Effect of artificial defoliation on the emergence of foliar buds of *Mimosa pigra*

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Abstract. This study was specified in documenting *Mimosa* reaction in the state of defoliation on the plants. As defoliation was believed to cause plants experiencing both positive and/or negative effects on its growth performance, thus among the aim of this study is to monitor the emergence of foliar buds in respond with vary level of defoliation intensities. The seedlings were grown singly in polybags up to four leaf stage as. Grown seedlings were randomly subjected under four different defoliation intensities: control (un-defoliated), 25%, 50%, and 100% in which 10 replicates of seedling for each treatment. Experiment was ceased at the 6th month after establishment of plants grew. Results shown that, the effect of defoliation on the production of foliar buds was significantly difference between the treatments ($P< 0.05$). As compared with 25%, 50% and 100% defoliation, un-defoliated plants showed the highest amount of foliar buds production which is 14 buds. While, there were no differences amount of foliar buds production between 25% and 50% defoliation with 5 foliar buds per plants. Emergence of foliar buds was reportedly lowest in 100% defoliation plant when there were no sign of buds emergence. Results concluded that, the subjected plants of control, 25% and 50% leaves defoliation treatments, were able to performed tolerance effect relative to the induced stressor. Apart from that, experiment revealed that the 100% defoliation has probability of detrimental effect on growth and reproduction of *Mimosa* seedling as it hindrance the germination of foliar buds.
Keywords: Defoliation, foliar buds, compensation, emergence.

Introduction

Invertebrate or vertebrate herbivore feeding pattern had numerous effect on plant either the plant compensated, undercompensated or overcompensated after being feed (Crawley, 1989; Rosenheim *et al*.,1997; Wirf, 2006). Regarding to the stressor, plants will response by having fitness changes that allow plants to increase or decrease the growth rate or reproduction or seed production (Crawley, 1989; Trumble *et al.,* 1993). Various pattern of damaged could be arise because herbivores diverge in their feeding behavior (Meyer, 1998; Susko & Superfisky, 2009). Some insects have concentrated and dispersed pattern of damage on leaves in which the pattern they chew the leaves is according to their own selective feeding manner (Edwards & Wratten, 1983; Singer & Stireman III, 2001).

Several studies have shown that defoliation have detrimental effect on plants growth (Tong *et al*., 2003; Susko & Superfisky, 2009). Certain plants showed compensatory effect by increasing in plants reproduction, biomass and even the growth rate, but at certain circumstances defoliation had no effect on plants growth. However, in response of herbivory, certain plants cannot endure and ends up with the greater losses of biomass and suppressing in growth. Family like *Nicotina tabaccum* performed great reduction in fruits production and mature leaves (Mc Naughton, 1983 in Susko & Superfisky, 2009). Patterns of compensatory can be varies depends on external factors for instance defoliation intensity, and different defoliate part and method (Wirf, 2006; Susko & Superfisky, 2009). This theory was proved where in their studies, 25% of leaves defoliation resulted in compensation of *Mimosa pigra* but not for *Brassica napus*.

A number of studies already practiced simulated herbivory in studying plant response to different type of damage (Meyer, 1998; Zhu, 2008). However, manual defoliation studies are often thought to be a poor representative of the effects of real herbivory, at a meantime, it is impossible to create the exact situation of the actual damage since the damage intensity is hard to be control in the field. The effect of defoliation on the emergence of Mimosa foliar bud, however, has not been investigated, and it is not known whether there will be a relation between the actions. So the aim of this study was to assess how the effects of different defoliation intensities affect on the production of foliar bud of *Mimosa pigra*.

Materials and Methods

Defoliation treatment

The defoliation experiment has been modified from Wirf (2006).The experiment was conducted under indirect sun inside plant house at Universiti Sains Malaysia where plants was

watered depends on manual irrigation twice a day. A number of scarified seeds were sown manually in every polybags provided. As the matured seedlings had grown until reached 4th leaf stage, the plants were thinned to one seedling per polybag where all the resulting seedlings were at the uniform size. Overall, 10 replicates of seedling were provided for each treatment. At this stage, the seedlings were randomly assigned under each following treatment: control, 25%, 50% and 100% defoliation and no fertilizer was added throughout the experiment. Defoliation was started on December, 2011 and was finished on May, 2012.

Effects of defoliation on the emergence of foliar bud were assessed by taking the production rate of foliar buds of the control and the experimental trees. The results had been taken on the sixth months of growing plants when the plants started having foliar buds. The differential of vary treatment can be referred by the amount of emergence foliar buds.

Statistical analysis

One-way ANOVA was used to compare the production rates of foliar buds of the four treatments at the end of experiment. The significance difference was indicated by the value of ($P<0.05$).

Results and Discussion

Foliar bud production

The production rates of the emergence foliar buds from four different defoliation intensities were compared with each other on the sixth months of seeds germination. Based on Figure 1, the chart showed that the germination of foliar buds was significantly decreasing with the increasing of defoliation intensities. Results showed that plants that subjected to 100% defoliation do not produced any foliar buds as compared with the others treatment. Control treatment showed the highest production of foliar buds followed with 25% and 50% defoliation in which both had the same degree of foliar buds emergence. Zero emergences also recorded on 100% defoliation. However, this experiment revealed that there were significant differences between the production of foliar buds of those four treatments (Table 1) where, ($P< 0.05$), thus shows that different intensities affect the foliar buds production rate. From the present data we can interpreted that, plants that were subjected to 100% defoliation had undercompensated for herbivory as they perform lower fitness (Strauss & Agrawal, 1999) relative to undamaged plants (control) in the number of foliar buds.

For plants that were subjected to different amount of defoliation but simultaneously exhibited the same level of tolerance, it appears that the initial physiological response of *Mimosa* to a given amount of damage is similar regardless of the intensities of damage at least for growth (Wirf, 2006). This situation could also happen from the similarity in the synthesis of phytochemicals induced after damage and their related cause (Karban & Baldwin, 1997; Agrawal, 1998). Preceding experiments have demonstrated that initial herbivore attack increase level of chemical, physical, and biotic defenses in wide diversity of plants ranging from simple to complex plants (Agrawal, 1998). The reduction number of foliar buds by the increasing of defoliation intensities could happen due to undercompensated plants response with those subjected stressor on plants. Leaves and roots play a very important mutual dependence role in plants development. By frequently defoliating the leaves, the less carbohydrate could be outsourced to the root for mineral uptakes needed for other growth part, and eventually affecting the development of foliar buds (Fogg, 1970).

From the observation, plants started having a foliar bud at the third months of growing age. Apparently as time passed by, the older foliar buds could not further their germination as it's died at the early stage without able to develop into flower. Localized of brown spot had been detected at the base part of buds of every 1-2 weeks old foliar bud and it is believed to be the inhibition factor of foliar buds development. The spot extended its growth from base and covered the whole foliar buds that caused buds to wither and eventually died. Surprisingly, the brown patches only grew and harmed on foliar buds without impairing others plant parts. Therefore, this experiment was extended to ascertain this inhibitor species that grew on *Mimosa* foliar buds.

Four species of fungi were found from the experiment (Figure 2). Identification of fungi was based on species description by Klich (2002) and Samson *et al*. (2010). Morphological characterization was done to identify the inhibitor growth factor of foliar buds by culturing the

infected foliar onto Potato Dextrose Agar (PDA). After 3 days of incubation, mycelium that grew from each foliar bud was placed onto a new PDA media (Leslie & Summerell, 2006). The fungi obtained were identified based morphological structures (conidia, conidiophores, colony color and pigmentation), thorough observation also needed by using a compound microscope (Olympus BX41-CCD) (Kamat, 1971).

The reproduction capable of *Mimosa* can be reduced by high level of fungus infection. Under favorable conditions, plants will normally develop flower from foliar buds within 6-8 months after germination (Lonsdale, 1992). From observation, since the first emergence of foliar buds, none of those that emerged successfully develop into a flower. The pattern of its growth had been seen perish at the time of development. The existence of these fungi is important that could be developed as biological control of *Mimosa*, as to date studies reported there are only two species of pathogenic fungi, *Diabole cubensis* and *Phloeospora mimosa-pigrae* had been released as *Mimosa* biological control and severely attacked leaves and stems of (Marko, 1999; Walden *et al.*, 1999; Anon, 2010).

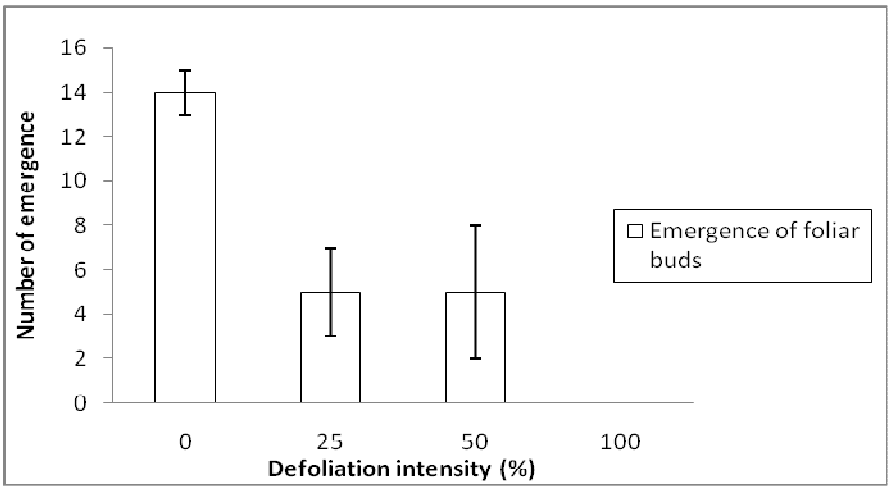

Figure 1. The average production of foliar buds of *Mimosa pigra* at four Different defoliation intensity (mean ± 9.00 sd) after 6 months of germination.

Table 1. The effects of vary defoliation intensities on the emergence of *Mimosa pigra* foliar buds. Response variable was analyzed with One-way ANOVA.

Bud	Sum of squares	df	Mean square	F	Sig
Between Groups	1121.275	3	373.758	80.330	.000
Within groups	167.500	36	4.653		
Total	1288.775	39			

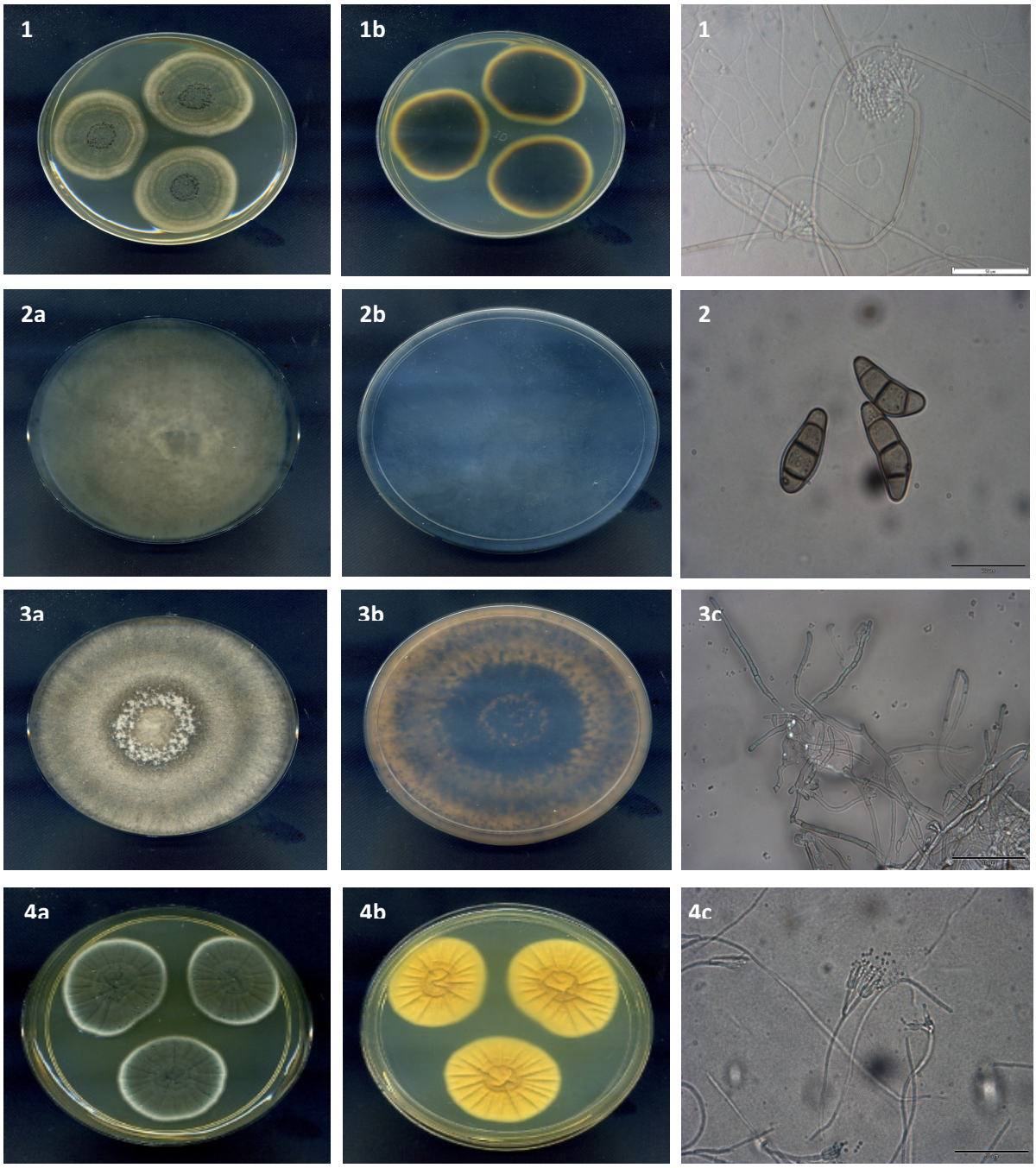

Figure 2: 1a) *Aspergillus melleus* (CYA), 1b) *A. melleus* (rev-CYA), 1c) *A. melleus* (conidiophore); 2a) *Culvularia geniculata* (PDA), 2b) *C. geniculata* (rev-PDA), 2c) *C. geniculata* (conidia); 3a) *Mycelia sterilia.* (PDA), 3b) *M. sterilia* (rev-PDA), 3c) *M. sterilia* (mycellium structure); 4a) *Penicillium chrysogenum* (CYA), 4b) *P. chrysogenum* (rev-CYA), 4c) *P. chrysogenum* (conidiophore).

Conclusions

Defoliation may not increase plant mortality directly, and it appears that *Mimosa* can compensate well for low levels of damage. However, the defoliating agents that are able to achieve moderate or high levels of defoliation play an important role in reducing the growth rate and size of individual plants, thereby reducing the height, stem diameter, and biomass of *Mimosa* (Wirf, 2006). Meanwhile, the way plants respond is associated with their growth pattern and nutrient status (Bryant *et al*., 1990 in Karban and Myers, 1989). Reduction of shoots slightly impaired development of plants growth with the restriction of mineral and

nutrient uptakes, and carbohydrate resource. In addition, the discovery of four species of fungi affecting the foliar development is important as these species could possibly be the potential bio control agent for Mimosa. However, this would require in depth study. Though, the invasion of four species of fungi in the middle of experiment was believed to be an intervention factor for monitoring the full reactions of plants relative to the stressor, consequently the fungi became an inhibiter for the growth of foliar buds.

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