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Tables : 3, Figs : 2

Effects of environmental stress (island vs. inland habitats) on allelopathic potential of tree species in South China

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ABSTRACT

The environmental stress strongly affects the allelopathic potentials of plants. Compared with the inland environment, islands have strong environmental stresses (i.e., high soil salinity/air, thin soil layers strong wind). We studied the 7-Donor tree species (*Eucalyptus urophylla* Blake., *Melastoma malabathricum* L., *Toxicodendron succedaneum* (L.) Ktze., *Litsea rotundifolia* Hemsl. *Var. oblongifolia* (Nees) Allen., *Rhodomyrtus tomentosa* (Ait.) Hassk., *Schefflera heptaphylla* (L.) Frodin. and *Acacia auriculiformis* A. Cunn. ex Benth.) allelopathic potential from island and inland habitats on two recipient test plants: (i). Cabbage (*Brassica oleracea var. capitata* L.), (ii). Radish (*Raphanus sativus* L.). Furthermore, to better understand the altered allelopathic potentials due to environmental stresses, we determined the concentrations of flavonoids and phenols in plants from island and inland habitats. We found that lower concentrations of extracts of all 7- Donor trees had weaker allelopathic effects on recipient spp. However, higher concentrations of extracts of *E. urophylla*, *M. malabathricum* and *T. succedaneum* showed stronger allelopathic potentials, when growing on island than from inland plants. Whereas, *L. rotundifolia* , *R. tomentosa* and *S. heptaphylla* showed weaker allelopathic potentials, when growing on island than from inland plants. The allelopathic potential of *A. auriculiformis* did not differ between the island and inland populations. Except *A. auriculiformis* and *S. heptaphylla*, the total phenols concentrations of all 5-species caused the allelopathic potentials. However, total flavonoids were found only in *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla*. This study showed that environmental stresses changed the allelopathic potentials of plants and various plant species and their phytochemicals depended on the environmental stresses.

Keywords: Allelopathic potential, environmental stress, flavonoids, forest, phenol, phytochemicals,

INTRODUCTION

Plants releases the chemicals into their surrounding environment, that influences the growth and establishment of other plants, due to ‘allelopathy’ and the phytochemicals are the basis of plants allelopathy (53). The indirect inhibitory effects of plants on other plants under environmental stress are due to the increase in allelochemicals, which enhances the allelopathic effects of plants. The phenols and terpenoids allelochemicals contents generally increase, when plant undergoes the stresses, viz., nutrients deficiency, drought and salt stress (16,27,42,45). Besides, under drought or high salinity, tannins and

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hydroxamic acid production is increased (46,57). The stresses change the types of phytochemicals and also their concentrations in plants (25,32,39). However, environmental stresses do not always increase the phytochemicals production. In some cases, stresses reduce phytochemical production due to the strong trade-off between the plant growth and their production of secondary metabolites (11,27,28). Thus, plant phytochemicals changes in different environmental stresses caused by variable habitats. The changes in plant phytochemicals influences the plant allelopathy.

Allelopathy plays an important role in interspecific plant-plant interactions (6,44) and is strongly affected by biotic/abiotic environmental factors (1,2). Allelopathy is commonly enhanced when plants are exposed to environmental stresses (14) which causes the phytochemicals variability (23). While in some cases, stresses reduced the allelopathic potential of plants (30,35). Different types of environmental stresses dominate in various habitats, which results in differential allelopathic potential of plants (32).

Small islands contribute greatly to the development and maintenance of biodiversity and other ecosystem services (24,34,54). However, the environmental conditions on islands are usually harsh [high soil/air salinity, strong wind and thin soil layers (3,43,50,51,56), tropical cyclones (13), tsunamis (40) and have resource limitations (3,43)]. Low soil water availability is a major stress factor on small islands, it increases the phenols and terpenoids production (27,47,49). High salinity increases the production of phenols, carotenoids and tocopherols due to salt-induced oxygen limitation (25). The strong winds increase the phenols production (42). Therefore, we hypothesized that the stressful conditions on small islands may increase the allelopathic potentials of plant-species colonizing the island habitats than their conspecifics in adjacent inland habitats.

We selected 7-Donor tree species (*E. urophylla*, *M. malabathricum*, *T. succedaneum*, *L. rotundifolia*, *R. tomentosa*, *S. heptaphylla* and *A. auriculiformis*) growing in both inland and island habitats in southern China. This study aimed to find the differential effects of these two habitats (Island, Inland) on plants allelopathic potentials. We addressed two questions: (i). Do environmental stresses increase the allelopathic potentials of common woody species on small islands and (ii). Can the altered allelopathic potentials be explained by the changes in concentrations of phytochemicals (flavonoids/phenols)? To understand how the environmental stresses on small islands may affect the plant allelopathic potentials? and identify plant species tolerant to environmental stresses for restoration of vegetation in islands.

MATERIALS AND METHODS

I. Study sites and test species

We selected two habitats (island and inland) in Zhuhai City, Guangdong Province. The Sanjiao Island of Zhuhai City, Guangdong, China (22°08’30”N, 113°42’34”E) is uninhabited. Its mean annual temperature: 22.5°C, strong winds year- round (6.5 m/s) and mean annual precipitation: 1849 mm. The main vegetation secondary forests (personal

observation), is sparse and intensively affected by human activities. The inland habitat, DaJing Mountain Forest Park, with ecosystem similar to Sanjiao Island, is situated in southeast of Zhuhai City, Guangdong, China (22°17′16″N, 113°32′44″E), 23.3 km away from Sanjiao Island. Its mean annual temperature: 22.6°C, mean annual precipitation: 2082 mm, and average wind speed: 2.9 m/s. The vegetation is well protected dense primary and secondary forests.

Table 1. The growth conditions in selected island (Sanjiao) and inland habitats (Dajing Mountain Forest Park)

	Sanjiao Island	Dajing Mountain Forest Park
Soil Physico-chemical properties		
Water content (%)	9.00±0.06	12.6±0.04
pH	5.50±0.29	5.17±0.18
Electrical Conductivity (ds/m)	1.80±0.19	1.52±0.17
Organic Matter (g/kg）	6.93±0.74	28.99 ±1.58
Total Nitrogen (g/kg)	0.35±0.16	1.15±0.33
Total Phosphorus (g/kg)	0.08±0.05	0.13±0.08
Total Potassium (g/kg)	27.77±1.17	30.71±0.93
Available Nitrogen (mg/kg)	37.02±1.85	54.45±2.39
Available Phosphorus (mg/kg)	0.80±0.23	1.39±0.36
Available Potassium (mg/kg)	68.60±1.27	94.75±3.12
Weather conditions		
Average wind speed (m/s)	6.5	2.9
Annual Precipitation (mm)	1849	2082

Data are presented as the mean ±SE (n=8).

To know the physico-chemical properties of soil in island and inland habitats, top 0-10 cm soil was sampled at 8-randomly chosen 10 x 10 m^2 plots, and 5 samples were collected per plot. The soil samples collected from each plot were pooled to obtain a composite sample. All the soil samples were coded and kept in sealable bags. We measured the soil water content and electrical conductivity of each soil sample using time domain reflectometry (TDR) in the field (55). We measured the soil pH by water extraction (soil : water 1 : 2.5, w:v) with pH meter (61). The soil's organic matters (52), total nitrogen (4), total phosphorus (33), total potassium (37), available nitrogen (58), available phosphorus (33) and available potassium (37) were determined by respective soil chemistry analysis method. The results showed that the soil water and nutrient availabilities on Sanjiao Island were lower than in Dajing Mountain Forest Park, while the soil acidity and electrical conductivity were higher on Sanjiao Island than in Dajing Mountain Forest Park (Table 1). This indicates that the environmental conditions on Sanjiao Island were harsher than in Dajing Mountain Forest Park.

Test plant species: We selected 7- Donor test tree species (*A. auriculiformis*, *S. heptaphylla*, *R. tomentosa*, *E. urophylla*, *T. succedaneum*, *L. rotundifolia* and *M. malabathricum*) (Table 2) common on both habitats (59).

II. Collection of test tree spp. leaves

In September 2018, we collected young, fresh, healthy and actively growing leaves of all 7-Donpor test species from both sites (Sanjiao Island and Dajing Mountain Forest Park). The leaves of 5- tree species (*A. auriculiformis, S. heptaphylla, R. tomentosa, L. rotundifolia* and *M. malabathricum)* were collected from 10-15 sampling points, and from 4-6 sampling points for *T. succedaneum* and *E. urophylla*. We collected leaves from 30-50 adult trees of each specie from the island and inland sites. The sampled trees of each species were growing 100-200 m apart.

Table 2. List of tree species

Scientific name	Family	Distribution in China
Acacia auriculiformis A. Cunn. ex Benth.	Fabaceae	South
Eucalyptus urophylla Blake.	Myrtaceae	South
Litsea rotundifolia Hemsl. *var. oblongifolia* (Nees) Allen.	Lauraceae	East and southeast
Melastoma malabathricum L.	Melastomataceae	South and southeast
Rhodomyrtus tomentosa (Ait.) Hassk.	Myrtaceae	South and southeast
Schefflera heptaphylla (L.) Frodin.	Araliaceae	Widespread
Toxicodendron succedaneum (L.) Ktze.	Anacardiaceae	Widespread

III. Preparation of aqueous extracts

In nature, the leaching and release of water soluble allelochemicals occur by rain. Hence, we used fresh water to prepare the extract to simulate allelochemicals leaching in nature (36,41). Chen *et al.* (7), used two concentrations of leaf leachates in bioassays: High concentration (0.3 g/mL) and Low concentration (0.06 g/mL), which were realistic to field levels (12). All collected-leaves were washed with distilled water and then cut into small pieces (1-2cm) (41). Thirty g leaf pieces for each species per site were soaked in 100 mL distilled water in beaker (covered by aluminium film) at room temperature (25 ± 1°C) for 48 h (7). The leaf-water mixture was then centrifuged at 9000 rpm for 15 min and allowed to stand for 15 min (Eppendorf Centrifuge 5804R, Eppendorf AG, Germany). We obtained the aqueous leachates concentration of 0.3 g/mL as the stock solution, of each tree species from each study site. A portion of the stock solution was stored at 4°C (11,41) in refrigerator until used in bioassays and remaining portion (water extracts used to detect phytochemicals), was stored at -18 ℃ (48). The leaf leachates of 0.06 g/mL were prepared from the stock solution with distilled water for the bioassay experiments.

IV. Bioassay

The recipient plants [Cabbage (*Brassica oleracea*) and radish (*Raphanus sativus*)] used are sensitive to allelochemicals and grew quickly (21,38). Their seeds were purchased from the Guangzhou Academy of Agricultural Sciences. Petri dishes were sterilized by immersing for 1 min in 70 % ethanol and then washed with distilled water (48). Each Petri dish (9 cm dia) was lined with double-layers of filter papers, 5 mL distilled water/leaf extracts was added per Petri dish and 30 seeds were sown equidistant on the filter paper. The experimental treatments consisted of three factors: (i). Extract concentrations: 3 (0, 0.06, 0.3g/mL), (ii). Donor plants 7 (*A. auriculiformis*, *S. heptaphylla*, *R. tomentosa*, *E. urophylla*, *T. succedaneum*, *L. rotundifolia* and *M. malabathricum*) and (iii). Study sites: 2 (Sanjiao Island and Dajing Mountain Forest Park). The treatments were replicated 5 times in Complete Randomized Design. Distilled water was used as control treatment. All Petri dishes were kept in incubators (BDP 1000C, Dianyi Ltd., Shanghai, China), RH: 75 %, 28 °C temperature (Day/Night), light (14 day/10 Night) (41,53). To keep the filter papers moist, 2-3 mL leaf extract/distilled water per petri dish was added every alternate day.

After 7-8 days, we counted the number of germinated seeds, harvested all germinated seedlings and measured their shoot/root length with scale. The seeds with radicle length of 1-2 mm were considered germinated (18,60). The seed germination (%) was calculated. All seedlings in each Petri dish were partitioned into shoots and roots, oven-dried at 60 °C for 72 h and weighed.

The allelopathic effects of studied species were quantified as the inhibition (%) of the extract treatment *vs*. control treatment as under (22):

$$I\ (\%) = (1\text{-}T/C) \times 100\%$$

Where, I: Inhibition (%). T: Trait value of extract treatment, C: Trait value of control treatment.

V. Total flavonoids/phenols

To determine the concentrations of total flavonoids the $NaNO_2$-$Al(NO_3)_3$-NaOH colorimetric method was used (58). The total flavonoids concentrations of plants were expressed as rutin equivalents/100 g fresh weight. The Folin-Ciocalteu colorimetric method was used to determine the concentrations of total phenols (9,17). The total phenols concentrations of plants were expressed as gallic acid equivalents/100 g fresh weight.

VI. Statistical analysis

All statistical analyses were conducted with SPSS 22.0 (version 22.0; IBM SPSS Statistics: Armonk, NY, USA). The Kolmogorov-Smirnoff test was used to assess the normality of the data and Levene's test was used to assess the homogeneity of the data. To test the overall effect of the environmental conditions of small islands on the allelopathic potentials of common tree species, we compared the allelopathic potentials between the island and inland populations of the 7 study species using *t*-tests, with positive values indicating a stronger effect of island *vs.* inland populations and negative values indicating otherwise. Moreover, to explore the underlying mechanisms for the inter- and intraspecific

differences in plant allelopathic potentials, we examined whether the allelopathic potentials of each species varied with its flavonoids/phenolic concentrations.

RESULTS AND DISCUSSION

I. The effects of habitats (island *vs*. inland) on plant allelopathic potential

The two recipient species: cabbage and radish, responded to the allelopathic treatments in similar manners in most cases. Thus, unless specifically mentioned, the results presented below apply to both recipient species.

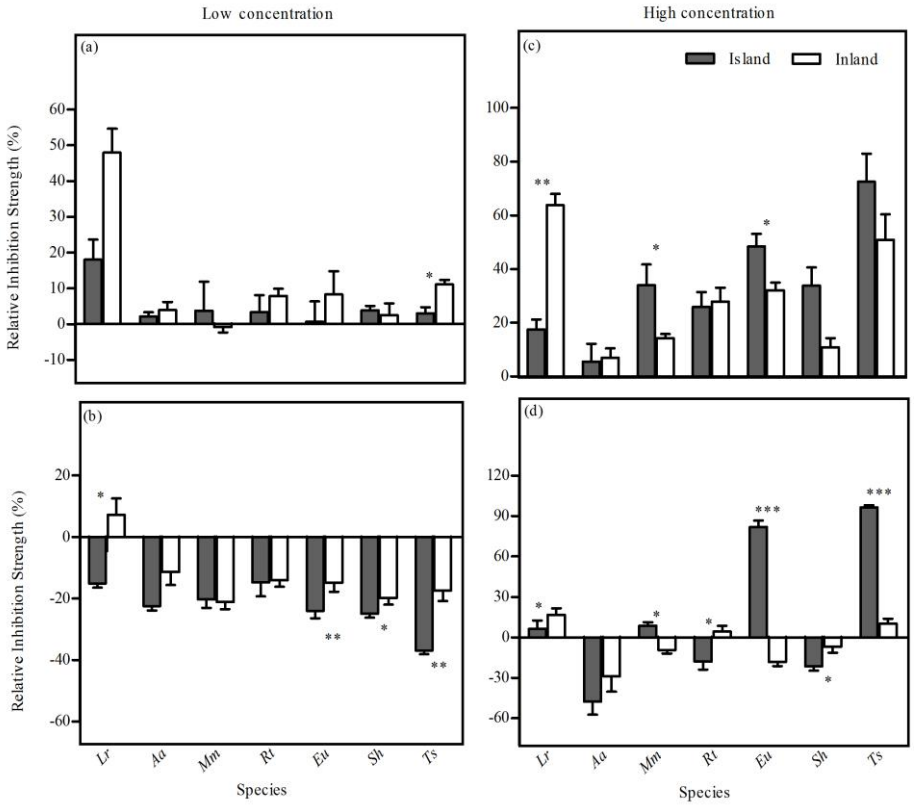

Figure 1. The overall allelopathic potential of studied species on radish at low (a) and high (c) concentrations and on cabbage under low (b) and high (d) concentrations. Significant results are marked by asterisks (* P <0.05, ** P <0.01, *** P <0.001). Data are shown as the mean ± SE (n=5). *Aa*: *A. auriculiformis*; *Eu*: *E. urophylla*; *Lr*: *L. rotundifolia; Mm*: *M. malabathricum*; *Rt*: *R. tomentosa*; *Sh*: *S. heptaphylla*; *Ts*: *T. succedaneum*.

Table 3. The differences in the allelopathic potential between the island and inland populations of the study species

Donor plant Specie	Germi-nation Rate	Root length	Shoot length	Root Mass (DW)	Shoot mass (DW)	Inhibition Index
	Extract Low Concentration (0.06 g/mL)					
	Radish					
A. auriculiformis	-1.18	-5.50**	1.01	-1.14	0.43	-0.84
E. urophylla	1.40	0.64	0.13	-2.97*	-3.89*	-0.96
L. rotundifolia	0.89	-2.46	-3.26*	-1.76	-2.41	-2.59
M. malabathricum	0.54	1.06	0.85	0.18	-0.32	0.50
R. tomentosa	1.37	-2.25	0.70	-1.26	-3.74*	-1.08
S. heptaphylla	0.00	0.74	0.30	1.32	-3.48*	0.33
T. succedaneum	-0.34	-5.99**	-0.39	-0.34	-3.30*	-4.31*
	Cabbage					
A. auriculiformis	1.00	-2.02	-1.25	-2.23	-1.48	-2.07
E. urophylla	1.00	4.02*	-10.92**	-1.04	-1.46	-4.74**
L. rotundifolia	1.00	-5.08**	-2.81*	-4.08*	-2.21	-4.25*
M. malabathricum	1.00	2.71	-1.52	0.19	-1.53	0.31
R. tomentosa	-[a]	-0.29	-2.12	0.59	1.52	-0.15
S. heptaphylla	-[a]	-2.78	0.48	-1.30	-0.41	-3.43*
T. succedaneum	1.00	-9.39**	-6.77**	1.26	-5.71**	-5.63**
	Extract High Concentration (0.3 g/mL)					
	Radish					
A. auriculiformis	0.30	-1.45	1.32	-0.85	-0.37	-0.23
E. urophylla	2.03	7.18**	3.74*	2.55	1.05	3.94*
L. rotundifolia	2.71	-5.24**	-5.48**	-5.19**	-8.00***	-6.33**
M. malabathricum	1.67	5.63**	2.45	2.92*	0.53	2.90*
R. tomentosa	-0.67	-1.47	0.02	-0.76	1.83	-0.24
S. heptaphylla	1.45	3.99*	2.51	1.28	1.82	2.58
T. succedaneum	2.56	0.31	0.26	1.68	2.91*	2.27
	Cabbage					
A. auriculiformis	-2.14	-1.46	-0.38	-1.56	-3.01*	-0.96
E. urophylla	8.08***	17.34***	65.90***	18.95**	13.85***	38.53***
L. rotundifolia	-0.99	-1.85	-2.32	-1.04	-0.91	-2.82*
M. malabathricum	1.63	9.96**	5.99**	2.93*	-3.91*	4.51*
R. tomentosa	-4.33*	-3.67*	-1.54	-2.73	-4.13*	-4.53*
S. heptaphylla	-1.50	-0.90	-1.52	-4.50*	-2.94*	-3.75*
T. succedaneum	6.12**	11.44***	10.12**	7.61**	17.55***	21.69***

t values are shown (+: Strong effect of island *vs.* inland populations, -: Negative effect of island *vs.* inland populations). Significant results are marked by asterisks (* P <0.05, ** P <0.01, *** P <0.001).

[a]*t*-test was not done as the standard deviation of one group was zero.

(i). **Inhibition Index**: When plants were treated with low concentration of extracts, inhibitory effects were weak (i.e. smaller Inhibition Index) of the island *vs*. inland populations of *E. urophylla*, *L. rotundifolia*, *S. heptaphylla* and *T. succedaneum*. No significant differences in the inhibitory effects between the island and inland populations were found in *A. auriculiformis*, *M. malabathricum* and *R. tomentosa* (Table 3; Fig. 1a, b). The high concentration extracts, from *E. urophylla*, *M. malabathricum* and *T. succedaneum* were strongly inhibitory in island populations than that in inland populations. The overall inhibitory effects of *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla* were weaker in the island population than that in inland populations. The inhibitory effects of island and inland populations of *A. auriculiformis* were similar (Table 3; Fig. 1c, d). These results indicated that the allelopathic potentials of the studied Donor species were species- and habitat- dependent.

(ii). **Germination and seedling growth**: The higher concentrations of extracts from island and inland populations significantly inhibited the seeds germination only in cabbage (Table 3). The high concentration of extracts from the island *vs*. inland populations of *E. urophylla* and *T. succedaneum* had stronger inhibitory effects, contrarily, the island vs. the inland population of *R. Tomentosa* had weak inhibitory effects (Table 3).

The low-concentration extracts, had weak inhibitory effects of *E. urophylla*, *L. rotundifolia*, *T. succedaneum* island populations on seedlings growth of test spp. than their inland populations (Table 3). At high- concentration of extracts, we found that the inhibitory effects of *E. urophylla*, *M. malabathricum* and *T. succedaneum* from the island habitat were stronger than from the inland habitat, contrarily, the inhibitory effects of *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla* from the island habitat were weaker than from the inland habitat (Table 3). The results were consistent with the Inhibition Index.

According to these results, different studied species under two habitats may have different levels of allelopathy on their neighbours. Specifically, the island populations of *E. urophylla*, *T. succedaneum* and *M. malabathricum* may strongly inhibit their neighbours compared to their terrestrial populations, when they occur in high abundance. In contrast, in most cases, the island populations of *R. tomentosa*, *L. rotundifolia* and *S. heptaphylla* were less inhibitory to their neighbours than their terrestrial populations, in both low and high abundance. In contrast, the allelopathy of island and inland populations of *A. auriculiformis* may not differ regardless of species abundance.

Plant allelopathy is influenced by many environmental factors. Some plant species are more sensitive to certain types of stresses, but less sensitive to other types of stresses than other species (5). The allelopathic potential of some plants is intensified by exposure to various environmental stresses (14); because of the higher concentrations or more types of allelochemicals (such as tannins, flavonoids and phenolic acid), in plant tissues, some individuals plant exhibit stronger allelopathic effects on their neighbours than on other individuals (26,58). In our study, *E. urophylla*, *T. succedaneum* and *M. malabathricum* were strongly inhibitory in the island habitat than on the inland habitat; our findings are consistent with above reports, suggesting that environmental stresses increased the allelopathic potentials of plant species (8,30).

In addition, our results support the notion that the same stress may have different effects on different plant species (19,20). In our study, *L. rotundifolia*, *S. heptaphylla* and *R. tomentosa* in the island were less inhibitory than those in the inland. While *A. auriculiformis* had no significant differences in allelopathy between the island and inland habitats. This result is similar to other allelopathic studies, which reported that the allelopathic potentials of some plants weakened or had no significant differences under certain environmental stresses (30,35). Therefore, the differences in the effects of island habitats on species allelopathic potential among different species may be the combined result of stress- and species-specific factors.

II. Total flavonoid/phenol concentration and plant allelopathic potential

(i). Flavonoids: According to the colorimetric analysis, total flavonoids were found only in *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla*. For these 3- species, the flavonoids concentration was consistently lower in the island populations than the inland populations (Fig. 2a). According to the evaluation of the allelopathic potential of the species, the island populations of these 3-species showed weaker allelopathic potentials than their inland populations. This indicated that the changes in allelopathic potentials (Fig. 1c, d; Table 3) depended on the flavonoids concentrations in these three species (Fig. 2a).

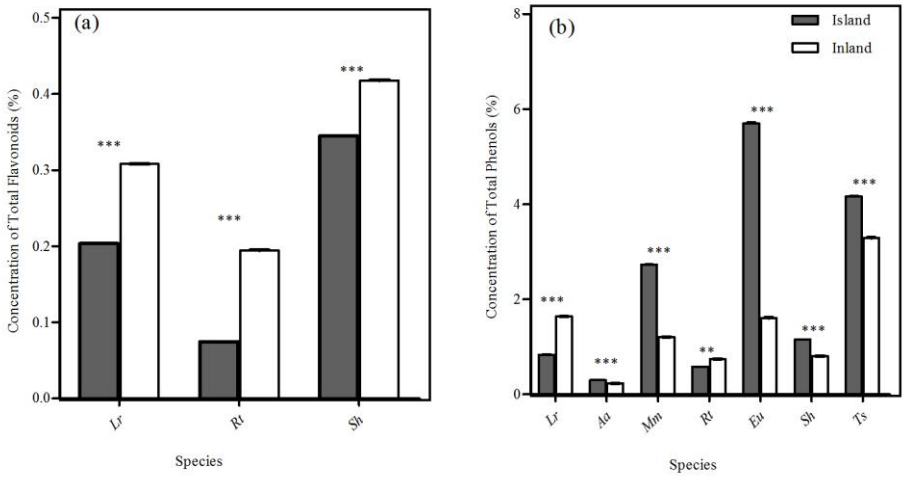

Figure 2. The differences in the concentration of total flavonoids (%) (a)/phenols (%) (b) between the island and inland populations of the study species. Significant results are marked by asterisks (* P<0.05, ** P<0.01, *** P<0.001). Data are shown as the mean ± SE (n =3).
Aa: *A. auriculiformis; Eu*: *E. urophylla*; *Lr*: *L. rotundifolia*; *Mm*: *M. malabathricum*; *Rt*: *R. tomentosa*; *Sh*: *S. heptaphylla*; *Ts*: *T. succedaneum.*

(ii). Phenols: In contrast, total phenols were found in the leaf tissues of all species from both the island and inland habitats. In 5-out of 7-species (i.e., *E. urophylla, T. succedaneum, M. malabathricum, S. heptaphylla* and *A. auriculiformis*), the concentration of total phenols was higher in the island than in the inland populations, whereas for the other two species (i.e., *L. rotundifolia* and *R. tomentosa*), the opposite pattern was observed (Fig. 2b). Except for *A. auriculiformis* and *S. heptaphylla*, the differences in the allelopathic potentials between the island and inland populations (Fig. 1c, d) were consistent with the differences in the total phenols concentration between the two populations (Fig. 2b).

As we know, phytochemicals (e.g., phenolic compounds) usually govern the mechanisms of allelopathy and influences the intra- and interspecific competition between plants (15). Many researchers have reported that the type and concentration of phytochemicals vary among the plant species (60). Changes in the environmental factors and habitats, leads to changes in phytochemicals. Our results confirmed that total phenols were found in all species, but total flavonoids were detected only in the extracts of *L. rotundifolia, T. succedaneum* and *S. heptaphylla*, which are shrubs or short bushes.

Moreover, in our study, the small island habitat increased the total phenols of five species (*E. urophylla*, *T. succedaneum*, *M. malabathricum*, *S. heptaphylla and A. auriculiformis*) but reduced those of other two species (*L. rotundifolia* and *R. tomentosa*). A decrease in the total flavonoids was also induced by the small island habitat in *L. rotundifolia*, *T. succedaneum* and *S. heptaphylla*. These results are similar to previous reports that phytochemicals production could increase under environmental stress (10), but that environmental stress did not always increase the phytochemicals; the phytochemicals production could reduce under certain circumstances (27,29). This is because stresses may reduce the energy allocated to allelochemicals production (11,27,28). Our study supported these findings by showing that the island habitat increased the total phenol compounds of *E. urophylla, T. succedaneum* and *M. malabathricum* (Fig. 2), which in turn enhanced their allelopathic potential (Fig. 1). In addition, in contrast, the island habitat decreased the phenol compounds (for *R. tomentosa*) and flavonoids production in *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla*, which in turn weakened their allelopathic potentials (Fig. 1 & 2). In addition, Kong *et al*. (31) reported that some plants do not alter their allelopathy when exposed to stressful conditions. In our paper, we also found that the allelopathic potential of *A. auriculiformis* did not differ under the two habitats, although there was significant differences in total phenols concentration between two habitats (31).

The *E. urophylla, T. succedaneum* and *M. malabathricum* had stronger allelopathic potentials in the island habitat due to higher total phenols concentrations than in the inland populations. While the weaker allelopathic potentials of *L. rotundifolia* and *R. tomentosa* in the island habitat showed were owing to lower total flavonoids/phenols concentrations than in the inland populations. The *S. heptaphylla* had weak allelopathic potential in the island habitat than in inland habitat, due to lower total flavonoids concentrations in island habitat than in inland habitat. This indicated that the allelopathic

potentials of studied species (except *A. auriculiformis*) may be due to their total flavonoids/phenols concentrations (Fig.1 & 2).

CONCLUSIONS

Island habitats had significant effects on plant's allelopathic potentials, which are species- specific. Among the 7-studied Donor species, the island habitat enhanced the allelopathic potentials of *E. urophylla*, *M. malabathricum* and *T. succedaneum*; weakened the allelopathic potentials of *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla;* but had little effect on *A. auriculiformis*. The differences in studied species allelopathic potentials were closely related to changes in their phytochemicals under environmental stresses. The island populations of *E. urophylla*, *M. malabathricum* and *T. succedaneum* had stronger allelopathic potentials and due to their higher total phenol concentrations than their inland populations. The island populations of *L. rotundifolia*, *R. tomentosa* and *S. heptaphylla* had weaker allelopathic potentials due to their lower total phenols (except *S. heptaphylla*) and flavonoids concentrations than their inland populations. The allelopathic potentials of the species [*L. rotundifolia*, *S. heptaphylla*, *R. tomentosa* and *A. auriculiformis*] less affected by the environmental stresses on islands, may be used to restore vegetation in islands.

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