Journal of **BIOLOGICAL RESEARCHES**

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

Volume 23| No. 1| December | 2017

Original Article

Diversity of parasitic plants and their hosts in Kepala Jeri and Pemping agroforestry Batam Indonesia

Solikin

Purwodadi Botanic Garden, Indonesian Institutes of Sciences

Abstract

Parasitic plants lived by adhering, absorbing water, minerals and food to host plants. The objective of this research was to determine the diversity of the parasitic plants and their hosts in agroforestry lands where farmers cultivated various plants around their houses or forests. The research was conducted in Kepala Jeri and Pemping Islands, Batam, Riau Islands Province in October 2014 using exploration methods. Plant inventory and data collection were done along determined exploration tracks. There were three species of the parasitic plants were found namely *Cassytha filiformis* L., *Dendrophthoe pauciflora* Dans. and *Viscum stenocarpum* Dans. The most dominant parasitic plant was *C. filiformis*, whereas the least dominant parasitic plant was *V. stenocarpum*. There were 26 species, from 24 genera and 17 families of host plants of *C. filiformis* whereas hosts of *D. pauciflora* were 15 species, from 12 genera and 9 families.

Keywords: Agroforestry, diversity, host, parasitic plant.

Received: 21 August 2017 Revised: 14 December 2017 Accepted: 28 December 2017

Introduction

Agroforestry is a system and land use technology where parennial plants (trees, shrubs, bamboos) and annnual or biennual plants (forage, vegetable, food, tuber, spice, medicinal plants) planted or cultivated in the same land and arrange by time and space (Arifin et al., 2010). It is a sustainable farming system which has been practiced by farmers since 19th century in Indonesia during Dutch East Indies colonial (Budiadi et al., 2012) such as home garden ("pekarangan" in Java). Mixed gardens and forest gardens were also practiced as agroforestry in Indonesia (Arifin et al. 2010). It provides an alternative strategy in meeting the challenges of scarcity of food, energy and water (Hasan, 2012).

Parasitic plants are often found on cultivated and wild plants in agroforestry lands. They live and grow attached to the host plants and absorbing water, nutrients and food from their hosts so they can inhibit growth and reducing yield of the hosts. Nelson (2008) reported that *C. filiformis* can inhibit growth of mango, citrus, nutmeg, avocado, sandalwood, neem and camphor trees and become dominant in natural vegetation with deleterious effects on wild species, such as *Scaevola taccada*, *Achyranthes splendens* and *Lumnitzera racemosa* on islands in the Chagos Archipelago (Indian Ocean). Sunaryo et al. (2006) reported that the parasitic plants caused growth inhibition, damage and death of distal branches of the hosts until 30 % in Purwodadi Botanic Garden.

Species and dominant species of parasitic plants vary depending on location, climate, vegetation and agroecosystem. Solikin (2015) reported four species obtained on fruits plants in home gardens in Malang city, namely *Dendrophthoe pentandra* (L.) Miq., *Macrosolen cochinchinensis* (Lour.) Teigh., *Scurrula atropurpurea* (Bl.) Dans. and *S. ferruginea* (Jack.) Dans. There were five species of parasitic plants obtained on medicinal plants colection in Purwodadi Botanic Garden namely *D. pentandra*, *M. tetragonous*., *S. atropurpurea*, *Viscum articlatum* Burm.f. and *V. ovalifolium* Wall ex DC (Solikin, 2014).

Inspite of the parasitic plants are harmfull to the host plants, they have potential as medicinal plants, such as *V. articulatum* being used by the Chinese as a hypertension drug (Bachhay et al., 2012), anticancer (Mutha et al., 2010), diuretic (Jadhav et al., 2010), antioxidant (Kuo et al. 2010), antiulcer (Naganjaneyulu 2011), antiepileptic (Geetha et al., 2010), and immunomodulatory (Lu et al., 2011). *Cassytha filiformis* was used againts gonorrhoe, kidney ailment and as diuretic in Taiwan (Mythili et al., 2011), hepatoprotector (Bincy et al., 2013), antibacterial action againts *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* (Adonu et al., 2013). Some chemical compounds contained in the parasitic plants were alkaloids, flavonoids, saponins, phenolic fraction of methanol-water and steroids (Daniel et al., 2012).

This research aimed to determine diversity of parasitic plants and their hosts in agroforestry (home gardens and forest gardens) in Kepala Jeri and Pemping Islands Batam.

Method

The research was conducted in Kepala Jeri and Pemping Islands Batam City in October 2014 on altitude 5-15 m above sea level and at latitude around N: 01º01'02" - 01º01 '57 and longitude around E: 103º41'40-103º47'20 " (Kepala Jeri Island) ; N: 01º05'28 "-01º05'35"

* Corresponding Author:
Solikin
Purwodadi Botanic Garden, Indonesian Institutes of Sciences
Jl. Raya Surabaya Malang KM 65 Purwodadi, Pasuruan East Java Indonesia
Phone: 081334522748 Fax: 03414266046
e-mail: solikin@lipi.go.id

http://dx.doi.org/10.23869/bphjbr.23.1.20178

and E: 103º47'18 "- 103º47'53" (Pemping Island) (Figure 1). Data collection were caried out in agroforestry lands (home gardens and forest gardens) using exploratory methods. Tracks of exploration in Kepala Jeri Island were Bukit Meja, Pil 58, Bukit Bangsit, Bukit Pasiran Bangsit, Pil 10, Bukit Ular and Bukit Kapur while in Pemping Island were Tanjung Panah , Kampung Tengah and Bukit Pemping (Figure 1).

Figure 1. Location of floral exploration (0)

Species names and amount of parasitic plants found on the host plants around 5 m the right and left side of the tracks were recorded. Vegetation analysis to determine the parasite species composition on the host plants was conducted by plotless method and purposive sampling. Determination of plant species was conducted by Inventory and Identification of the plants directly and indirectly in the fields where the hosts and parasitic plants founded. Taking photographs and making herbarium were conducted for species identification. Plants species determination refered to Backer and van den Brink (1963, 1965, 1968), Holtum (1968), Barlow (1997), and Yong et al. (2014). Calculating Relative Density (RD), Relative Frequency (RF) and Importance Value Index (IVI) were modified fromKrebs (1994) and Indriyanto (2006) as follow:

$$\text{Relative density (RD)} = \frac{\text{Density of a species}}{\text{The total density of all species}} \times 100\%$$

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of species}}{\text{The total frequency of all species}} \times 100\%$$

$$\text{Important Value Index (IVI)} = \text{RD} + \text{RF (only for Parasitic Plant)}$$

$$\text{Frequency (parasite)} = \frac{\text{Encounter number of a parasite species on host Plants}}{\text{The total number of host plants}}$$

$$\text{Frequency (host)} = \frac{\text{Encounter number of a host plant species on track}}{\text{The total number of tracks}}$$

Results

Species of Parasitic Plants

There were three species of the parasitic plants found, namely *Dendrophthoe pauciflora* Dans. , *Cassytha filiformis* L. and *Viscum stenocarpum* Dans. (Table 1, Table 2), from the family of Loranthaceae, Lauraceae and Viscaceae respectively. *Dendrophthoe pauciflora* and *C. filiformis* were found in Kepala Jeri and Pemping Islands while *V. stenocarpum* was not found in Pemping Island. It may be by chance because *V. stenocarpum* grew as hyperparasite attached to the other parasitic plants such as *D. pauciflora* during this study.

The most dominant parasitic plant in Kepala Jeri and Pemping Islands was *C. filiformis* (Figure 2), or local people call it "cat's eye", with value of IVI 110.9 and 148.83 respectively (Table 1, Table 2) where as *V. stenocarpum* (Figure 3) the least dominant with IVI value of 5.86.

Table 1. Relative density (RD), relative frequency (RF) and important value index (IVI) of parasitic plants in Kepala Jeri Island Batam

No.	Species	RD	RF	IVI
1	*Cassytha filiformis* L.	60.90	50.00	110.90
2	*Dendrophthoe pauciflora* Dans	37.59	45.65	83.24
3	*Viscum stenocarpum* Dans.	1.51	4.35	5.86

Table 2. Relative density (RD), relative frequency (RF) and important value index (IVI) of parasitic plants in Pemping Island Batam

No	Species	RD	RF	IVI
1	*Cassytha filiformis* L.	76.28	72.55	148.83
2	*Dendrophthoe pauciflora* Dans	23.72	27.45	51.17

Host Plants

Host plants of *C. filiformis* found in the two islands were 26 species from 24 genera and 17 families; while in Kepala Jeri Island there were 15 species from 15 genera and 11 families (Table 3); and 19 species, from 18 genera and 16 families in Pemping Island (Table 4). There were

7 species from 7 genera and 7 family found to be hosts of *C. filiformis* in the two islands such as *Melastoma malabathricum* L. and *Adinandra dumosa* Jack and *Dicranopteris linearis* Clarke (Table 5). *M. malabathricum*. and *A. dumosa* were often found in Kepala Jeri and Pemping Islands were *M. malabathricum* with value of relative frequency 17.39 and 13.51 respectively (Table 3, Table 4).

Table 3. The population number. frequency and relative frequency of host plants of *C. filiformis* in Kepala jeri Island Batam

No	Species	Local name	Family	Habitus	Number	F	RF
1	*Melastoma malabatricum* L.		Melastomataceae	SH	20	4	17.39
2	*Acmena acuminatissima* (Bl.) Merr.&Perry		Myrtaceae	SH/ST	10	2	8.696
3	*Archidendron pauciflorum* (Benth.) Nielsen	jengkol	Mimosaceae	T	6	2	8.696
4	*Dicranopteris linearis* (Burm.f)Undew	paku resam	Gleycheniaceae	FR	10	2	8.696
5	*Memecylon* sp.		Melastomataceae	SH	5	2	8.696
6	*Parkia speciosa* Hassk.	petai	Euphorbiaceae	T	10	2	8.696
7	*Adinandra dumosa* Jack	tiup/tiup	Theaceea	SH/ST	2	1	4.348
8	*Artocarpus integer* (Thunb.) L.f.	cempedak	Moraceae	T	6	1	4.348
9	*Ficus* sp.		Moraceae	T	1	1	4.348
10	*Lepisanthes amoena* (Hassk.) Leenh		Sapindaceae	SH	1	1	4.348
11	*Macaranga* sp.		Euphorbiaceae	SH	1	1	4.348
12	*Malotus* sp.		Euphorbiaceae	SH	1	1	4.348
13	*Scleria ciliaris* Nees	Teki	Cyperaceae	H	1	1	4.348
14	*Tabernaemontana pandacaqui* Poir.	mondokaki	Apocynaceae	SH	1	1	4.348
15	*Vitex pubescens* Vahl.	laban	Verbenaceae	T	6	1	4.348

FR = fern . H= herb. SH/ST= shrub/small tree. T= tree

Table 4. Population number, frequency and relative frequency of host plants of *C. filiformis* in Pemping Island Batam

No	Species	Local name	Family	Habitus	Number	F	RF
1	*Adinandra dumosa* Jack	tiup/tiup	Theaceea	SH	44	5	13.51
2	*Malotus* sp.		Euphorbiaceae	SH	20	4	10.81
3	*Mangifera indica* L.	Mangga	Anacardiaceae	T	20	4	10.81
4	*Melastoma malabatricum* L.		Melastomataceae	SH	20	4	10.81
5	*Vitex pubescens* Vahl.	Laban	Verbenaceae	T	20	4	10.81
6	*Parkia speciosa* Hassk.	Petai	Euphorbiaceae	T	16	3	8.11
7	*Acasia mangium* Willd.	Akasia	Mimosaceae	T	1	1	2.70
8	*Acmena acuminatissima* (Bl.) Merr.&Perry		Myrtaceae	SH	5	1	2.70
9	*Alstonia scholaris* (L.) R.Br.	Pule	Apocynaceae	T	1	1	2.70
10	*Artocarpus heterophyllus* Lam.	Nangka	Moraceae	T	1	1	2.70
11	*Artocarpus altilis* (Park.) Fosberg	Sukun	Moraceae	T	1	1	2.70
12	*Callophyllum soulattri* Burm.f.	Bintangur	Clusiaceae	T	1	1	2.70
13	*Dicranopteris linearis* (Burm.f)Undew	paku resam	Gleycheniaceae	FR	1	1	2.70
14	*Lepisanthes amoena (*Hassk.*)* Leenh		Sapindaceae	SH	1	1	2.70
15	*Microcos* sp.		Tilliaceae	SH	5	1	2.70
16	*Nephelium lappaceum* L.	Rambutan	Sapindaceae	T	2	1	2.70
17	*Nephenthes gracilis* Korth.	kantong semar	Nepenthaceae	H	1	1	2.70
18	*Pouteria* sp.		Sapotaceae	T	3	1	2.70
19	*Sonchus arvensis* L.	Tempuyung	Asteraceae	H	1	1	2.70

Note: FR = fern . H= herb. SH/ST= shrub/small tree. T= tree

Table 5. The Host plants of *C. filiformis* in Kepala Jeri and Pemping Islands Batam

No.	Species	Local name	Family	Location (island)	
				Kepala Jeri	Pemping
1	*Acasia mangium* Willd.	akasia	Mimosaceae	-	+
2	*Acmena acuminatissima* (Bl.) Merr.&Perry		Myrtaceae	+	+
3	*Adinandra dumosa* Jack	tiup-tiup	Theaceea	+	+
4	*Alstonia scholaris* (L.)R.Br.	pule	Apocynaceae	-	+
5	*Archidendron pauciflorum* (Benth.) Nielsen	jengkol	Mimosaceae	+	-
6	*Artocarpus heterophyllus* Lam.	nangka	Moraceae	-	+
7	*Artocarpus altilis* (Park.) Fosberg	sukun	Moraceae	-	+
8	*Artocarpus integer* (Thunb.) L.f.	cempedak	Moraceae	+	-
9	*Calophyllum soulattri* Burm.f.	bintangur	Clusiaceae	-	+
10	*Ficus* sp.		Moraceae	+	-
11	*Dicranopteris linearis* Clarke	paku resam	Gleycheniaceae	+	+
12	*Lepisanthes amoena (*Hassk.*)* Leenh		Sapindaceae	+	+
13	*Macaranga* sp.		Euphorbiaceae	+	-
14	*Malotus* sp.		Euphorbiaceae	+	+
15	*Mangifera indica* L.	mangga	Anacardiaceae	-	+
16	*Melastoma malabatricum* L.		Melastomataceae	+	+
17	*Memecylon* sp.		Melastomataceae	+	-
18	*Microcos* sp.		Tilliaceae	-	+
19	*Nephelium lappaceum* L.	rambutan	Sapindaceae	-	+
20	*Nephenthes gracilis* Korth.	kantong semar	Nepentheceae	-	+
21	*Parkia speciosa* Hassk.	petai	Euphorbiaceae	+	+
22	*Pouteria* sp.		Sapotaceae	-	+
23	*Scleria ciliaris* Nees	teki	Cyperaceae	+	-
24	*Sonchus arvensis* L.	tempuyung	Asteraceae	-	+
25	*Tabernaemontana pandacaqui* Poir.		Apocynaceae	+	-
26	*Vitex pubescens* Vahl.	laban	Verbenaceae	+	+

Note: - = absent. + = present

Host plants of *D. pauciflora* in the two islands were 15 species, from 12 genera and 9 families, while 11 species, from 9 genera and 7 families were found in Kepala Jeri Island (Table 6) and 8 species, from 7 genera and 7 families were found in Pemping Island (Table 7). All of the hosts of *D. pauciflora* in agroforestry lands were tree such as *P. speciosa*, *Archidendron pauciflorum* and *Nephelium lappaceum* (Table 6, Table 7).

The dominant hosts of *D. pauliflora* in Kepala Jeri and Pemping Islands were *Artocarpus integer* and *Mangifera indica* with relative frequency value each 23.81 and 28.57 respectively (Table 6, Table 7). The host plants which were found in Kepala Jeri and Pemping Islands were *Artocarpus integer*, *Mangifera indica*, *Mangifera odorata* and *Parkia speciosa* (Table 8).

Table 6. Population number, frequency (F) and relative frequency (RF) of host plants of *D. pauciflora* in Kepala Jeri Island Batam

No.	Species	Local name	Family	Habitus	Number	F	RF
1	*Artocarpus integer* (Thunb.) L.f.	cempedak	Moraceae	T	5	5	23.81
2	*Parkia speciosa* Hassk.	petai	Mimosaceae	T	4	4	19.05
3	*Archidendron pauciflorum (*Benth.) Nielsen	jengkol	Mimosaceae	T	2	2	9.524
4	*Mangifera indica* L.	mangga	Anacardiaceae	T	2	2	9.524
5	*Syzygium malaccensis* (L.) Merr. & Perry	jambu bol	Myrtaceae	T	2	2	9.524

6	*Acasia mangium* Willd.	akasia	Mimosaceae	T	1	1	4.762
7	*Citrus* sp.	jeruk	Rutaceae	T	1	1	4.762
8	*Mangifera odorata* Griff.	kuweni	Anacardiaceae	T	1	1	4.762
9	*Nephelium lappaceum* L.	rambutan	Sapindaceae	T	1	1	4.762
10	*Syzygium polyanthum (*Wight*)* Walp.	salam	Myrtaceae	T	1	1	4.762
11	*Tectona grandis* L.f. (Bl.) Merr. & Perry	jati	Verbenaceae	T	1	1	4.762

Note: T= tree

Table 7. Population number, frequency (F) and relative frequency (RF) of host plants of *D. pauciflora* in Pemping Island Batam

No	Species	Local name	Family	Habitus	Number	F	RF
1	*Mangifera indica* L.	mangga	Anacardiaceae	T	17	4	28.57
2	*Artocarpus integer* (Thunb.) L.f.	cempedak	Moraceae	T	15	3	21.43
3	*Manilkara zapota* (L.) P.van Royen	sawo	Sapotaceae	T	4	2	14.29
4	*Clausena excavata* Burm.f	-	Rutaceae	T	1	1	7.143
5	*Garcinia manggostana* L.	manggis	Clusiaceae	T	2	1	7.143
6	*Mangifera odorata* Griff.	kuweni	Anacardiaceae	T	5	1	7.143
7	*Parkia speciosa* Hassk.	petai	Mimosaceae	T	5	1	7.143
8	*Syzygium samarangensis (*Blume*)* Merr. & L.M. Perry	kelampok	Myrtaceae	T	2	1	7.143

Note: T= tree

Table 8. The Host plants of *D. pauliflora* in Kepala Jeri and Pemping Islands Batam

No.	Species	Local name	Family	Location (Island)	
				Kepala Jeri	Pemping
1	*Acasia mangium* Willd.	akasia	Mimosaceae	+	-
2	*Archidendron pauciflorum (*Benth.) Nielsen	jengkol	Mimosaceae	+	-
3	*Artocarpus integer* (Thunb.) L.f.	cempedak	Moraceae	+	+
4	*Citrus* sp.	jeruk	Rutaceae	+	-
5	*Clausena excavata* Burm.f	-	Rutaceae	-	+
6	*Garcinia manggostana* L.	manggis	Clusiaceae	-	+
7	*Mangifera indica* L.	mangga	Anacardiaceae	+	+
8	*Mangifera odorata* Griff.	kuweni	Anacardiaceae	+	+
9	*Manilkara zapota* (L.) P.van Royen	sawo	Sapotaceae	-	+
10	*Nephelium lappaceum* L.	rambutan	Sapindaceae	+	-
11	*Parkia speciosa* Hassk.	petai	Mimosaceae	+	+
12	*Syzygium malaccensis* (L.) Merr.&Perry	jambi bol	Myrtaceae	+	-
13	*Syzygium polyanthum* (Wight) Walp.	salam	Myrtaceae	+	-
14	*Syzygium samarangensis* (Blume) Merr. & L.M. Perry	kelampok	Myrtaceae	-	+
15	*Tectona grandis* L.f. (Bl.) Merr.&Perry	jati	Verbenaceae	+	-

Note: - = absent. + = present

Discussions

Species of Parasitic Plants

The existence of *V. stenocarpum* (Figure 2) in Kepala Jeri Island was very rare. It was indicated by its value of RF and IVI were the smallest each 4.35 and 5.86 (Table 1). This can be caused by its dependency to other parasitic plants as hosts such as *D. pauciflora*. It was also reported by Solikin (2016) on *V. articulatum* in Purwodadi Botanic Garden that its population was depended on the population of *D. pentandra* as a host namely from 13 specimens (2006) increased to 46 specimens (2013) following the increasing population of *D. pentandra* from 198 specimens in 2006 to 290 specimens in 2013.

V. stenocarpum was not found adhered to *C. filiformis* but only on *D. pauciflora* (Figure 4) while *V. articulatum* in Purwodadi Botanic Garden was only found

on *D. pentandra*, olthough there were other parasitic plants namely *V. ovalifolium*, *S. atropurpurea*, and *M. tertragonus* (Solikin, 2016). It may be a genetic character of *V. stenocarpum* and *V. articulatum* that they lived on other parasitic plants such as *Dendrophthoe* (famlily Loranthaceae).

The dominance of *C. filiformis* (Figure 3) may be related to the characteristics of the parasite and environment included vegetation around it which were suitable for the growing and development of this parasite.

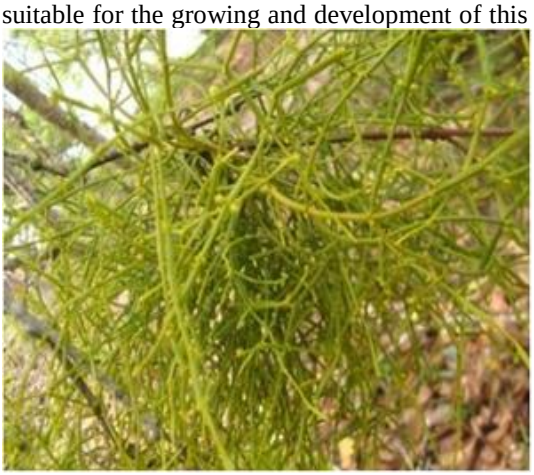

Figure 2. *Viscum stenocarpum* Dans.

Figure 3. *Cassytha filiformis* L.

C. filiformis able to reproduce generatively by seed and vegetatively by cutting/ fragmentation of the stems also the stem easily growth on plants where the stem adhere to them so it will grow and develop quickly to become dominant in fields if no controlling. It can smothered and killed branches of hosts by the stems and haustoriums which rowing, twinning and covering the canopy. Parker (2014) reported that this parasite had negative impact to hosts damage, modification of successional patterns, agriculture, forestry, reduced native biodiversity, habitat alteration, threat to endangered and native species. Sumariono et al. (2016) reported that this parasite had allelopathic effect which inhibited seed germination of *Amaranthus spinosus* L.

C. filiformis is a parasitic plant with a pan-tropical distribution (GBIF 2014), primarily on coastal area with wide range climate (tropical monsoon, tropical rainforest, tropical savanna, tropical wet, desert, warm temperate) and sunny area where it may become dominant and invasive species on wild grasses, shrubs, ferns, and trees (Mukhtar et al., 2010; Kokubugata and Yokota 2012; Parker 2014) such as around agroforestry lands in Kepala Jeri and Pemping Islands.

Generative reproduction by seed of *C. filiformis* was started from the seeds germinating after falling on the ground then it grows twinning and climbing to be a parasite on wide range of host plants. The seeds were dispersed by wind, water or animals. During seed germination, the cotyledons remain fully intact inside the seed coat. Radicles are tuberous, swollen and whitish-green. The plumule is filiform, cord-like, light green and with minute alternate leaves (Augustine, 2004). Seedlings can survive for up to 8 weeks without a host, growing to a length of 30 cm or more, presumably relying mainly on the seed reserves (Nelson, 2008).

Figure 4. *Dendrophthoe pauciflora* Dans.

Host Plants

Melastoma malabathricum L. and *Adinandra dumosa* Jack. are shrub or small tree which often being found in open lands or outside of secondary forests on coastal area that were not managed for crops cultivation such as in Kepala Jeri and Pemping islands. *C. filiformis* often being found as a parasite and become the most dominant parasite on these plants in these islands. This was agreed with Parker (2014) who reported that shrubs or small trees which had low, much-branched woody shrubs can become dominant and favoured host plants of *C. filiformis* such as *Trema lamarckianum, Lantana involucrata, Baccharis dioica, Pithecllobium guadalupense, Eupatorium villosum* and particularly *Acacia choriophylla.* This indicated that shrubs or small trees have important hosts on the growth and development of *C. filiformis*. These habitus may be suitable and provide enough space for sunlight interception or penetration for seed germination, growth and twining the stems of this parasite. Parker (2014) reported that this parasitic plant was sensitive to shading which can inhibited plant growth so sunlight acceptance is very important to its growth. Table 3 and Table 4 showed that the number of wild shrubs or

herbs becoming hosts of the parasite in Kepala Jeri and Pemping Islands were the most each 80% and 68%.

C. filiformis was also found as a parasite on the cultivated plants in agroforestry lands in Kepala Jeri and Pemping islands with frequency 20.00 and 32.00, respectively(Table 3, Table 4) included *Parkia speciosa*, *Artocarpus heterophylla* and *Nephellium lappaceum*. All of them were tree which the parasite need sticking to reach their canopies. Shrubs, grasses, ferns, herbs and small trees have important role as materials/places for twinning and climbing to reach the canopy of the trees such as *Acmena acuminatissma*, *Adinandra dumosa*, *Dicranopteris linearis*, *Lepisanthes amoena*, *Macaranga* sp., *Malotus* sp., *M. malabathricum*, and *Memecylon* sp. (Table 3, Table 4).

Parasitic plants have negative impact to the growth and yield of cultivated plants in agroforestry by inhibiting and reducing plants growth reducing yield. *C. filiformis* on *Parkia speciosa*, *Nephelium lappaceum* and *Mangifera indica* can inhibit and reduce the growth of the branches, leaves and fruits, even drying and dying the branches. This parasitic plant is also dengerous to spreading of plant virus diseases to cultivated plants such as reported by PROTA4U (2013) that *C. filiformis* was a host for citrus mosaic virus and citrus yellow corky vein viroid that the viruses can be transmited to another plants. Covering the plants canopy by stems of *C. filiformis* decreased photosyntesis and inhibited the host plants growth so this or other parasite plants on cultivated plants must be controled early before they covered the plants canopy.

All of host plants of *D. pauciflora* in agroforestry lands in Kepala Jeri and Pemping islands were tree such as *P. speciosa*, *Archidendron pauciflorum* and *Nephelium lappaceum* (Table 6 and Table 7). It was also reported by Soenaryo et al. (2006) and Solikin (2016) on *D. pentandra* that the most dominant host plants of this parasite in Purwodadi Botanic Garden were the tree. It may relate to dispersal of this parasite conducted by birds. Solikin (2013, 2016) reported that the seeds of *Dendrophthoe* such as *D. pentandra* in Purwodadi Botanic Garden were dispersed especially by "chilli birds" (*Dicaeum* spp.) which like to fly and perch on branches or twigs of the trees. The birds eated the fruits and then seeds fall together with feces. The seeds which adhered on surface of branches will germinated and grew as new parasite if the invironment was suitable for its growth and development. So this parasite was almost never found on herbs, grasses or ferns.

The host plants of *D. pauliflora* found in Kepala Jeri and Pemping Islands were *Artocarpus integer*, *Mangifera indica*, *Mangifera odorata* and *Parkia speciosa* (Table 8). The dominant hosts in the two islands were *Artocarpus integer* and *Mangifera indica*. It may be caused these plants cultivated more and had important role to the people.

There were three species of the parasitic plants in agroforestry lands in Kepala Jeri Island namely *Cassytha filiformis*, *Dendrophthoe pauciflora* and *Viscum stenocarpum* which were found on 15, 11 and 1 species of the host plants respectively, while in Pemping Island was found two parasitic plants namely *C. filiformis* and *D. pauciflora* which were found each on 19 and 8 species of host plants. *C. filiformis* was the most dominant parasitic plants in Kepala Jeri and Pemping islands with IVI value 110.9 and 148.83 respectively, whereas the least dominant was *V. stenocarpum* with IVI value 5.86. Herbs and shrubs were dominant host plant of *C. filiformis*; while trees were dominant host plants of *D. pauciflora*.

Acknowledgment

We thanks to The Director of Centre for Plant Conservation of Botanical Gardens,Indonesian Institute of Sciences who gave honor and chance to explore flora of Kepala Jeri and Pemping Islands, Batam. We also thanks to Head of Dinas Kelautan, Perikanan, Pertanian dan Kehutanan, Batam City Riau Islands Province with her staffs who helped and cooperated in the field. Thank you for Mr. Slamet, Mr. Sri Wahyuadi and Mrs. Sutini who helped during floral exploration.

References

Adonu CC, Eze CC, Ugwueze ME, Ugwu KO, 2013. Comparative study of *Cassytha filiformis* and *Cleistopholis patens* for antimicrobial activity. *World Journal of Pharmacy and Pharmaceutical Sciences* (WJPPS) 2(3):1434-1445.

Arifin HS, Wulandari C, Pramukanto Q, Kaswanto RL. 2009. Analisis Lanskap Agroforestri. IPB Press, Bogor.

Augustine KT 2004. Seedling morphology of *Cassytha filiformis* L. (Lauraceae) from Thumba, Thiruvananthapuram, Kerala. *Journal of Economic and Taxonomic Botany* 28(1):107-109.

Bachhav SS, Bhutada MS, Patil SD, Baser B, 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.

Backer CA, Van den Brink B.Jr. 1963. Flora of Java Vol. I. NVP Noordhooff. Groningen-The Netherlands.

Backer CA, Van den Brink B.Jr. 1963. Flora of Java Vol. III. Wolters & Noordhooff NV. Groningen-The Netherlands.

Backer CA, Van den Brink B.Jr. 1965. Flora of Java Vol. II. NVP Noordhooff. Groningen-The Netherlands.

Barlow BA. 1997. Loranthaceae & Viscaceae. Flora Malesiana. Rijksherbarium Hortus Botanicus. Leiden. I(3): 226-441, 403-442.

Bincy Raj, Singh SDJ, Samual VJ, Soosamma John, Ayesha Siddiqua, 2013. Hepatoprotective and antioxidant activity of Cassytha filiformis against CCl₄ induced hepatic damage in rats. *Journal of Pharmacy Research* 7(1):15-19.

Budiadi, Suryanto P, Sabarnurdin S. 2012. Pembaharuan paradigma agroforestri Indonesia seiring meningkatnya isu kerusakan lingkungan dan sustainable livehood. In: Widiyanto E, Prasetyo TS, Widyaningsih, Kuswantoro DP (eds). *Prosiding Seminar Nasional Agroforestri III*. UGM, Yogjakarta,18 Desember 2012.

Daniel CS, Padin MSL. 2012. Uji bioaktivitas beberapa fraksi dari ekstrak benalu sirsak (*Dendrophthoe pentandra* (L.) Miq.) yang berasal dari Kalimantan Timur. *Mulawarman Scientific* 11(1):83-94.

GBIF. 2014. GBIF data portal. Copenhagen, Denmark: Global Biodiversity Information Facility (GBIF). http://data.gbif.org

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

Hasan Z. 2012. Arahan Menteri Kehutanan pada acara Seminar Nasional Agroforestry.In: Widiyanto E, Prasetyo TS, Widyaningsih,

Kuswantoro DP (eds). *Prosiding Seminar Nasional Agroforestri III*. UGM, Yogjakarta, 18 Desember 2012.

Holtum RE. 1968. Fern of Malaya. Revised Flora of Malaya Vol. II. The Botanic Gardens Singapore. Singapore

Indriyanto .2008. Ekologi Hutan. PT Bhumi Aksara, Jakarta.

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

Kokubugata G, Yokota M, 2012. Host specificity of Cassytha filiformis and C. pergracilis (Lauraceae) in the Ryukyu Archipelago. *Bulletin of the National Museum of Nature and Science*. Series B, Botany 38(2):47- 53.

Krebs CJ.1994. Ecology. Fourth Edition. Harper Colleus Publishers, New York.

Kuo YJ, Yang YC, Zhan LJ.2010. Flavanone and diphenylpropane glycosides and glycosidic acyl esters from *Viscum articulatum*. *J. Nat. Prod*. 73 (2): 109–114.

Lu TL, Chuang JY, Yang JS, Chiu ST, Hsiao NW, Wu MC, Wu SH, Hsu CH 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.

Mukhtar I, Khokhar I, Mushtaq S. 2010. First report on *Cassytha filiformis* L. (Lauraceae), a parasitic weed from Lahore, Pakistan. *Pakistan Journal of Weed Science Research* 16(4):451-457. Mythili S, Sathiavelu A, Sridharan TB 2011. Antimicrobial activity of selected Indian folk medicinal plants. *Journal of Pharmacy Research* 4(6):1894-1898

Mutha RE, Shimpi RD, 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, Basha DJ. 2011. Antiulcer activity of *Viscum articulatum* Burm f. (Viscaceae) . *International Journal of Innovative Pharmaceutical Research* 2(2):139-143.

Nelson SC 2008. *Cassytha filiformis*. Plant Disease Leaflet PD 42. Hawaii: Cooperative Extension Service. 10.

Parker C 2014. *Cassytha filiformis* L Invasive Species Compendium. http://www.cabi.org/isc/datasheet/11493

Prota4U. 2013. PROTA4U web database. Grubben GJH, Denton OA, eds. Wageningen, Netherlands: *Plant Resources of Tropical Africa*. http://www.prota4u.org/search.asp

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

Solikin. 2014. Parasitic plants on medicinal plants: Study in Purwodadi Botanic Garden. In: Rizal M, Januwati NM,Widyastuti Y, Brotokardono L, Effendi R, Rohadi D, Herwati T (eds). *Proceeding of International Seminar Proceedings Forest & Medicinal Plants for Better Human Welfare*. Centre for Forest ProductivityResearch and Development, Bogor, 12-13 September 2013.

Solikin. 2015. Benalu pada tanaman buah-buahan di Kota Malang. In: Setyawan AD, Ridwan M, Pamungkas DW, Ruspendi ECA, Kharismamurti K, Muthmainnah N, Lisa N, Putri RDA. *Prosiding Seminar Nasional Biodiversitas*. Surakarta, 15 November 2014.

Solikin. 2016. Population Dyniamic of *Viscum articulatum* Burm.f. on Its Host in Purwodadi Botanic Garden. *Journal of Biological Recsearches* 21(2):81-84.

Sumariono, Widaryanto E, Nugroho A. 2016. Allelopathy Test of the Love-Vine's (*Cassytha filiformis* L.) Extract as A Bioherbicide Againts Seed Germination of Amaranth (*Amaranthus Spinosus* L.) . *IOSR Journal of Agriculture and Veterinary Science* (IOSR-JAVS) 9(5): 59-62

Sunaryo, Rahman E, Uji T. 2006. Kerusakan morfologi tumbuhan koleksi Kebun Raya Purwodadi oleh benalu (Loranthaceae dan Viscaceae). *Berita Biologi* 8(2): 129-139.

Yong JWH, Chew SYJ, Min BC. 2014. Plants in Tropical Cities. 1 st Edition. Singapore.