PAPER NAME

24. 172-179 (corrected final copy) (4).pdf

WORD COUNT

4475 Words

CHARACTER COUNT

24564 Characters

PAGE COUNT

8 Pages

FILE SIZE

821.7KB

SUBMISSION DATE

Jul 13, 2022 1:46 PM GMT+7

REPORT DATE

Jul 13, 2022 1:46 PM GMT+7

5% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 4% Internet database
- 2% Publications database
- Crossref database
- Crossref Posted Content database
- 2% Submitted Works database

Excluded from Similarity Report

- Bibliographic material
- Quoted material
- Cited material
- Manually excluded sources

Res. Crop. **23** (1) : 172-179 (2022) DOI : 10.31830/2348-7542.2022.024
With three figures
Printed in India

Phenology of flowering and fruiting of Calliandra (*Calliandra* spp.) species in submontane forest, Indonesia

AGUS YADI ISMAIL[1], TOTO SUPARTONO[1], CECEP KUSMANA[2], YAYAN SUMEKAR[3,*], SUKRON AMINUDIN[4], YAYAN HENDRAYANA[1] AND AI NURLAILA[1]

[1]*Forestry Study Program, Faculty of Forestry*
Universitas Kuningan, Kuningan, West Java, Indonesia
**(e-mail : yayan.sumekar@gmail.com; agus.yadi@uniku.ac.id)*

(Received : November 12, 2021/Accepted : January 1, 2022)

ABSTRACT

The phenology of flowering and fruiting by predicting the correct timing of flowering and fruiting can be the basis of a national park area management strategy in controlling invasive alien species such as Calliandra (*Calliandra* sp.). The research was conducted from June - September 2020 to determine the phase and phenology of flowering and fruiting of red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*). Direct field observations using *purposive sampling method* with characteristics of trees in a state of flowering based on the four cardinal directions and altitude, the analysis used is the average difference test or t test. The results showed the phenological period for red Calliandra (*C. calothyrsus*) was 97-125 days and white Calliandra (*C. portoricensis*) 72-101 days which occurred in June – September. Red Calliandra phenological periods *(C.calothyrsus)* and white Calliandra *(C.portoricensis)* were not significantly different between the variable direction (0.912 and 0.707) and variable heights (0.924 and 0.800). Therefore, Calliandra (*Calliandra* sp) can growth at an altitude up to 1.700 meters above sea level and is also able to adapt to shade through avoidance and tolerance mechanisms.

Key words : Foreign species; phenology; red Calliandra; white Calliandra

INTRODUCTION

Mount Ciremai National Park (MCNP) with an area of 15,500 ha is a natural conservation area functions as a protection area for plants and animals, several types of local plants in MCNP are saninten (*Castanopsis argentea*), rasamala (*Altingia excelsa*), pasang (*Quercus sundaica*), puspa (*Schima wallichii*), teureup/tekalong/benda (*Artocarpus elasticus*), jamuju (*Podocarpus imbricatus*) and huru sintok (*Cinnamomum sintoc*). In addition, there are also invasive species that were introduced to Mount Ciremai National Park (MCNP) namely acacia (*Acacia decurrens* Wild.) and Calliandra (*Calliandra* sp.) with the ability to easily spread and have invaded the area.

Invasive alien species that most seriously threaten the ecology in a habitat are species that do not have natural enemies, have good generative and vegetative development tools, easy distribution, quickly form shade, generally have a habitus of shrubs, lianas, herbs, trees and palms (Nursanti and Ade, 2018; Chhetri *et al.*, 2021). Srivastava *et al.* (2014) Competition between endemic species and invasive species in the consumption of natural resources can lead to changes in soil structure, decomposition, and nutrient content of the soil. As such, weed species are a serious barrier to conservation efforts with consequent impacts. Zulharman (2017) said that invasive alien species have become a global concern because their impacts can cause ecological damage and economic losses.

Calliandra (*Calliandra* sp.) is a species belonging to the leguminous group that enters

[2]Department of Silviculture, Faculty of Forestry, Bogor Agricultural University, Bogor, Indonesia.
[3]Faculty of Agriculture, Universitas Padjadjaran, Jatinangor, West Java, Indonesia.
[4]Forestry Study Program, Faculty of Forestry, Universitas Kuningan, Kuningan, West Java, Indonesia.

Java from southern Guatemala and has a plant height ranging from 4-6 m, but if the environment allows it can grow up to 12 m with a stem diameter of up to 30 cm. Calliandra (*Calliandra sp.*) is one of the invasive alien species in Mount Ciremai National Park which can disturb biodiversity (Nurlaila *et al.*, 2019). Meanwhile, Calliandra (*Calliandra* sp.) is commonly found in national park areas such as the Bukit Barisan Selatan national park and also in the Manokwari Nature Park, West Papua as an invasive species. With the entry of this invasive alien species, it can disturb endemic plants in Mount Ciremai National Park.

Information about the phases of flowering and fruiting or the phenology of flowering and fruiting Calliandra (*Calliandra* sp.) is very important information for the expansion of knowledge about plants for the benefit of scientific development. According to Syamsuwida *et al.* (2014) understanding of the phenology of flowering and fruiting through prediction of the correct flowering and fruiting time of Calliandra (*Calliandra* sp.). can be the basis of a national park area management strategy for invasive *alien species*. Weed control activities will be carried out by providing information on when flowering and fruiting occur. Thus, studies to determine the phenological phases of flowering and fruiting of red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) as well as the period required for each phase are important in the context of area and species conservation.

MATERIALS AND METHODS

Study Area

This research was conducted at Karangsari Research Station, Gunung Ciremai National Park, Darma District, Kuningan Regency, West Java. in June to September 2020. For more details, the research location is presented in Fig. 1.

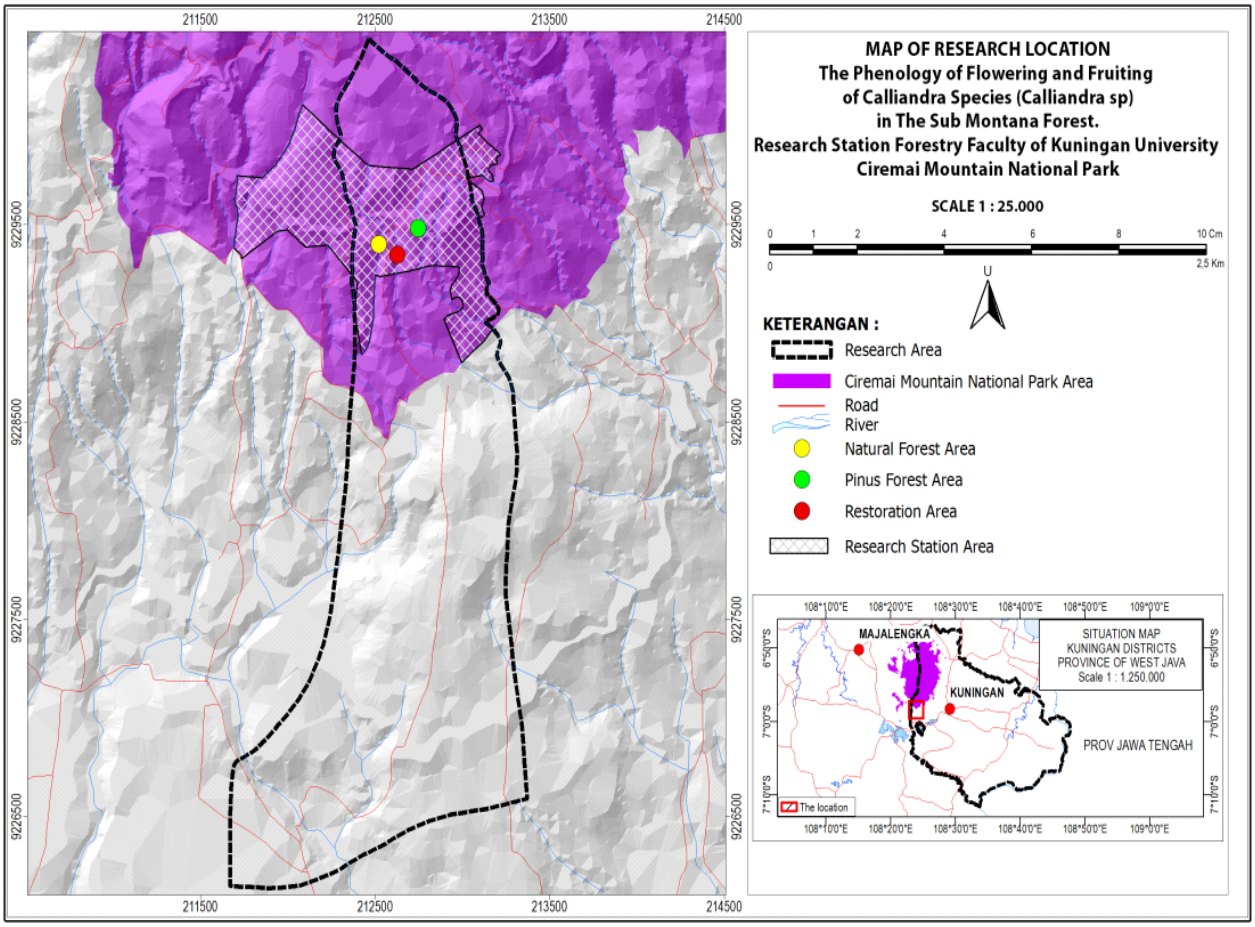

Fig. 1. Research location at Karangsari Research Station, West Java, Indonesia.

Procedures

The observation of Calliandra (*Calliandra sp.*) using the Purposive Sampling Method with the characteristics of trees in a state of flowering based on four cardinal directions and at an altitude of 1,100-1,300 m above sea-level. The data used in this study consisted of primary data, namely data obtained directly in the field from the object of research through direct observation. Primary data includes data on the phenological period of flower growth, flower morphology, temperature and humidity.

The secondary data was obtained based on material or literature references and reviews of documents, books, reading materials, reports, and laws and regulations related to the problems studied. This secondary data includes general condition of the research site, climate, rainfall, and literature on Calliandra (*Calliandra* sp.).

Data Analysis

Data analysis in this study used the mean difference test method or t test using the SPSS version 25 application. The variables used were the phenological period of the developmental phase for the dependent variable, then cardinal directions and altitude for the independent variable.

RESULTS AND DISCUSSION

Phenology of Flowering and Fruiting of Calliandra (*Calliandra* sp.)

Based on the results of direct observations in the field, this study noted that the phenological phases that occurred for red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) were the same starting from the flower initiation phase to the fruit development phase, as well as the phenological period observed from various altitude intervals, namely 1,100 to 1,300 m above sea-level and with a sample of 20 trees per species, it takes 97 to 125 days for red Calliandra (*C. calothyrsus*) with an average of 110 days and 72 to 101 days with an average of 85 days. for white Calliandra (*C. portoricensis*), the phenological period of flowering and fruiting (Tables 1 and 2).

Table 1. Phenology period of the flower initiation phase the development of the red Calliandra fruit (*C. calothyrsus*)

Phase	Number of samples	Average (days)	Minimum (days)	Maximum (days)
Flower initiation (F0)	20	10	7	12
Small bud (F1)	20	15	11	19
Big bud (F2)	20	4	2	6
blooming (F3)	20	5	4	7
Fruit growth (F4=S0)	20	76	73	81
Total (F0-F4)	20	110	97	125

Source : Primary data.

Table 2. Phenology period of the flower initiation phase the development of the white Calliandra fruit (*C. portorisensis*)

Phase	Number of samples	Average (days)	Minimum (days)	Maximum (days)
Flower initiation (F0)	20	10	8	12
Small bud (F1)	20	14	12	17
Big bud (F2)	20	5	2	6
blooming (F3)	20	5	4	7
Fruit growth (F4=S0)	20	50	44	59
Total (F0-F4)	20	85	72	101

Source : Primary Data.

Tables 1 and 2 shows the average period required for red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*). In the flower initiation phase (F0), which was the earliest phase of the flower development process for each plant species, the length of the initiation period for the red Calliandra flower was estimated at an average of 10 days with a range of 7-12 days. Meanwhile, white Calliandra had an average flower initiation period of 10 days with a range of 8-12 days.

The length of the period needed to complete the small bud phase (F1) with an average of 15 days ranging from 11-19 days for red Calliandra (*C. calothyrsus*) and an average of 14 days with a range of 12-17 days for white Calliandra (*C. portoricensis*). The calculation of the average cumulative days needed to reach the large bud phase (F2) since the beginning of flower initiation is 25 days with a range of 18-31 days for red Calliandra (*C. calothyrsus*) and 24 days with a range of 20-29 days for Calliandra. white (*C. portoricensis*). The large bud phase was estimated to last on average 4 days (range 2-6 days) and 5 days (range 2-6 days).

Phase open interest (F3) occurs since a large bud stage ends, namely an average of 5 days with the range of 4-7 days for red Calliandra *(C. calothyrsus)* and not different with white Calliandra *(C. portoricensis).* The cumulative calculation of the average number of days needed to reach the open flower phase (F3) is 29 days with a range of 20-37 days and 29 days with a range of 22-35 days for white Calliandra (*C. portoricensis*) calculated from the initial phase of flower initiation.

The fruit development (fruiting) phase (F4) begins at the end of the open flower phase (F3). Observations indicate that this phase occurs on average after the 34th day from the beginning of flower initiation (range 24th to 44th day) for red Calliandra (*C. calothyrsus*) and 34th day (range 26-42). days) for white Calliandra (*C. portoricensis*). In the table above can be seen that the rapid ripe fruit is 73 days and the longest was 81 days for red Calliandra *(C.calothyrsus)* while 44 days for the fastest and 81 days for the longest white Calliandra *(C.portoricensis).* This phase is quite long when compared to other phases during flowering and fruiting, while the shortest phase is in the large bud phase (F2).

Illustrations of the flowering and fruiting cycles of red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) can be seen in Figs. 2 and 3, respectively.

From Figs. 2 and 3, it can be seen that red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) in the ovary phase or flower initiation (F0) begin to appear in early June, then the ovary stalk appears and lengthens in the early June. small bud phase (F1) in mid-June. After that the flower buds begin to develop in the large bud phase (f2) in late June. Flowers bloom in the open flower

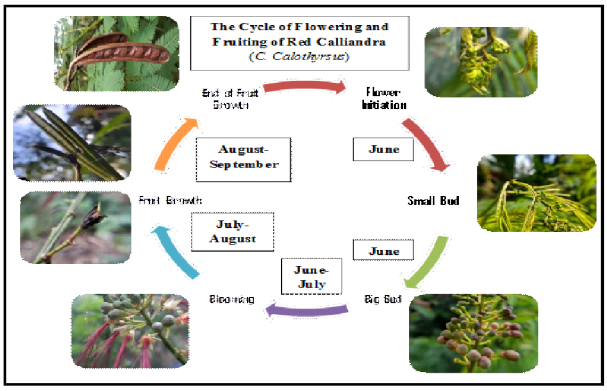

Fig. 2. Cycle of flowering and fruiting of red Calliandra.

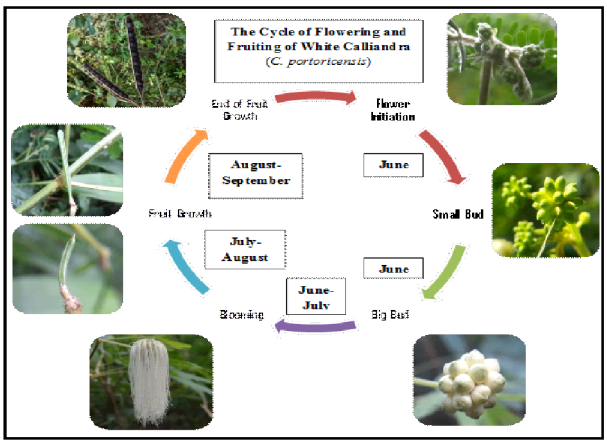

Fig. 3. Cycle of flowering and fruiting of white Calliandra.

phase (f3) which mostly occurs at the end of June to early July, a few days later the flowers experience a threshing process. In early to mid-July the partially fallen flowers show enlargement of the ovaries which indicates fruiting has occurred and develops into young fruit in late July to early August. In August the size of the fruit increases and the fruit ripens at the end of September. Thus, the flowering and fruiting cycle of red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) lasts about 3 to 4 months from June to September in 2020.

Ratio of the Period of Flowering and Fruiting Calliandra (*Calliandra* sp.)

In this study using the analysis of the average difference test or t-test with a confidence interval (α) of 95% or 0.05. As for the results of the t-test analysis are presented in Table 3.

The average difference test or t-test was conducted to determine the level of difference phenological periods required in each type of variable direction and altitude, the results of the analysis showed that the red Calliandra phenological periods (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) is not significantly different with a significance value > 0.05.

Table 3. Recapitulation of analysis results Calliandra t-Test (*Calliandra* spp.)

No	Type	Direction	Sig	Direction	Sig
1	Red Calliandra (*C. calothrysus*)	Not real different	0.912	Not real different	0.924
2	White Calliandra (*C. portoricensis*)	Not real different	0.707	Not real different	0.800

Flowering and fruiting of red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) lasts for 3-4 months in June-September. Meanwhile, according to Baskorowati *et al.* (2020) the development of flower buds until the red Calliandra fruit (*C. calothyrsus*) reaches maturity takes 6 to 7 months. Syamsuwida and Aam (2020) also said that Turi (*S. grandiflora*) which is a type of energy wood has a flower and fruit development cycle ranging from 3-4 months. According to Tenorio and Manriquez (2007), this time period is common for plant species that grow in the tropics which require a relatively short time of less than one year compared to temperate plant species which have four seasons. This is different from the findings of Baskorowati *et al.* (2020) that R. species *mucronata* takes 15-16 months for flowering and fruiting phenology.

In this study, it was shown that there was the shortest phenological period in the large bud phase and the longest time period in the fruit development phase, this happens because a phenology is very closely related to climatic and non-climatic factors (Brown *et al., 2016*). Jamsari and Musliar (2007) reported that the difference in time required for each plant species to complete certain phases of its phenological cycle, in addition to being related to plant genotype responses, is also influenced by the environment such as photoperiod or ambient temperature. The climatic conditions of the location of research shows the average temperature from 20.7 to 21.0^{0}C and humidity from 80 to 83%, and towards the end of the dry season and the beginning of the rainy season. It is similar to the findings of Macqueen (1996) who says that Calliandra *(Calliandra* sp.) require daily temperature of 22 to 28^{0}C and a maximum ambient temperature tolerance grows between 18 and 22^{0}C. In addition, factors such as rainfall also affects the *C. brenesii,* when flowering tends to correlate with rainfall, while fruit development correlates with humidity (Cambronero and Ronald, 2019). Excessive rainfall will cause the death of honeybees which act as pollinating insects, so that low pollination causes the fruiting process to decrease and produce less fruit.

Sunlight is one of the factors that affect the process of plant growth (Aji *et al,* 2015). One of its characteristics is the intensity of light which has an effect on triggering flowering (Fauzi *et al.,* 2017). The longer the plant gets sunlight, the more intensive the photosynthesis process and accelerates the flowering phase (Sutoyo, 2011). Ripe fruit plants of Calliandra *(Calliandra* sp.) usually be broken or experience dehisced when the pods have reached a certain moisture content, red Calliandra (*C. calothyrsus*) has a moisture content of more than the white Calliandra *(C.portoricensis)* caused by the difference in weight of pods, *viz.*, red Calliandra (*C. calothyrsus*) ranged from 9.2 to 27.2 grams with an average of 18.1 grams while white Calliandra (*C. portoricensis*) ranged from 2.2 to 9.6 grams with an average of 6.1 grams. According to Darmawan *et al.* (2014) the water content decreased significantly from the beginning of the fruit development phase until the fruit was ripe. Excess water content in flowers can cause losses so that the fruit produced will be less than the flowers (Ashari *et al.*, 2014).

The results of the analysis showed that the phenological period of each type of Calliandra was not significantly different with a significance value > 0.05. This is because Calliandra (*Calliandra* sp.) can grow at an altitude of up to 1,700 meters above sea level (Macqueen, 1996). *C. estebanensis* grows at an altitude of 1430-2130 m, *C. peninsularis* grows at an altitude of 1,000-1,800 m and *C. californica* at an altitude of 5-550 m (Hernandez and Carlos, 2019; Castillon *et al.,* 2019). In addition, there is also the adaptability of invasive species based on that invasive plants are able to adapt to shade through avoidance and tolerance mechanisms. Avoidance of lack of light is done by increasing the efficiency of light capture. This is evidenced by *C. riparia* showing structural changes in leaf anatomy as an effort adaptation with increasing altitude (Alvarado *et al.,* 2020).

Calliandra (*Calliandra* sp.) is a popular multi-purpose plant that is easy to plant, grows quickly, and sprouts again after repeated pruning. In several places in Indonesia, Calliandra (*Calliandra* sp.) is widely used as firewood, protective plants, land reclamation and conservation, green manure, bee feed and as high-quality forage for livestock as well as other types of leguminous species. Also, Calliandra is one of the potential sources of biomass energy because of its fast growth and high calorific value (Siarudin and Indrajaya, 2020; Syamsuwida *et al.*, 2014; Amirta *et al.*, 2016).

Kenya uses red Calliandra (*C. calothyrsus*) as animal feed to increase milk production of dairy cows (Tuwei *et al.,* 2019). Also used for landslide mitigation (Hairiah *et al.,* 2020; Handayani *et al.,* 2021) and as a pioneer species for watershed rehabilitation in Manolo Fortich, Philippines (De Luna *et al.,* 2020). Furthermore, red Calliandra (*C. calothyrsus*) can be used as a shade tree for arabica coffee plants in North Toraja Regency, South Sulawesi (Lisnawati *et al.,* 2017). Likewise, the essential oil produced by white Calliandra (*C. portoricensis*) is commonly used for herbal medicine for the people of Nigeria (Okhale *et al.,* 2018). Alleopathic properties of the aqueous extract of *Calliandra hematocephala* Hassk functions as weed control (Ayala *et al.,* 2020) and the endodontic content of red Calliandra (*C. calothyrsus*) can be used as an alternative material for controlling fungi (Emitaro *et al.,* 2020).

Many benefits of Calliandra (*Calliandra* sp.) researchers to evaluate the potential of Calliandra plant species, especially for land reclamation and conservation, as well as high-quality forage for livestock as well as other Leuguminosae families (Tangendjaja *et al.*, 1992). In addition to the many benefits obtained and fast growth, this causes the growth of Calliandra (*Calliandra* sp.) to be uncontrolled. On the island of Bali, based on a population simulation analysis, it shows that in the next 50 years it tends to have a larger population (Yudaputra, 2020), therefore there must be a control strategy, especially for conservation areas such as Gunung Ciremai National Park. Four main strategies that can be used to deal with the growth of *Calliandra* sp. namely eradication, containment, control and mitigation (Wittenberg and Ayam, 2001; Handayani *et al.,* 2021).

Based on the strategy and research results regarding the flowering and fruiting cycles of red Calliandra (C.*calothrysus*) and white Calliandra (C. *portoricensis*) it can be controlled such as periodic pruning before the pollination process. Tassin *et al.* (1996) reported that the Calliandra can be pruned 3-4 times a year with pruning height generally between 0.5-1 m, this is the same as the results of research that the long period of time for flowering and fruiting development of red Calliandra (*C. calothyrsus*) and Calliandra white (*C. portoricensis*) about 3-4 months in one cycle. In addition, the management of Calliandra (*Calliandra* sp.) can include animals as predators of invasive species. Utilization of these foreign plant species, especially Calliandra (*Calliandra* sp.) is an alternative option that can reduce pressure on native species so that it can lead to the conservation of their diversity (Wagh and Jain, 2018; Handayani *et al.,* 2021).

CONCLUSION

The flowering and fruiting phases of red Calliandra (*C. calothyrsus*) and white Calliandra (*C. portoricensis*) did not differ for all phenological phases, but experienced differences in the phenological period in the fruit development phase.

REFERENCES

Aji, I. M. L., Sutriono R. and dan Yudistira (2015). Pengaruh Media Tanam dan Kelas Intensitas Cahaya Terhadap Pertumbuhan Benih Gaharu (*Gyrinops versteegii*). *Media Bina Ilmiah J.* **9** : 1-10.

Alvarado, G., Damelis, J., Marina, G., Hipolito, A. and Freddy, Z. (2020). Foliar anatomy of *Calliandra riparia* pittier an elevation gradient on the high basin of the Tocuyo River, Venezuela. *Investigation* **13** : 13-24.

Amirta, R., Yuliansyah, A. E., Ananto, B. R., Setiyono, B., Haqiqi, M. T., Septiana, H. A., Lodong, M. and Oktavianto. R. (2016). Plant diversity and energy potency of community forest in East Kalimantan, Indonesia: Searching for fast growing wood species for energy production. *Nusantara Biosci.* **8** : 22-31.

Ashari, H., Hanif, Z. and Supriyanto, A. (2014). Kajian dampak iklim ekstrim curah hujan tinggi (La-Nina) pada jeruk siam (*Citrus nobilis* var. Microcarpa) di Kabupaten Banyuwangi, Jember dan Lumajang. *Planta Tropika* **2** : 49-55.

Ayala, V. R., Luis, R. G., Paul, V. J., Betty, H., Mats, H., Ingrid, T., Dayana, B., Lorena, G. and Dionisio, A. (2020). Allelopathic properties of *Calliandra haematocephala* Hassk. Extracts and fractions as an alternative for weed management in quinoa and rice corps. *Acta Physiol. Plant.* **42** : doi.org/10.1007/s11738-020-03041-z.

Baskorowati, L., Rina, Nur, Mashudi, Mudji, Dedi. (2020). Low reproduction success of *Calliandra calothrysus* and its implication for breeding. In: Proceeding of the 3rd KOBI

Congress, International and National Conferences (KOBICINK 2020), Atlantis Press.

Brown, C. J., Connor, M., Poloczanska, E. S., Schoeman, D. S., Buckley, L. B., Burrows, M. T., Duarte, C. M., Halpern, B. S., Pandolfi, J. M., Parmesan, C. and Richardson, A. J. (2016). Ecological and methodological drivers of species' distribution and phenology responses to climate change. *Global Ch Biol.* **22** : 548-60.

Cambronero, L. B. and Ronald, S. P. (2019). Phenophases of the bush *Calliandra brenesii* (Fabaceae, Mimosoideae), Alberto Manuel Brenes Mora Biological Reserve, Costa Rica. *Revi. Pens. Actual* **19** : 052-61. doi: 10.15517/PA.V19I32.37797.

Castillon, E. E., Jon, F. R. and Jose, A. V. Q. (2019). *Astragalus comonduensis* and *Calliandra pilocarpa* (Fabaceae), two new species from Baja California sur, Mexico. *Phytotaxa* **391** : 057-68. doi: org/10.11646/phytotaxa.391. 1.4.

Chhetri, S., Dharmveer and Pandey, S. (2021). Effect of different growing media on the growth and biomass of poplar (*Populus deltoide* W. Bartram ex Marshall) stem cuttings. *Res. Crop.* **22** : 644-51.

Darmawan, A. C., Respatijani and Lita, S. (2014). Pengaruh tingkat kemasakan benih terhadap pertumbuhan dan produksi cabai rawit (Capsium frutescent L.) varietas comexio. *J. Produksi Tanaman* **2** : doi: 10.21176/protan.v2i4.115.

De Luna, C. C., Margaret, M. C., Rex, O. C., Enrique, L. T. J. and Wilfredo, M. C. (2020). The economic value of Calliandra calothyrsus in watershed rehabilitation in Manolo Fortich, Bukidnon, Philippines. J. Environ. Sci. Manage. S1-2 : 76-84. doi: org/10.47125/ jesam/2020_sp2/06.

Emitaro, W. O., David, M. M. and George, T. O. (2020). Bioactivity of endophytes from *Calliandra calothyrsus, Leucanea diersifolia* and *Sesbania sesban* against *Cercospora Zeae-maydis. Int. J. Res. Sci. Innov.* **7** : 117-21.

Fauzi, A. A., Sutari, W., Nursuhud and Mubarok, S. (2017). Faktor yang mempengaruhi pembungaan pada mangga (*Mangifera indica* L.). *Kultivasi J.* **16** : 461-65.

Hairiah, K., Widianto, W., Suprayogo D. and Noordwijk, M. V. (2020). Tree penahan akar dan pengikat tanah: Mengurangi risiko longsor di agroforestri Indonesia. *Lahan J.* **9** : doi: 10.3390/land9080256.

Handayani, A., Ervizal, A. Z. and Indrawan J. D. (2021). Menilai pemanfaatan spesies tumbuhan asing yang dinaturalisasi oleh masyarakat untuk menginformasikan strategi pengelolaanya; studi kasus di Biosfer Cibodas Cadangan, Jawa Barat, Indonesia. *Biodiversitas* **22** : 2579-588. doi: 10.13057/biodiv/d220705.

Hernandez, H. M. and Carlos, G. H. (2019). A narrowly endemic new species of *Calliandra* series *Racemosae* (fabaceae) from Sinaloa, Mexico. *Phytotaxa* **401** : 049-54. doi.org/ 10.11646/phytotaxa.401.1.4.

Jamsari, Y. and Musliar, K. (2007). Fenologi perkembangan bunga dan buah spesies Unvaria gambir. *Biodiversitas* **8** : 141-46.

Lisnawati, A., Abubakarm, L., Syahrir, Y. and Yosep, R. (2017). Keankeragaman hayati sistem agroforesti budidaya kopi arabika di Kabupaten Toraja Utara, Sulawesi Selatan, Indonesia. *Biodiversitas* **18** : 741-51. doi: 10.13057/biodiv/d180243.

Macqueen, D. J. (1996). Calliandra taxonomy and distribution, with particular references to the series Racemosae. In: D. O. Evans (Ed). Proceedings of International Workshop in the Genus Calliandra. Forest, Farm and Community Tree Research Reports (Special Issue). Winrock International, Morrilton Arkansas USA. pp. 1-17.

Nurlaila, A., Dede, K., Iing, N. and Meggy, Y. (2019). Keanekaragaman dan pola sebaran tumbuhan spesies asing invasif (*invasive alien species*) di Taman Nasional gunung Ciremai. Di dalam: Prosiding pengembangan sumberdaya perdesaan dan kearifan local berkelanjutan *IX;* Purwokerto: Universitas jendral Soedirman. pp. 63-71.

Nursanti and Ade, A. (2018). Diversity of invasif alien species in Sultan Thaha Saifuddin Grand Forest Park, Jambi. *Media Konserv.* **23** : 85-91.

Okhale, S. E., Ijeoma, J. O., Chiemeka, C. E. and Peters, O. O. (2018). GC-MS characterization, antimicrobial and antioxidant effects of the leaf essential oil of *Calliandra portoricensis* (Jacq.) Benth. *Int. J. Pharma, Sci. Res.* **3** : 38-43.

Siarudin, M. and Indrajaya, Y. (2020). Adaptation and productivity of Calliandra for biomass energy source. In : IOP Conference Series : Earth Environ. Sci. **415** : doi: 10.1088/ 1755-1315/415/1/012016.

Srivastava, S. A., Dvivedi, R. and Shukla, R. P. (2014). Invasive alien species of terrestrial vegetation of North-Eastern Uttar Pradesh. *Int. J. For. Res.* **2014** : 1-9. doi: 10.1155/ 2014/959875.

Sutoyo (2011). Fotoperiode dan pembungaan tanaman. *Buana Sains J.* **11** : 137-44.

Syamsuwida, D. and Aam, A. (2020). Phenology and potential reproduction of turi (*Sesbania*

grandiflora) at Cibinong, Bogor, Indonesia. *Nusantara Biosci.* **12** : 13-20. doi: 10.13057/nusbiosci/n120103.

Syamsuwida, D., Aminah, A., Nurochman, N., Sumarni, E. B. and Ginting, J. (2014). Siklus perkembangan pembungaan dan pembuahan serta pembentukan buah kemenyan (*Styrax benzoin*) di Aek Nauli. *Penelit. Hutan Tan. J.* **11** : 89-98.

Tangendjaja, B. E., Wina, T. M., Ibrahim, B., Palmer. (1992). Calliandra (*Calliandra calothyrsus*) dan Manfaatnya. Balai Penelitian Ternak dan The Australian Centre for Institute Agricultural Research. pp. 13-42.

Tassin, J., Perret, S., Cattet, R. and Leuser, D. (1996). Improving soil physical properties with Calliandra hedgerows in Reunion Island. In: D. O. Evans (Ed). Proceedings of international workshop in the genus Calliandra. Forest, Farm and Community Tree Research Reports (Special Issue). Winrock International, Morrilton Arkansas, USA. pp. 164-67.

Tenorio, G. C. and Manriquez, G. I. (2007). Plant reproductive phenology in a temperate forest of the Monarch Butterfly Biosphere Reserve, Mexico. *Interciencia* **32** : 445-52.

Tuwei, P., Ebby, C. O., Yunus, K. and Josephine, W. (2019). Adoption of *Calliandra calothyrsus* for improved dairy production in Embu County, Kenya. *J. Bio. Agric. Health* **9** : 25-31. doi: 10.7176/JBAH.

Wagh, V. V. and Jain, A. K. (2018). Status tanaman invasif etnobotani di madya barat. *South Afr. J. Bot.* **114** : 171-80. doi: 10.1016/j.sajb.2017.11.008.

Wittenberg, R. and Ayam, M. J. (2001). Spesies asing invasif: Perangkat terbaik pencegahan dan pengelolaan praktek. CABI. doi: 10.1079/9780851995694.0000.

Yudaputra, A. (2020). Memodelkan distribusi potensial saat ini dan penyebaran spesies invasif dimasa depan *Calliandra calothyrsus* di Pulau Bali, Indonesia. *Biodiversitas* **21** : 674-82. doi: 10.13057/biodiv/d210233.

Zulharman (2017). Analisis Vegetasi Tumbuhan Asing Invasif (*Invasive Species*) pada Kawasan Revitalisasi Hutan, Blok Argowulan, Taman Nasional Bromo tengger Semeru. *Natural* **4** : 78-87.

5% Overall Similarity

Top sources found in the following databases:

- 4% Internet database
- Crossref database
- 2% Submitted Works database
- 2% Publications database
- Crossref Posted Content database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	**biodiversitas.mipa.uns.ac.id** Internet	<1%
2	**questjournals.org** Internet	<1%
3	**scielo.br** Internet	<1%
4	**Universitas Jenderal Soedirman on 2022-02-14** Submitted works	<1%
5	**D. C. Dunn. "Highly selective vagotomy and pyloric dilatation for duode...** Crossref	<1%
6	**sciencepublishinggroup.com** Internet	<1%
7	**Harper Adams University College on 2022-06-07** Submitted works	<1%
8	**epa.oszk.hu** Internet	<1%

9	internationalsurgery.org Internet	<1%
10	pt.scribd.com Internet	<1%
11	hindawi.com Internet	<1%
12	internationaljournalssrg.org Internet	<1%
13	University of Leicester on 2022-03-22 Submitted works	<1%

Excluded from Similarity Report

- Bibliographic material
- Cited material
- Quoted material
- Manually excluded sources

EXCLUDED SOURCES

cropresearch.org Internet	12%
pubag.nal.usda.gov Internet	4%
smujo.id Internet	2%