan Naungan terhadap Mutu Bibit Mindi, Buletin, Puslitbang Cepu Vol. X, 2007. [In Bahasa Indonesia]

[18] M.K. Gallagher, S. Wagenius, Seed source impacts germination and early establishment of dominant grasses in prairie restorations, Journal of Applied Ecology (53) (2015) 251–263. DOI : https://doi.org/10.1111/1365-2664.12564