Journal of **BIOLOGICAL RESEARCHES**

ISSN: 08526834 | E-ISSN:2337-389X

Volume 21| No. 2| June | 2016

Original Article

POPULATION DYNAMIC OF *Viscum articulatum* Burm. f. ON ITS HOST IN PURWODADI BOTANIC GARDEN

Solikin*

Purwodadi Botanic Garden-Indonesian Institute of Sciences

ABSTRACT

V. articulatum Burm. f. is a parasitic plant that has potential as medicinal plant. The research aim is to study the population dynamic and hosts of *V. articulatum* Burm. f. in Purwodadi Botanic Garden which was conducted in April-September 2013 by cruising method and literature study on previous research of parasitic plants in Purwodadi Botanic Garden. The results show that *V. articulatum* Burm. f. found living as hyperparasite on the parasite *Dendrophthoe pentandra* (L.) Miq. The population number of *V. articulatum* Burm. f. increased following the increasing of host and time. The species, genera and family of the host trees increased from 20 species, 14 genera and 13 families in 2005 to 23 species, 19 genera and 17 families in 2013.

Keywords: *host, parasite, population, V. articulatum Burm. f.*

INTRODUCTION

Parasitic plant number is reported about 1 % of flowering plants, with more than 3000 species distributed in 16 families (Kuijt 1969). Among these species, mistletoes (Family Loranthaceae and Viscaceae) are widely recognized as an ecologically important functional group (Watson 2001). Types of the parasites can be chategorized as obligative, facultative, hemiparasite and hyperparasite. The facultative parasites or hemiparasites have photosynthetic organs such as leaves or stem containing chlorophyll to fulfill the need of carbohydrates for their growth as commonly found on Viscaceae and Loranthaceae. The hyperparasite attach to another parasites species, commonly on family Loranthaceae (Barlow, 1997) such as *V. articulatum* Burm.f. which attached to the parasite *D. pentandra* (L.) Miq. (Sunaryo et al. 2006).

The parasitic plants live attach to and absorb water, nutrients and food from their hosts so they can inhibit growth and reducing yield of their hosts. Sunaryo et al. (2006) reported that the parasite caused hosts growth inhibition, damage and death of distal branches until 30 %. Although the parasites known as harmful plant species to the host plants, the plants have long been known as a source of traditional medicine (Kirana, 1996; Chozin et al. 1998; Windadri and Rahajoe 1998) such as *V. articulatum* Burm.f. had been used by the Chinese as a hypertension drug (Bachhay et al. 2012), anticancer (Mutha et al. 2010), diuretic (Jadhav et al. 2010), antioxidant (Yu-Jen Kuo et al. 2010.), antiulcer (Naganjaneyulu, 2011), antiepileptic (Geetha et al. 2010), immonodulatory (Tzu et al. 2011). Leaves of *V. articulatum* Burm. f. contains triterpenoids (betuline, oleanolic acid, lupeol stearate, palmitate lupeol, lupeol acetate, a-amyrin, lupeol betulinic acid), flavonoid, steroids (ß-sitosterol), saponins , glycosides , tannic acid, ceryl oleonolate and mesoinositol (Anonymous, 2013).

V. articulatum Burm. f. belongs to family Viscaceae which is found in the tropics from to eastern India to Vietnam and to the south in Malesia region and Australia (Barlow, 1997). This species has been found in Purwodadi Botanic Garden since 1995 (Soejono, 1995). Population and host plants of this species are dynamic and tend to increase as reported Solikin (2013 & 2014) that the population of parasitic plants included *V. articulatum* Burm.f. and *D. pentandra* (L.) Miq. on Family Rutaceae and medicinal plants in Purwodadi Botanic Garden increased in 2005-2013. Study of population dynamic of parasitic plants is important to control them on crops production or cultivate them for herbal medicine.

This research aimed to study the population dynamic of *V. articulatum* Burm. f. and its hosts in Purwodadi Botanic Garden.

METHODS

The research was conducted in Purwodadi Botanic Garden in April-September 2013 by cruising method (Rugayah et al. 2004) in the area of about 85 hectares and literature study on previous research of the parasitic plants in the garden. The host trees and primary parasites that *V. articulatum* attached to were recorded The population parameters, growth rate (Agustina, 1988) and frequency of *V. articulatum* both were calculated Burm. f. as followed :

$$GR \text{ (growth rate)} = \frac{P(t_2) - P(t_1)}{(t_2 - t_1)}$$

$P(t_2)$ = *population number of V. articulatum at the end observation*

$P(t_1)$ = *population number of V. articulatum at early observation*

t_2-t_1 = *time priods* t_2-t_1 *(year)*

* Corresponding Author:
Solikin
Purwodadi Botanic Garden - Indonesian Institute of Sciences
Jl.Raya Surabaya Malang km 65 Purwodadi Pasuruan
East Java
telp : +6281334522748
e-mail : lipisolikin@gmail.com

Frequency = Number of V. articulatum found
The total number of primary host parasite
The primary host parasite was D. Pentandra.

RESULTS

Population

Total population of *V. articulatum* and its host, *D. pentandra* in 2013 compared to 2006 was increase, each was 46.64 % and 48.38 % (Table 1). The population number of *D. pentandra* and *V. articulatum* were 198 and 31 specimens, respectively in 2006. Whereas in 2013, they increased to 290 and 46 specimens respectively (Table 1). Growth rate (GR) of *V. articulatum* was lower than its host plant, *D. pentandra*, each was 2.14 plants. year^{-1} at *V. articulatum* and 13.14 plants year^{-1} at *D. pentandra* (Table 1).

Not all the specimens of *V. articulatum* on the hosts was life. Table 2 showed that there was about 47.83 % of the 46 specimens which were found on six host trees were died. The highest mortality was found on *Cassia fistula* L. which reached 32.61 %.

Host Plant

All of the parasitic plants require host plants for their life. Table 3 showed that there were difference composition or richness of the host plants species, genera and families where *V. articulatum* found during 2005-2013. The host plants increased to 6 species, 7 genera and 5 family during 8 years between 2005–2013. The species, genus and family of the host trees of this parasite increased from 20 species, 14 genera and 13 families in 2005 to 23 species, 19 genera and 17 families in 2013. The dominant host tree was *Cassia fistula* L in 2013.There were about 11 plant species become new hosts for *V. articulatum* such as *Averrhoa carambola, Ceiba pentandra* and *Dillenia philippensis* (Table 4). The presence of *V. articulatum* in this study in 2013 only found on *D. pentandra* as the primary host (Table 5).

Table 1 . The population of *V. articulatum* and its host *D. pentandra* in 2006-2013.

Year	Population		Frequency	Host (trees)	
	D. pentandra	*V. articulatum*	*V. articulatum*	*D. pentandra*	*V. articulatum*
2006 (*)	198	31	0,156	52	20
2013	290	46	0,158	86	26
Growth (%)	46.64	48.38		65.34	30.00
Growth rate (plant.year^{-1})	13.14	2.14		4.857	0.857

Note : (*)= Sunaryo et al. (2006)

Table 2. The mortality of *V. articulatum* on the host trees in 2013

No.	Host tree	Number	Mortality(%)
1	*Cassia fistula* L.	15	32.61
2	*Hydnocarpus sumatrana* (Miq.) Koord.	1	2.17
3	*Cassia garrethiana* Craib.	1	2.17
4	*Tectona grandis* L.	1	2.17
5	*Scolopia spinosa* (Roxb.) Warb.	1	2.17
6	*Lagerstroemia thorelii* Gagnep	1	2.17
	Total die	22	47.83

Note : The population of *V. articulatum* was 46 psecimens

Table 3. The richness of species, genus and family of host plants of *V. articulatum* in 2005 – 2013

Year	Species	Genus	Family
2005(**)	20	14	13
2006 (*)	17	12	12
2013	26	21	18

Note : (*) = Sunaryo et al.(2006); (**) = Uji and Samiran (2005)

DISCUSSION

Increasing of the parasitic plant *V. articulatum* and its primary host numbers, *D. pentandra* in 2013 compared to 2006 (Table 1) was due to seeds dispersal by birds and increasing the host plants population during 2006-2013. Sunaryo et al. (2006) reported that the birds played an important role on the seeds dispersal of parasitic plants such as *D. pentandra* and *V. articulatum*. The birds belong to the family Dicacidae (Van Leeuwen, 1954), especially 'Peppers bird' (*Dicaeum* spp.) (Pitojo, 1996) which eated the fruits of these species.

The fruit of *V. articulatum* is berry, flesh white, taste sweet, seed single, covered with a sticky substance such as rubber *viscin* that is not digested in the digestive system of the birds and will be wasted with faeces or the seeds eaten were wasted moment. The seeds which falls on to the tree branches or twigs will stick, germinate and become new plants. However, not all the seeds can germinate and grow well. The seeds can also stick and germinate on the leaf surface, but they can not develop well because the leaves will fall.

The high GR on *D. pentandra* (Table 1) was caused by domination of this parasitic plant in Purwodadi Botanic Garden. Uji and Samiran (2005), Sunaryo et al. (2006) and Solikin (2013 & 2014) reported that this parasitic plant was the most dominant in this garden so it has more ability and posibility to spread, grow and develop widely than other parasites such as *Macrosolen tetragonus, Scurulla atropurpurea* and *V. ovalifolium.* Whereas the low GR on *V. articulatum* was caused by the parasite has a less attractive fruit, fruit flesh thin, small in

size and it has seed germination type easily removed when rains or more sensitive to the environment. Shade leaves barriers of the host tree and the primary host *D.pentandra* can also interfere the attachment of the parasite seeds on their host. Dependence on a particular host can also be a factor of the low GR of *V. articulatum*.

Table 4. The host trees of *V. articulatum* in Purwodadi Botanic Garden in 2005-2013.

No.	Species	Family	2005(**)	2006(*)	2013	Frequency 2013
1	*Aegle marmelos* (L.) Cross.	Rutaceae	v	v		0.000
2	*Albizia procera* (Roxb.) Bth.	Mimosaceae	v			0.000
3	*Averrhoa carambola* L.*)	Averrhoaceae			v	0.022
4	*Barringtonia asiatica* (L.) Kurtz.	Lecythidaceae	v			0.000
5	*Cassia fistula* L.	Caesalpiniaceae	v	v	v	0.244
6	*Cassia garrettiana* Craib.	Caesalpiniaceae	v	v	v	0.022
7	*Ceiba pentandra* L.*)	Bombacaceae			v	0.022
8	*Dilenia philippensis* Rolfe*)	Dilleniaceae			v	0.022
9	*Dillenia pentagyna* Roxb.	Dilleniaceae	v	v	v	0.022
10	*Diospyros blancoi* A.DC.	Ebeneceae		v	v	0.022
11	*Diospyros malabarica* (Desr.) Kostel.	Ebeneceae	v	v	v	0.022
12	*Euodia sp. *)*	Rutaceae			v	0.022
13	*Ficus fistulosa* Reinw.ex Bl.	Moraceae		v		0.000
14	*Ficus callosa* Willd.	Moraceae	v		v	0.022
15	*Ficus microcarpa* L.f.	Moraceae	v	v		0.000
16	*Ficus paniiflora*	Moraceae	v	v		0.000
17	*Ficus religiosa* L.	Moraceae	v		v	0.022
18	*Ficus superba* Miq.	Moraceae	v	v	v	0.022
19	*Ficus variegata* L.	Moraceae	v		v	0.022
20	*Garcinia dulcis (Roxb.) Kurz.*	Clusiaceae	v	v	v	0.022
21	*Glochidion sp3 *)*	Euphorbiaceae			v	0.022
22	*Holoptelea integrifolia Planch. *)*	Urticaceae			v	0.022
23	*Hydnocarpus sumatrana* (Miq.) Koord. *)	Flacourtiaceae			v	0.022
24	*Ixora longifolia* J.E.Smith	Rubiaceae	v	v		0.000
25	*Lagerstroemia thorelii* Gagnep	Lytheraceae	v		v	0.022
26	*Lagerstromea floribunda* Jack	Lytheraceae		v		0.000
27	*Lagerstromea loudonii* Teijsm.&Binn.*)	Lytheraceae			v	0.022
28	*Mangifera indica* L.	Anacardiaceae	v	v	v	0.044
29	*Osmanthus fragrans* Lour.*)	Oleaceae			v	0.022
30	*Pithecellobium dulce* (Roxb.)Benth.	Mimosaceae		v	v	0.111
31	*Saccopetalum horfieldii* Benn.	Annonaceae	v	v	v	0.022
32	*Scolopia spinosa (Roxb.) Warb. *)*	Flacourtiaceae			v	0.022
33	*Stelechocarpus burahol* (Bl.)Hook.f.&Th.*)	Annonaceae			v	0.022
34	*Tectona grandis* L.	Verbenaceae	v	v	v	0.022
35	*Terminalia catappa* L.*)	Combretaceae			v	0.022

Note : (*) = Sunaryo et al.(2006); (**) = Uji and Samiran (2005); (v) = found ; ( ) = not found; *)= new host

Table 5. The presence of *V. articulatum* on parasitic plants in Purwodadi Botanic Garden in 2005-2015

No.	Species of parasitic plants	2005 (**)	2006 (*)	2013
1	*Macrosolen tetragonus* (Blume)Miq.	v	v	
2	*D. pentandra* (L.)Miq.	v	v	v
3	*Scurrula atropurpurea* (Blume)Danser			
4	*V. ovalifolium* DC.			

Note : (*) = Sunaryo et al.(2006); (**) = Uji and Samiran (2005); (v) = found ; ( ) = not found

The highest mortality of *V. Articulatum* which reached 32.61 % (Table 2) may be caused by the death of branches, twigs or the host plant where *V. articulatum* sticked. This species mostly was found as a parasite on *D. pentandra* as its primary host (Solikin, 2014) so the death of *V. articulatum* will increase following the death of its host**.** Prunning of hosts branches or throwing the parasites on plants collection management affected the population and mortality of this parasite.

V. articulatum was only found on *D. pentandra* as the primary host during the study (Table 5), although Uji and Samiran (2005) also Sunaryo et al. (2006) reported that this parasite had ever been found on the parasite *Macrosolen tetragonus* as showed at Table 5. This was presumably caused by the death of the hosts and the parasite so the presence of the parasite was not found at this time. Solikin (2014) reported that host trees of the parasitic plants was dynamic and able to change. The most dominance host trees was *Ceiba pentandra* (L.) Gaertn in 1995 (Soejono, 1995), whereas in 2006 was dominated by *Ficus* spp. (Sunaryo et al. 2006). *Cassia fistula* L. was the most dominance host tree of *V. articulatum* in 2013 (Table 4). The presence of *V.*

articulatum on various species of parasitic plants was possible to find.

This research can be concluded that population of *V. articulatum* and its hosts was dynamic and able to change. The population of *V. articulatum* increased from 31 to 46 specimens during 2006 -2013 with population growth rate 48.38% while the population of its host, *D. Pentandra* increased from 198 to 290 specimens with population growth rate 46.64%. Host trees of *V. articulatum* increased from 20 species, 14 genera and 13 families in 2005 to 23 species, 19 genera and 17 families in 2013. The dominant host tree was *Cassia fistula* L. with frequency 0.244.

ACKNOWLEDGEMENT

Author would like to thank to Director of Purwodadi Botanic Garden for the attention, Mr. Rahmawan Adi Laksono and Mr. Bambang Walujo S. for the assistance during the research.

REFERENCES

Agustina L., 1988. Analisis Tumbuh Tanaman. Jurusan Budidaya Pertanian. Fakultas Pertanian. Universitas Brawijaya. Malang. 46.

Anonymous, 2013. Taka *V. articulatum* Burm. f., leafless mistletoe. Philippine Medicinal Plant. http://stuartxchange.com/Taka.html,. acessed 20 January 2014.

Bachhav SS, Bhutada MS, Patil SD, Baser B, and Chaudhari KB, 2012. Effect of *V. articulatum* Burm. (Loranthaceae) in Nω-nitro-L-arginine methyl ester induced hypertension and renal dysfunction., *J.Ethnopharmacol.*142(2): 467-73.

Barlow BA, 1997. Viscaceae. In: Kalkman C, Kirkup DW, Nooteboom HP, Stevens PF and de Wilde WJJO (eds) *Flora Malesiana*. I(13): 403-442.

Chozin AB, Wahjoedi, and Pudjiastuti, 1998. Informasi penelitian botani dan fitokimia tanaman benalu., *Warta Tumbuhan Obat Indonesia*. 4(4): 1-2.

Geetha KM Bhaskara Gopal PVVS and Murugan V. 2010. Antiepileptic activity of aerial parts of Viscum articulatum (Viscaceae) in rats *Journal of Pharmacy Research*. 3(12): 2886

Jadhav N, Patil CR and Chaudhari KB, 2010. Diuretic and natriuretic activity of two mistletoe species in rats *Pharmacognosy Research*. 2(1): 50-57.

Khwaja T Dias A, and Pentecost CB, 1986. Recent studies on the anticancer activities of mistletoe (*V. album*) and its alkaloids" *Onconology* .43: 42-50.

Kirana C, 1996. Bioavtive compounds isolated from *Scurullaoortiana* parasitizing tea plant *Camelia chinensis.* Thesis of master or agriculture program, Adelaide University.Adelaide.

Kuijt J, 1969. The biology of Parasitic Flowering Plants. Univ. California Press. Berkeley.

Mutha RE, Shimpi RD, and Jadhav RB, 2010. Study of preliminary anticancer potential of some hemiparasite plants. IJPRD. PUB, ARTI.2(1).

Naganjaneyulu R, Kumar CKA, Kumar GA, Dalith MD and Basha DJ. 2011. Antiulcer activity of *Viscum articulatum* Burm f. (Viscaceae), *International Journal of Innovative Pharmaceutical Research*: 2(2):139-143.

Pitojo S., 1996. Benalu hortikultura: Pengendalian dan pemanfaatan. Trubus Agriwidya, Wildl.Monogr. Ungaran , 86:1–66

Rugayah, Widjaja EA, and Pratiwi, 2004. Pedoman Pengumpulan Data Keanekaragaman Flora Pusat penelitian Biologi-LIPI. Bogor.

Soejono, 1995. Inventarisasi pohon inang benalu Di Kebun Raya Purwodadi Pasuruan, Jawa Timur" *Seminar Nasional Biologi IX*, Universitas Gadjah Mada, Yogjakarta.

Solikin, 2013.Tumbuhan inang benalu pada suku Rutaceae di Kebun Raya Purwodadi. *Prosiding Seminar Nasional Pendidikan dan Saintec.*. In: Sugiyarto E, Mahajoeno, Chalimah S and Julendra H(eds). Prodi Biologi FKIP UMS. 12 Mei 2013. 186-194.

Solikin, 2014.Parasitic palnts on medicinal plants: Study in Purwodadi Botanic Garden. In: Rizal M, Januwati NM, Widyastuti Y, Brotokardono L, Effendi R, Rohadi D and Herwati T (eds). Proceeding of International Seminar Proceedings Forest & Medicinal Plants for Better Human Welfare. Centre for Forest ProductivityResearch and Development. Bogor. 35-46

Sunaryo, Rahman E, and Uji T, 2006. Kerusakan Morfologi Tumbuhan Koleksi Kebun Raya Purwodadi oleh Benalu (Loranthaceae dan Viscaceae)", *Berita Biologi*. 8(2):129-139.

Tennakoon K, Chak W, Im LLL, and Bolin J, 2014. Mineral nutrition of the hyperparasitic mistletoe *V. articulatum* Burm.f.(Viscaceae) in tropical Brunei Darussalam. *Plant Specie Biology* (29)101–107.

Tzu-Li Lu, Jing-Yuan Chuang, Jai-Sing Yang, Shau-Ting Chiu, Nai-Wan Hsiao, Mei-Chen Wu, Shih-Hsiung Wu, and Ching-Hsiang Hsu.2011. Production of Active Nonglycosylated Recombinant B-Chain of Type-2 Ribosome-Inactivating Protein from *Viscum articulatum* and Its Biological Effects on Peripheral Blood Mononuclear Cells . ,*Evidence-Based Complementary and Alternative Medicine*. Article ID283747. http://dx.doi.org /10.1155/2011/283747.

Uji T and Samiran, 2006. Keanekaragaman jenis benalu dan Tumbuhan inangnya di Kebun Raya Purwodadi, Jawa Timur Laporan Teknik. Bidang Botani, Bogor Puslit Biologi_LIPI. 269-277.

Van Leeuwen WM, 1954. On the biology of some javense Loranthaceae and the role birds play in their life history" *Beaufortia*. 4(41). 103-207.

Watson DM, 2001. Mistletoe - a keystone resource in forests and woodlands worldwide. *Annual Review of Ecology and Systematics* . 32: 219-249

Windadri FI and Rahajoe JS, 1998. Keanekaragaman jenis benalu di pulau Jawa. *Warta tumbuhan obat Indonesia*,. 4(4): 25-29.

Yu-Jen Kuo, Yu-Ching Yang, Li-Jie Zhan, 2010. Flavanone and diphenylpropane glycosides and glycosidic acyl esters from Viscum articulatum, *J. Nat. Prod*., 73 (2): 109–114.