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GROWTH PATTERN AND CONTROL OF *Dieffenbachia seguine* (JACQ.) SCHOTT

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ABSTRACT

Dieffenbachia seguine (Jacq.) Schott (Araceae) is an herbaceous perennial plant. It was introduced in Malaysia as an ornamental plant. This present study is mainly to determine the growth pattern, biomass allocation and chemical control of *D. seguine* in oil palm area at Kampung Terasi, Sadong Jaya, Kota Samarahan, Sarawak. Five quadrates of 1m x 1m were established in both area, open and shaded areas in 4 years old oil palm plantation. The highest total number of plants and leaves were recorded at the open area. While shaded areas have the highest value for the leaf area (LA), the specific leaf area (SLA) and the leaf area ratio (LAR). The plant parts that contribute to the highest biomass partitioned are, the roots and stems at the opened areas and the leaves and petioles for shaded areas. The highest sprouting of *D. seguine* via stem cutting was recorded during the immature growth stage and when the plant has three nodes. Six treatment were done to control this plant, however it does not show 100% desiccation effects. The three single treatments are, 2,4-D dimethylamine, metsulfuron methyl and paraquat dichloride and the three combination treatments are, 2,4-D dimethylamine and metsulfuron methyl, paraquat dichloride and metsulfuron methyl and lastly metsulfuron methyl and glyphosate-isopropylammonium. The most effective method to control the growth of *D. seguine* is the combination of 2,4-D dimethylamine and metsulfuron methyl.

Key words: *Dieffenbachia seguine,* growth pattern, biomass allocation, control methods, herbicides

INTRODUCTION

Weeds are one of the main element or problem in a plantation and an agriculture system. The distribution of weeds consists of the combination of grasses, sedges, and broadleaved plants which changes frequently (Mohamad *et al.*, 2010). These changes are based on the growth level of the crops which provide specific climatic and environmental conditions fitting for a specific weed to grow. In oil palm plantation, if the oil palm does not close up its canopy early enough, it can accommodate weeds with or without preference for shade for relatively longer period. This probably would yield the presence of a wider diversity of weeds (Essandoh *et al.*, 2011)

Dieffenbachia seguine (Jacq.) Schott (Araceae) was introduced as an ornamental plant in Malaysia. *D. seguine* has been an important ornamental foliage plant used as a living specimen for interior decoration, since its introduction in 1759 (Chen *et al.*, 2002). However, *D. seguine* has been increasingly important as weed in oil palm plantation as it has the ability to noxiously establish (Chen *et al.*, 2002). The present study was conducted to determine the growth pattern, biomass allocation pattern of *D. seguine* in its natural habitat and its control.

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MATERIALS AND METHODS

The study was conducted at Kampung Terasi, Sadong Jaya, Kota Samarahan, Sarawak. Five quadrates (1m X 1m) were established in both areas, open and shaded areas in 4 years old oil palm plantation. The main parts of the plant contributed to the biomass dry matter, which composed of stems, leaves, petioles and roots, were brought to the External Laboratory at Universiti Malaysia Sarawak.

Number of the *D. seguine* species within the quadrates were calculated to determine Total Number of Plants (TNP) and plants were divided according to the vegetative parts, leaves, roots, petioles and stems, for measurement of the dry weight ratio. AT Delta-T Scan (Delta-T devices LTD, England) was used to measure the leaf area (LA). All separated vegetative parts were dried at 60°C for 8 days, for the determination of Total Plant Dry Weight (TPDW), Leaf Weight Ratio (LWR), Petiole Weight Ratio (PWR), Stem Weight Ratio (SWR) and Root Weight Ratio (RWR). The biomass allocation pattern was interpreted using the methods adapted from Flint and Peterson (1983). Finally, all the data were analyzed using T-test analysis via software IBM SPSS Statistic 22.0.

The stem was divided according to its development stages. The shoot is considered the youngest stage, the middle part of the plant is considered intermediate stage and the bottom part is considered the oldest stage. Each development stages were cut according to the number of nodes, whether one, two or three nodes. A total of nine stem cuttings were done. All stems were left to sprout in a shallow tray consist of a medium of moist sand. Watering was done daily and the number of stems sprouting was recorded every week for six-week period.

Four types of herbicides were used, which are 2,4-D dimethylamine 48% a.i (D- Amine 480), metsulfuron methyl 20% a.i (Elike 20 WG), paraquat dichloride 13% (ZA Paraquat) and glyphosate-isopropylammonium 41% a.i (bm Glyphosate 41). A total of 6 treatments were done. The three single treatments are, 2,4-D dimethylamine, metsulfuron methyl and paraquat dichloride, and the three combination treatments are, 2,4-D dimethylamine and metsulfuron methyl, paraquat dichloride and metsulfuron methyl, and lastly metsulfuron methyl and glyphosate-isopropylammonium. There is no single treatment for glyphosate-isopropylammonium because the preliminary trial with single application of glyphosate-isopropylammonium showed no obvious phytotoxic effect on *D. seguine*.

The rates of application were 1.7L/ha for 2,4-D dimethylamine, 50g/ha for metsulfuron methyl, 5.4L/ha paraquat dichloride and 2.0L/ha glyphosate-isopropylammonium. These rates are the recommended field or concentration for these chemicals. The effects of weed control treatments on *D. seguine* is reported weekly for six weeks through visual assessment in the form of percentage for 6 weeks. Table 1 shows the linear rating scale that was used to assess weed control or crop damage in this study (0% indicates no weed reduction or injury and 100% for complete destruction).

RESULTS AND DICUSSION

The results for the TNP, Total Number of Leaves (TNL), TPDW, Leaves Dry Weight (DWL), Stem Dry Weight (DWS) and Root Dry Weight (DWR) shows higher value in the open area compared to the shaded area. While for Petiole Dry Weight (DWP), it shows a higher value in the shaded area. All of these values has no significant difference when compared for both areas. According to Ipor *et al* (2009), higher light concentration encourages more leaf production, while lower light concentration produces less number of leaves, but the leaf area will be become wider. Figure 1 shows the results for the above parameters.

For LWR and PWR, it was recorded that both have a higher value in the shaded area. Both values have significant difference when compared between both areas. The results can be due to the response of plants towards the limitation of light, which then causes a decrease in internal carbohydrate concentration and these can lead to further production of leaves and a reduction of root growth (Mooney & Winner, 1991). According to Ipor *et al* (2009), limitation of light can also result in increasing petiole growth as plants need a longer petiole in order to reach sufficient light intensity. Begna *et al* (2002) also states that light plays an important role in the development of morphological characteristics and resource allocation in plants, and

Table 1. A linear rating scale that can was used to assess weed control or crop damage. (Modified from Frans *et al*., 1986)

Rating Weed Control	Crop Damage
0 No weed control	No crop reduction or injury
10 Very poor weed control	Slight crop discolouration or stunting
20 Poor weed control	Some crop discolouration, stunting or stunt loss
30 Poor to deficient weed control	Crop injury more pronounced, but not lasting
40 Deficient weed control	Moderate injury, crop usually recovers
50 Deficient to moderate weed control	Crop injury more lasting, recovery doubtful
60 Moderate weed control	Lasting crop injury, no recovery
70 Weed control somewhat less than satisfactory	Heavy crop injury and stand loss
80 Satisfactory to good weed control	Crop nearly destroyed – A few surviving plants
90 Very good to excellent weed control	Only occasional live crop plants left
100 Complete weed destruction	Complete crop destruction

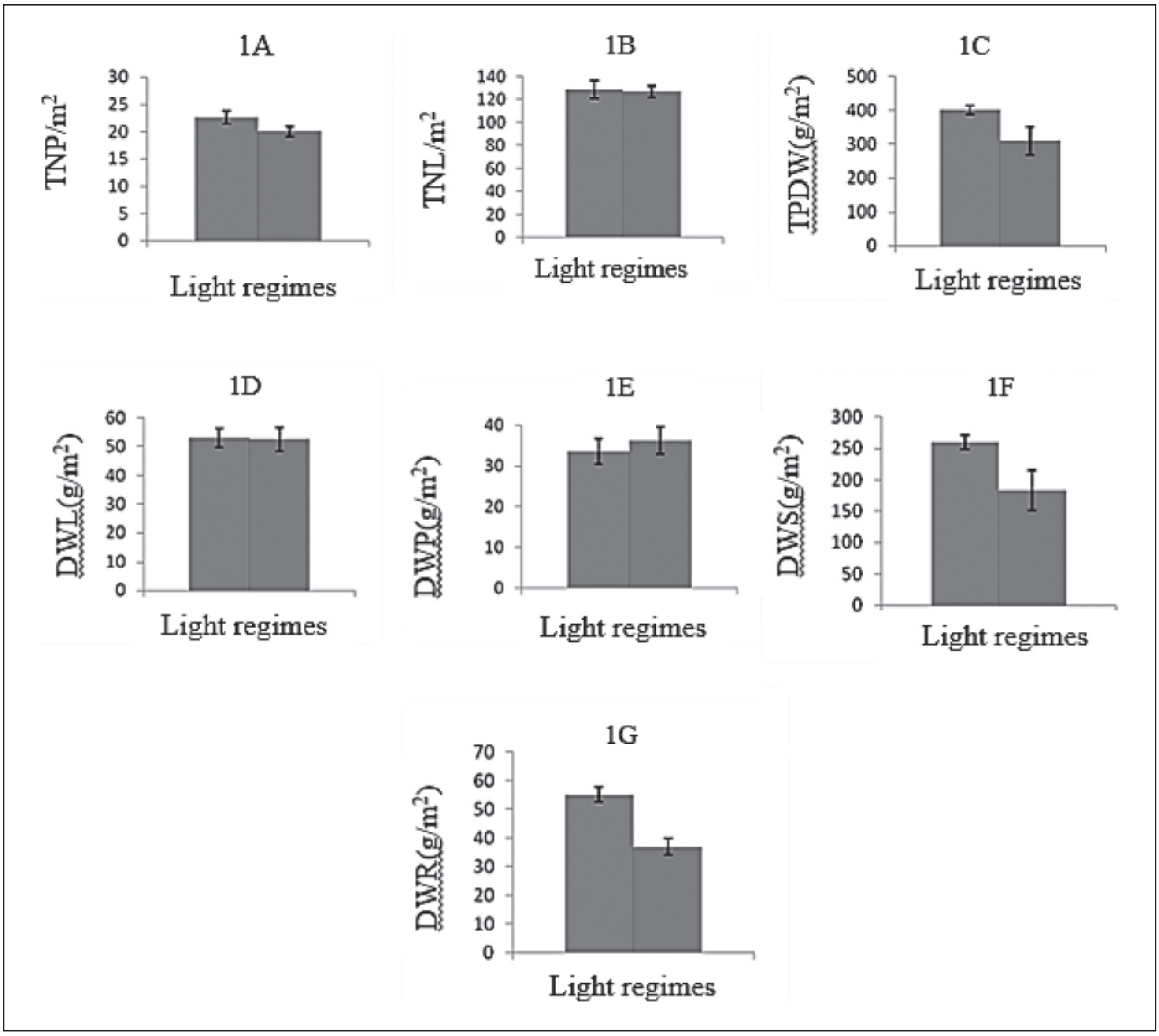

Fig. 1. The vegetative characteristics of *D. seguine* in open area ( ) and under shaded area ( ). 1A = Total number of plants (TNP), 1B = Total number of leaves (TNL) (g/m²), 1C = Total plant dry weight (TPDW) (g/m²), 1D = Leaves dry weight (DWL) (g/m²), 1E = Petiole dry weight (DWP) (g/m²), 1F = Stem dry weight (DWS) (g/m²), 1G = Root dry weight (DWR) (g/m²). Vertical bars are values of standard error.

shaded plants tends to allocate much of their photosynthesis to their shoot structures to allow more absorption of light.

However, for SWR and RWR it was recorded that both have higher value in the open area. The value for SWR shows significant difference when compared between both areas, while the value for RWR shows no significant differences. According to Hendrik *et al* (2012), plant will assign relatively more biomass to roots if the limiting factor for growth is below ground (e.g. nutrients, water), whereas they will allocate relatively more biomass to shoots if the limiting factor is above ground (e.g. light, carbon dioxide gas).

In Table 2, the Leaf Area (LA), Leaf Area Ratio (LAR) and Specific Leaf Area (SLA) have higher values in the shaded area compared to the open area. The values show significant difference when compared between both areas. In greater light intensity, cell membrane and cuticle get thicker, cells and stomas decrease in size and get closer, thus causes the leaf veins to become thinner and the leaf becomes narrower and erected resulting in a lower LA (Albayrak & Camas, 2007) in the open area. The SLA and LAR were greater if the plant exposed in shaded areas (Dasti *et al.,* 2002). Basically, the enlargement of leaf area with respect to shaded area is an action of leaf to increase the photosynthetic surface and more chlorophyll was available (Ipor *et al.*, 2009). In conclusion, shading is one of the factors that greatly affects the plants biomass allocation (Ipor *et al.*, 2006).

During the first week, there is no sprouting occur for all stages. By the second week, the youngest and

Table 2. Vegetative growth, leaves area and biomass allocation of *D. seguine* in open and under shaded area. Analysis was according to T- Test analysis. Values sharing the same letter within row are not significantly different at 0.05 levels

Parameter	Open Area	Under Trees Canopy Shading Area
Total Number of Plant/m^2	22.60 (±2.70)^a	20.00 (±2.24)^a
Total Number of Leave/m^2	128.60 (±16.98)^a	126.80 (±12.08)^a
Total Plant Dry Weight (TPDW) (g)/m^2	401.21 (±28.70)^a	308.65 (±12.83)^b
Leaf Area (LA) cm^2/m^2	219.88 (±42.27)^a	311.92 (±55.81)^b
Leaf Weight Ratio (LWR) (g/g)	0.13 (±0.03)^a	0.17 (±0.02)^b
Petiole Weight Ratio (PWR) (g/g)	0.08 (±0.01)^a	0.12 (±0.01)^b
Stem Weight Ratio (RWR) (g/g)	0.65 (±0.02)^a	0.58 (±0.04)^b
Root Weight Ratio (RWR) (g/g)	0.14 (±0.01)^a	0.12 (±0.01)^a
Leaf Area Ratio (LAR) (cm^2/g)	0.55 (±0.06)^a	1.06 (±0.12)^b
Specific Leaf Area (SLA) (cm^2/g)	4.16 (±0.61)^a	6.03 (±1.29)^b

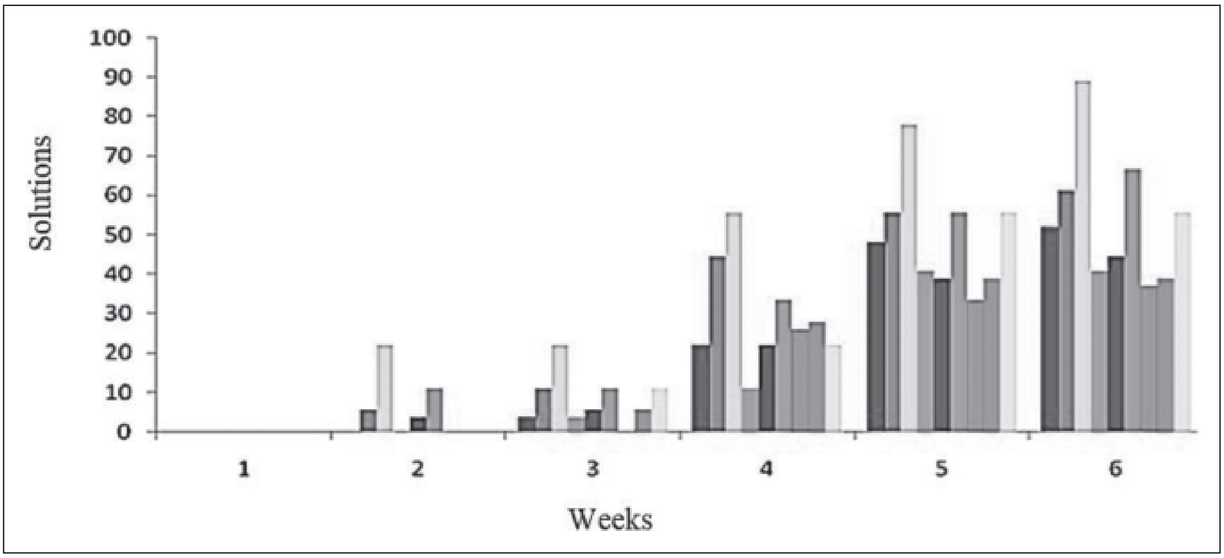

Fig. 2. The weekly comparison sprouting percentage at immature and one node ( ), immature and two nodes ( ), immature and three nodes ( ), intermediate and one node ( ), intermediate and two nodes ( ), intermediate and three nodes ( ), mature and one node ( ), mature and two nodes ( ), mature and three nodes ( ).

intermediate stage began to sprout, while the oldest stage only sprout after the third week. During the third and fourth week there is a drastic increment in the number of plants produced, from the youngest stage with two nodes and three nodes. After six weeks the highest percentage of sprouting of stems was by the youngest stage with three nodes, while the lowest percentage was by the oldest stage with one node (Figure 2).

Dieffenbachia is usually propagated by seeds, shoot or stem cuttings, division and air layering. Seed is not usually used except in breeding because it does not stimulate the development of the species, beside limited the seed production (Elsheikh *et al.,* 2013). According to Ipor *et al* (2009), propagation through stems usually tend to be more effective as compared to the seed dispersion and seed production could be inconsistent and seasonal, whereas stems production occurs throughout the year. The purpose for studying the rate of sprouting for *D. seguine* is to understand how effective *D. seguine* dispersed and sustained by means of vegetative propagation, such as stem cutting.

After six weeks, the percentage of control (%) by the treatment combination of 2,4-D dimethylamine with Metsulfuron methyl has the highest value and then followed by application of sole 2,4-D dimethylamine (Figure 3). Combination of herbicides produces a more effective control at considerably lower dosages compared to the application of sole herbicide (Budu *et al.,* 2014). However, there were no significant difference between the treatment of combination of 2,4-D dimethylamine with metsulfuron methyl and application of sole 2,4-D dimethylamine in this study (Table 3).

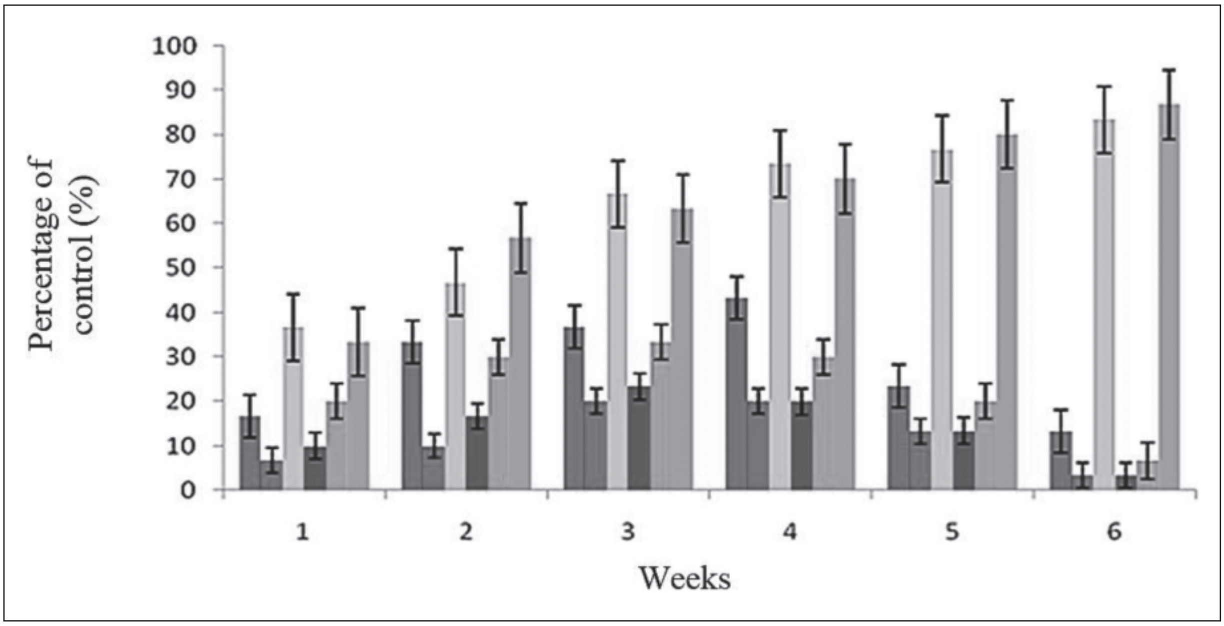

Fig. 3. Control of *D. seguine* at natural habitat by Paraquat dichloride ( ), Metsulfuron methyl ( ), 2,4-D dimethylamine ( ), Paraquat dichloride with Metsulfuron methyl ( ), Metsulfuron methyl with Glyphosate-isopropylammonium ( ), and 2,4-D dimethylamine with Metsulfuron methyl ( ). Vertical bars are values of standard error.

Table 3. The percent of control (%) after treatment. Analysis was according to Analysis of Variance (ANOVA) and then followed by Tukey's test. Values sharing the same letter within column are not significantly different at 0.05 levels

Treatment	Percent of control (%)					
	1st week	2nd week	3rd week	4th week	5th week	6th week
Paraquat dichloride	16.67^{b}	33.33^{b}	36.67^{b}	43.33^{b}	23.33^{b}	13.33^{b}
Metsulfuron methyl	6.67^{b}	10.00^{c}	20.00^{bd}	20.00^{c}	13.33^{bd}	3.33^{bc}
2,4-D dimethylamine	36.67^{a}	46.67^{a}	66.67^{a}	73.33^{a}	76.67^{a}	83.33^{a}
Metsulfuron methyl and Glyphosate-isopropylammonium	10.00^{b}	16.67^{c}	23.33^{bcd}	20.00^{cd}	13.33^{bcd}	3.33^{bcd}
Paraquat dichloride and Metsulfuron methyl	20.00^{b}	30.00^{b}	33.3^{bcd}	30.00^{bcd}	20.00^{bcd}	6.67^{bcd}
2,4-D dimethylamine and Metsulfuron methyl	33.3^{a}	56.67^{a}	63.33^{a}	70.00^{a}	80.00^{a}	86.67^{a}

The application of sole paraquat dichloride, a combination of paraquat dichloride with metsulfuron methyl, application of sole metsulfuron methyl, and the combination of metsulfuron methyl with glyphosate-isopropylammonium showed slowest crop reduction and faster re-grow. The result proves that the treatments of fewer efficacies could cause weed to re-growth and recover faster or in shorter periods (Mohamed *et al.*, 2010).

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REFERENCES

Albayrak, S. & Camas, N. 2007. Effects of temperature and light intensity on growth of fodder beet (*Beta vulgaris* var. crassa Mansf.). *Bangladesh Journal of Botany*, **36(1)**: 1-12.

Begna, S.H., Dwyer, L.M., Coultier, D., Assemat, L., DiTommaso, A., Zhou, X., Prithiviraj, B. & Smith, D.L. 2002. Decoupling of light intensity effects on the growth of C_3 and C_4 weed species through sucrose supplementation. *Journal of Experimental Botany*, **53(376)**: 1935-1940.

Budu, K.G.O., Zutah, V.T., Avaala, S.A. & Baafi, J. 2014. Evaluation of metsulfuron-methyl and combinations in controlling weeds in juvenile oil plantation. *International Journal of Agronomy and Agriculture Research*, **4(4)**: 9-19.

Chen, J., Henry, R.J. & McConnell, D.B. 2002. Development of new foliage plant cultivars, p. 466-472. In: *Trends in new crop and new uses*. J. Janick and A. Whipkey (eds.). ASHS Press, Alexandria, Virginia. 234pp.

Dasti, A.A., Fatime, K. & Malik, S.A. 2002. How photoperiod affects growth rate and biomass allocation pattern: A comparative study on three genotypes of *Arabidopsis thaliana*. *Asian Journal of Plant Science*, **1(2)**: 176-179.

Elsheikh, A.M., Daffalla, H.M. & Khalfala, M.M. 2013. *In vitro* micropropagation of the ornamental plant *Dieffenbachia* – A Review. *Universal Journal of Plant Science*, **1(3)**: 91-99.

Essandoh, P.K., Frederick, A.A., Justice, O.O., David, O.Y. & Ernest, K.A.A. 2011. Floristic composition and abundance of weeds in an oil palm plantation in Ghana. *ARPN Journal of Agricultural and Biological Science*, **6(1)**: 20-31.

Flint, E.P. & Peterson, D.T. 1983. Comparative water relation, photosynthesis and growth of soybean (*Glycine max*) and seven associated weed. *Weed Science*, **31**: 318-322.

Frans, R., Talbert, R., Marx, D. & Crowley, H. 1986. Experimental design and techniques for measuring and analyzing plant responses to weed control practices. In: *Research Methods in Weed Science*. N.D. Camper (3rd eds.). Champaign, IL: Southern Weed Science Society. pp. 29–46.

Hendrick, P. & Lawren, S. 2012. Pitfalls and possibilities in the analysis of biomass allocation patterns in plants. *Journal of Frontiers in Plant Science*, **3**: 259.

Ipor, I.B., Meekiong, K., Selamat, H. & Tawan, C.S. 2009. Response of *Cryptocoryne zaidiana* Ipor & Tawan (Araceae) to shading and water depth. *Journal of Tropical Biology and Conservation*, **5**: 15-29.

Ipor, I.B., Tawan, C.S., Zaini, R., Singka, R.C., Simon, A. & Sidi, M. 2006. Ecology and response of *Amorphophallus borneensis* (Engl.) Engl and Gehrm to shading. *Malaysian Applied Biology*, **35(1)**: 15-26.

Mohamad, R.B., Wibawa, W., Mohayidin, M.G., Puteh, A.B., Juraimi, A.S., Awang, Y. & Lassim, M.B. 2010. Management of mixed weeds in young oil-palm plantation with selected broad-spectrum herbicides. *Pertanika Journal of Tropical Agricultural Science*, **33(2)**: 193-194.

Mooney, H.A. & Winner, W.E. 1991. Partitioning response of plants to stress. In: *Response of plants to multiple stress*. H.A. Mooney, W.E. Winner & E.J. Pell (eds.). Academic Press Incorporated. pp. 129-139.