Correlation of lead (Pb) content towards the number of stomata on the plant *Dracaena marginata tricolor* in some places of Surabaya City

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Abstract. This research is an observational study that aims to determine the characteristics of stomata in the leaves of *Dracaena marginata tricolor*. This research is descriptive analysis. Sampling was carried out at three locations which had different levels of motor vehicle density, the location at Bundaran Dolog, Jl.Gading Ketabang and Kebun Bibit 2.The calculation of the average lead level in the *Dracaena marginata tricolor* leaf from the highest was obtained at the Bundaran Dolog Surabaya 2.01 µg / g. Calculation of the average lead level at*Dracaena margata tricolor* leaf of Jl. Gading Ketabang was obtained at 1.06 µg / g and at Kebun Bibit 2 Surabaya obtained an average lead level in the leaves of *Dracaena marginata tricolor* of 0.82 µg / g. The highest calculation of the number of leaf stomata at the Bundaran Dolog Surabaya of 21. At the location of Jl. Gading Ketabang obtained an average number of stomata of 18 and at the location Kebun Bibit 2 Surabaya the results of the calculation of the average number of stomata were 16.

1 Introduction

Air is an important factor in life, but with the increasing physical development of cities and industrial centers, air quality has changed. Moestikahadi (2001) said that changes in the air environment are generally caused by air pollution. Generally on large roads, the contribution of pollutants is largely derived from combustion results on motor vehicles that pass through the road. One of the pollutants released from the fuel combustion process is lead (Pb). Lead emissions into the Earth's atmosphere can be in the form of gases and particles. Lead (Pb) is a type of heavy metal which when inhaled through breathing and consumed will have a very bad effect on human health, the presence of lead (Pb) in the human body can inhibit the activity of enzymes involved in the formation of hemoglobin (Hb). Inhibition of the formation of hemoglobin (Hb) results in anemia. Pb metal can damage the nervous system, kidney function, reproductive system, endocrine system and heart, and disorders of the brain so that children experience intellectual and mental

disorders (Widowati et al, 2008). Seeing the magnitude of the negative impact of Pb on humans, action is needed to reduce lead from the air, one of which uses plants. Stomata are part of plants as one of the pathways used by plants to interact with their environment. The main function of stomata is as a place of gas exchange, such as CO_2 which is needed by plants in the process of photosynthesis. However, stomata also act as one of the entry points of pollutants, especially pollutants originating from the air. The mechanism of entry of Pb particles into leaf tissue is through leaf stomata. The stomata gap is about 10 μm long and between 2-7 μm wide. Because Widagdo (2005) states that the entry of Pb lead into leaf tissue is strongly influenced by the size and number of stomata. The greater the size and the greater the amount of stomato, the greater the absorption of Pb that enters the leaf. Thus the accumulation of Pb in leaf tissue will be greater, which mainly accumulates in the palisade tissue (fence tissue). Plant *Dracaena marginata tricolor* is a shrub that is often encountered in the main streets of Surabaya as a shade plant road but it can also be encountered as an ornamental plant in some parks in the city of Surabaya. Bioaccumulation of lead (Pb) to leaves in plants will be more common in plants on the side of large roads that are densely populated by motor vehicles (Antari and Sundra, 2002). Chemical changes can be seen from the level of accumulation and content of elements in leaf tissue. Determination of plants as an indicator of lead (Pb) through physical changes is still considered lacking, considering the physical changes in leaves can be caused by many factors other than lead (Pb). For this reason, it is necessary to conduct laboratory tests to determine the level of accumulation and lead content in plant leaves used is SSA (Atomic Absorption Spectroscopy).

2 Method

Design study was observational using descriptive analysis methods. This study examined the differences in lead content (Pb) and the amount of stomata in *Dracaena marginata tricolor* plants . Sampling was carried out at three different locations, among others, BundaranDologSurabaya which has a high level of traffic density, Jl. Gading Ketabang which has a moderate level of traffic density and Surabaya's Kebun Bibit 2 area which has a low level of traffic density. *Dracaena marginata tricolor* leaf samples were taken from February to March for 3 times. Each location was taken as many as 3 plants. Each plant was taken as many as three leaves, namely on the 5th, 6th and 7th leaves. *Dracaena marginata tricolor* leaf samples taken were then stored in plastic bags that have been labeled for further observation of the number of stomata using a microscope at 400x magnification . Making these stomata preparations using a replica method begins by cleaning the leaves from dust and dirt with tissue then on the underside of the leaf smeared with transparent nail polish on the leaf buds, leaf center and leaf base then left to dry. Furthermore, the tape is attached to the leaf which has been smeared with polish and leveled. The tape used is transparent colored tape then the tape is peeled off and pasted on a glass object and labeled which contains: part of the leaf (shoots, middle, base) and plant replication then preparations are observed under a microscope and photographed. Furthermore, the remaining leaves that have been observed the number of stomata are then taken to the Laboratory of the Industrial Research and Consultation Agency (BPKI) to measure lead content by the SSA method.

To answer whether there are differences in the number of stomata on the leaves of *Dracaena marginatatricolor* due to lead exposure, homogeneity and data normality tests are performed. For homogeneous data, ANOVA test (one way ANOVA) and independent t-test with Duncan's coefficient ($P < 0.005$) were used using SPSS 22.0.

3 Result

The results of the calculation of the number of motor vehicles at each sampling location, observing the number of stomata of *Dracaena marginata tricolor* leaf samples, and analysis of the Pb content in *Dracaena marginata* tricolor leaves can be seen in Table 1, Table 2, Table 3, Table 4, Table 5 and Figure 1, Figure 2, Figure 3, Figure 4 below :

Table 1. Data From the Calculation of Motor Vehicles Passing at Surabaya

Locations	Vehicle average/day
Bundaran Dolog Surabaya.	336
Jl. Gading Ketabang Surabaya	179
kawasan Kebun Bibit 2	81

Table 2. Lead (Pb) Content in *Dracaena marginatatricolor*leaves

Plants	Lead Content in*Dracaena marginata tricolor*Leaves		
	Bundaran Dolog	Jl.Gading Ketabang	Kebun Bibit 2
1	2,02 µg/g	1,00 µg/g	0,79µg/g
2	1,98 µg/g	1,08 µg/g	0,81µg/g
3	2,05µg/g	1,12µg/g	0,88µg/g
Average	2,01 µg/g	1,06µg/g	0,82µg/g

Table 3. Average of stomata's number in *Dracaena marginata* tricolor leaves

Locations	Average of stomata's number in *Dracaena marginata tricolor*leaves
BundaranDolog	21
JlGadingKetabang	18
JlGadingKetabang	16

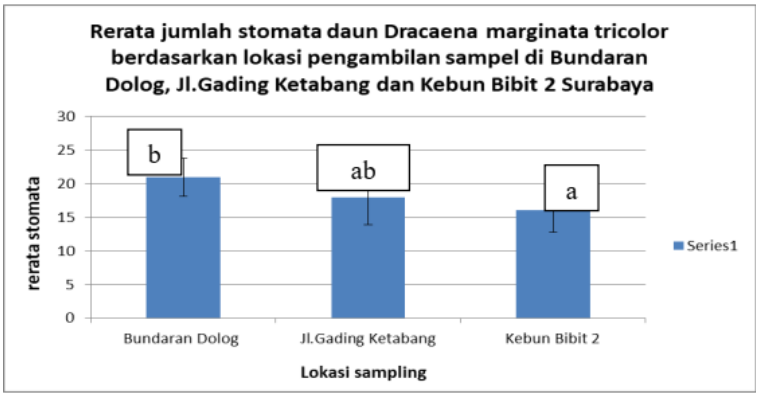

Figure 1. Average number of stomata of *Dracaena marginatatricolor* leaves based on the locations of sampling

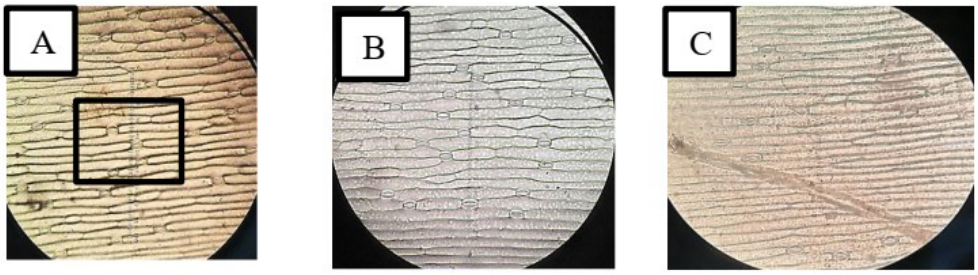

Fig.2. Stomata of *Dracaena marginata tricolor* leaves (A=BundaranDolog Surabaya, B=Jl. Gading Ketabang, C=KebunBibit 2) with 400x magnification

Table 4. The Correlation Test to Determine The Effect of Lead Levels in *Dracaena marginatatricolor* on the Number of Stomata

Correlations			
		Konsentrasi Pb	Jumlah Stomata
Konsentrasi Pb	Pearson Correlation	1	,854**
	Sig. (2-tailed)		,003
	N	9	9
Jumlah Stomata	Pearson Correlation	,854**	1
	Sig. (2-tailed)	,003	
	N	9	9

**.Correlation is significant at the 0.01 level (2-tailed).

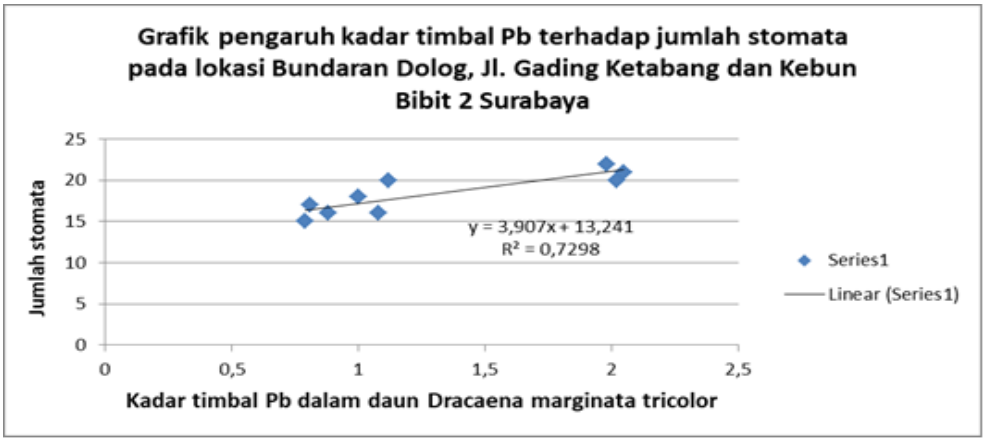

Fig.3. Graph of the effect of lead content on the number of stomata

4 Discussion

4.1 Lead concentration on the leaves of *Dracaena marginatatricolor* at the BundaranDolog, Jl. GadingKetabang and KebunBibit 2 Surabaya

Based on Table 2, the highest lead level in *Dracaena marginata tricolor* leaves was at BundaranDolog Surabaya, 2.01 µg / g. At the location of Jl.GadingKetabang, the lead content in the leaves of *Dracaena marginatatricolor* was 1.06 µg / g while the lowest lead content at KebunBibit 2 was 0.81 µg / g. This is consistent with the statement of Sulasmini*et.al* (2007) which states that the amount of Pb in the leaf surface and is affected by the number of motorized vehicles. Motorized vehicles will emit the remaining combustion results in the form of gas emissions, one of which is lead. The mechanism of entry of Pb particles into leaf tissue is through leaf stomata. The stomata gap is about 10 µm long and between 2-7 µm wide. Because of the small size of the Pb, which is less than 4 µm and the mean 0.2 µm, the particles will enter the leaf through the stomata gap and settle in the leaf tissue between the palisade tissue cell slit (Smith, 1981).

4.2 The difference in the number of *Dracaena marginata tricolor* leaf stomata at the BundaranDolog, Jl. GadingKetabang and KebunBibit 2 Surabaya

Based on the analysis using T-test at the three locations (BundaranDolog, Jl. GadingKetabang and KebunBibit 2) shows that the location of Jl. GadingKetabang and KebunBibit 2 showed no significant difference with a value of 0.106. T-test results at the location of Jl. GadingKetabang with BundaranDolog shows that there is no significant difference with a value of 0.083. While the results of the T-test at the location of the BundaranDolog and KebunBibit 2 showed a significant difference of 0,000.

The results of the T-test can be concluded that the location of Jl.GadingKetabang and the location of KebunBibit 2 do not have significant differences. At the location of Jl. Gading and BundaranDolog also did not have any noticeable differences, while at the location of theBundaranDolog with the Bibit 2 garden there were significant differences. This happens because the number of motorized vehicles passing at the BundaranDolog has a greater number than the location of KebunBibit 2. The results of this study are in accordance with the opinion of Azmat (2009), that the high and low accumulation of lead in the leaves of each type of plant varies depending on the location of the place where the research is good it is seen from the location of sampling, the level of motor vehicle density. FurthermoreGunarno (2014) states that the number of stomata in polluted areas is higher than in non-polluted areas. This is a form of physiological adaptation due to air pollution. The response of plants due to the presence of pollution from transportation activities, carried out by plants in an effort to reduce the diffusion of pollutants into leaf tissue. Exhaust gas emissions in an environment will enter the leaf through the stomata gap. Pollutants attached to the stomata will accumulate and if in large enough quantities can damage stomata cells. Damaged stomata cells will then stimulate the production of stomata in greater numbers, so that the process of photosynthesis can run normally.

In Figure 2 the appearance of *Dracaena marginata tricolor* leaf stomata at theBundaranDolog site had the most number of stomata but was small in size while in the KebunBibit 2 site had fewer and larger stomata as seen in Figure 4. The same thing happened in Ingeswari's research in his research stated that, the closer the angsana plant (Pterocarpusindicus Will) from the crowd of vehicles the size of the stomata was getting smaller and vice versa the further the distance of the plant from the crowded places of the vehicle also increased the size of the stomato. Fathia, et al (2015) in their research

Plumbagoauriculata, Rhododendron obtusum and Pseuderanthemumreticulatum plants which were in high vehicle intensity were known to have more stomata but smaller stomata size compared to those in low vehicle intensity. Enlarge (open) and shrink (close) the size of the stomata occur to regulate the entry and exit of water content in the leaves so that there is no shortage of water content that causes dryness and wilting of plants as well as to set limits on CO2 uptake for photosynthesis. The presence of pollution due to vehicle emissions (CO, HC, Nox, Pb and SO2) stimulates the synthesis of amino acids proline. The role of proline amino acids as osmoprotectants is seen as a guardian of stomata cells, where amino acids proline is synthesized as an effort to limit pollutants entering the stomata by narrowing the size of stomata cells. The size of stomata cells and their guardian cells become narrower or smaller, so that it can limit the input of flue gas pollution into leaf tissue (Ulo and Markus, 2013).

4.3 Effect of lead (Pb) levels in *Dracaena marginata tricolor* leaves on the number of leaf stomata at the BundaranDolog, Jl. GadingKetabang and KebunBibit 2 Surabaya

Based on the results of the correlation test using spss 22.0 in Table 6 obtained the results of the correlation with a significant value of 0.003. This shows that there is a relationship between lead levels in leaves with the number of stomata per visual field. There is a person correlation value of 0.854, this indicates a strong influence between the levels of lead in leaves on the number of stomata and the positive relationship, namely the higher levels of lead in the leaves, the number of stomata is also shown by the correlation value of the person with a positive value. Based on the results of the correlation test graph in Figure 5 can be seen the large correlation value between the lead content on the leaves of Dracaena marginata tricolor with the number of stomata obtained by the formula Y = 3,907X + 13,241 which means that each increase in lead content in leaves by 1 unit will increase the number of stomata in leaves 3,907 units. R2 value of 0.7298, which means 72.98% of the variable lead content in leaves affects the variable number of stomata. Meanwhile, the remaining 27.02% is influenced by other variables. The same thing happened in the angsana leaf study conducted by Yudha, et al (2013), namely the positive correlation of Pb accumulation with the number of stomata. In addition, according to Santoso, et al (2012) states that Pb absorbed by plant leaves will accumulate in the palisade tissue and the effectiveness of Pb through stomata and affect the number of stomata and stomata size. Siregar (2005) in his research stated that lead in the air enters the leaves through the diffusion process and will close the mouth of the stomata so that the anatomy of the leaf will change (respond). One of the responses given is leaf due to lead increases the number of stomata.

5 Conclusion

1. The average concentration of Pb lead content in *Dracaena marginata tricolor* leaves exposed to pollution at BundaranDolog is 2.01 µg / g, at Jl.GadingKetabang at 1.06 and the location of KebunBibit 2 is 0.81.
2. There are differences in the number of stomata on roads with high vehicle density (BundaranDolog) and roads with low vehicle density (KebunBibit 2)
3. There is a strong positive correlation of 0.854 between the levels of lead in the leaves of *Dracaena marginata tricolor* which is high on the increasing number of leaf stomata with the formula Y = 3,907X + 13,241 with r of 0.7298.

6 Suggestion

1. Future studies are recommended to measure external factors (wind direction and speed, temperature, humidity, and climate).
2. The relevant agencies should look for alternative plants that are better than *Dracaena marginata tricolor* plants to absorb lead air and greening the city of Surabaya.

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