IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 6 Ver. I (June 2018), PP 39-51
www.iosrjournals.org

Facilitating Transportation and Recovery of Oil Palm (*Elaeisguineensis*Jacq.) Seedlings inthe Field by Leaf Dressing and Soil Stripping

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Abstract: *Transportation cost of oil palm seedlings with soil in the polythene nursery bags(~ 90% weight) from the nursery to the field is one of the major limitations to farmers in Cameroon.The general objectiveof this study was to reduce this cost while preserving their ultimate survival capacity. To achieve this, ten-month-old seedlings were off rooted(stripped: D), dressed (H: leaves cut to reduce transpiration surface), plasticized (P) and planted after storage for 0, 3, 6, 9 and 12 days. Water loss was evaluated for all treatments before planting. Seven months after planting, the rate of plant survival, the number of new leaves, the collar diameter and the leaf area were evaluated. The results show that water loss increased over time; < 4% for seedlings planted after 3 days of storage (DoS) and ~ 10% for 12 DoS. Water loss varied from 3.33% (DHP) to 7.54% (DhP). The survival rate was > 50% for zero, 3 and 9 DoS respectively for bare-rooted seedlings. It was < 50% for those planted after 6 and 12 DoS. However, survival rate was > 60% for dressed seedlings compared with 20% for undressed seedlings. The rate of leaf production varied between 44.66% and 54.66% for 12 and 9 DoS respectively. This rate was 58.83% for dressed seedlings against 26.39% for undressed. Results suggest that transportation is facilitated by off rooting, dressing and planting of seedlings within 12 days. This technology helped reduce expenses to 120 000 XAF for the treatment and transport of plants and a 70% profit (258 000 XAF) in relation to the untreated plants.It can also facilitate the rapide extention of palm plantations while reducing the potential spread of vascular wilt disease caused by thesoil borne Fusarium oxysporum f. sp. elaeidis.*

Keywords*: Oil palm seedlings, transport facilitation, field recovery, plant dressing.*

Date of Submission: 30-05-2018 Date of acceptance: 17-06-2018

I. Introduction

The African oil palm (*Elaeis guineensis* Jacq.) has been known worldwide since 2006 as the highest vegetable oil producing plant. As a result, its high yield and good return on investment attracts many planters (Belcher et al, 2004; Sandker et al, 2007; Sheil et al, 2009), hence the continuous increase of oil palm plantations (Levang et al, 2008; Sheil et al, 2009). In Cameroon, the extension of smallholder palm plantations is confronted with numerous economic constraints linked to the transport of seedlings from the nursery to the planting site. The conventional method of transporting oil palm seedlings from the nursery to the plantation consists of carrying the plant with all its clod of soil in the nursery sachet. However, this method requires excessive transport cost due to the very high weight of the plant (about 12 kg/unit). The transport of bare-root seedlings seems necessary to solve this problem, as about 90% of the total weight of the seedling is attributed to the clod of soil in the polythene nursery bag. According to statistics from the Rural oil palm Development Program (PDPV) in Cameroon, the cost of transporting a seedling over a distance of 100 km varies between 200 and 400 XAF, i.e. a national average of 300 XAF per seedling transported. Thus, the PDPV spent about XAF 99 million to transport 330,000 seedlings across the country for one cropping season (Bitjoka, 2008). These excessive transport costs can further increase during the rainy season. However, this cost can be considerably reduced if the soil is stripped or removed from the roots before transport. Soil stripping will also limit the propagation of soil borne diseases like Fusarium wilt caused by *Fusarium oxysporum* f. sp. *elaeidis*(Ngando et al, 2013, Ntsomboh-Ntsefong et al, 2012, 2015).

In fact, soil stripping consists in the tearing of the sachets in which nursery seedlings are grown and the cautious and complete removal of soil from their roots, rendering the plant lighter for transportation (Bitjoka, 2008). The soil is actually the main support of roots, which in turnconstitutes the main channel for water and nutrient intake by the plant. In fact, roots absorb water and nutrients used for photosynthesis and transpiration processes (Kolek and Kozinka, 1992). Therefore, stripping leads to the absence of water and nutrients resulting in progressive changes in the structure and functioning of the plant such as reduced transpiration surface, and a decrease in its production (Anonym, 2000). Considering the importance of water and nutrients' supply through the roots for the seedlings in the nursery, their elimination and abrupt exposure of roots cannot be without side effects. According to Davies and Bacon (2003), the elimination of the clod of earth around roots causes water stress in the plant as a direct reaction of the roots. Two approaches were considered to limit stress. The first was the protection of roots with plastic paper while the second was by cutting the leaves (dressing) of the plant to reduce evapotranspiration.

The overall objective of the study was to rationally reduce the cost of transporting oil palm seedlings from the nursery to the plantation while preserving their ability to recover later. The first specific objective was to evaluate the impact of seedling off rooting over a maximum period of 12 days. The second was to appreciate the importance of dressing on the survival of bare-rooted seedlings. The third specific objective was to determine the effect of plasticizing of bare-rooted seedlings. The fourth was to determine the water loss of bare-rooted seedlings.

II. Materials and Methods

2.1. Study site

This study was carried out at the IRAD Specialized Oil Palm Research Center (CEREPAH) in La Dibamba (Fig. 1). The study zone is found in the Littoral Region with geographical coordinates 3°50' and 3°58' north latitude; 9°46' and 9°54' east longitude; at an altitude of less than 50 m. It is found at 50 kilometers from Douala Town.

The average annual rainfall is about 3000 mm with a monomodal distribution, high and stable temperatures (26.7 °C). The minimum average temperature in Douala for 30 years (1961 - 1990) is 22.6 °C in July and the maximum average temperature is 32.3 °C in February. The relative humidity of the air remains high throughout the year and is close to 100% (Din et al, 2008). The soil has a sandy texture.

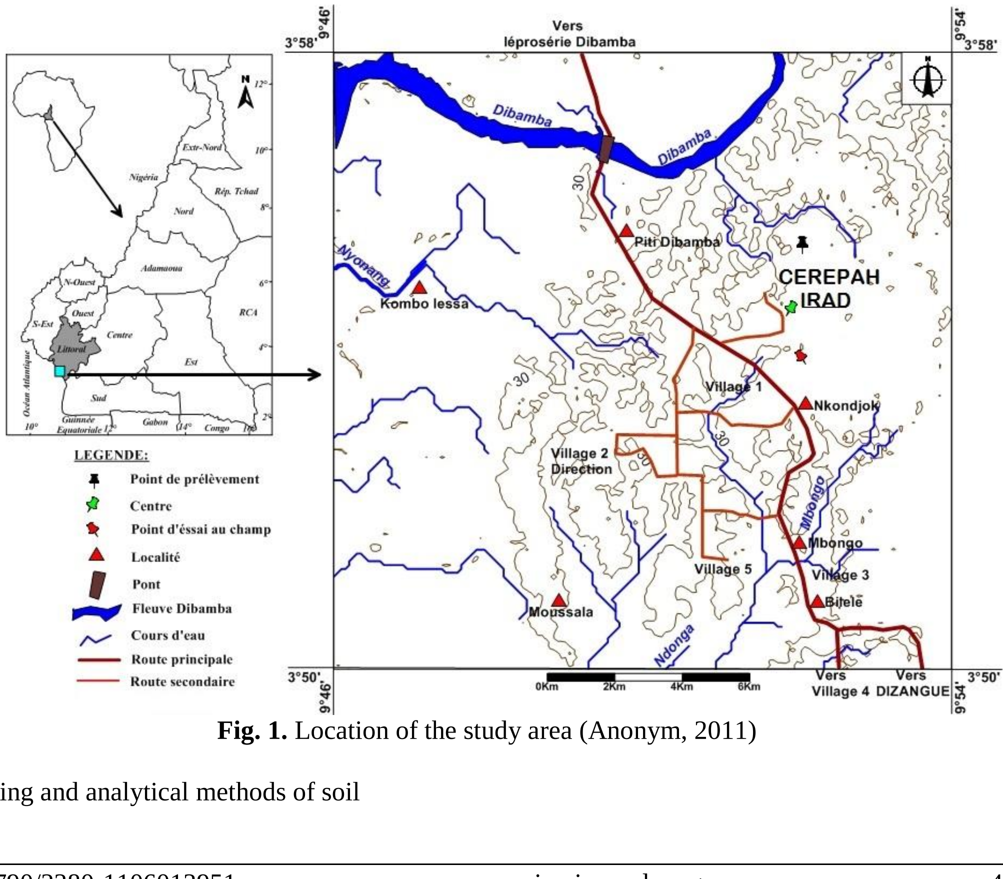

Fig. 1. Location of the study area (Anonym, 2011)

2.2. Sampling and analytical methods of soil

At the start of the study, composite soil samples were collected from each of the two plots (B60 and B70), which were to be used for the test, at a depth of 0-20 cm. These soil samples were analyzed in the soil, plants and water laboratory of IRAD. Soil pH was determined with a pH meter using 1:1 soil water ratio (Bates, 1954), organic C by the dichromate oxidation method as described by Nelson and Sommers (1982), total N by the microkjedahl method (Jackson, 1962), available P by Bray No.1 method (Bray and Kurtz, 1945), CEC by ammonium acetate saturation method (Chapman, 1965), exchangeable bases by extraction with 1 N ammonium acetate at pH 7 (Kundsenet al., 1982), K and Na were determined by Flame Photometry while Mg and Ca were determined using EDTA method from the leachate and particle size analysis was carried out using Bouyoucos hydrometer method as described by Gee and Bouder (1986). The particle size analysis was carried out by Robinson's pipette method on air-dried samples and sieved at 2 mm.

2.2. Plant material

Plant material used consisted of 1260 oil palm nursery seedlings of the variety "tenera" aged 10 months. This is material of the second cycle of selection from Deli x La Me (origin LM 269D x DA 115D; category C2301 II) currently distributed to planters by CEREPAH. The nursery seedlings were 0.6 to 1 m high and all had at least 10 functional leaves. This material is characterized by its high yield (4.5 tons of oil / ha / year under La Dibamba conditions), a reduced growth rate of the stipe (about 45 cm / year) and early bearing aptitude (2.5 - 3 years after planting).

2.2.1. Description of plant treatments

The seedlings were watered abundantly one day before off rooting which was done in the morning between 6 am and 9 am. Apart from the control seedlings without any treatment, all the others were stripped (D) of soil clod, some were dressed (H) and others not (h) while some were plasticized (P) and others unplasticized (p) as shown in Figure 2.

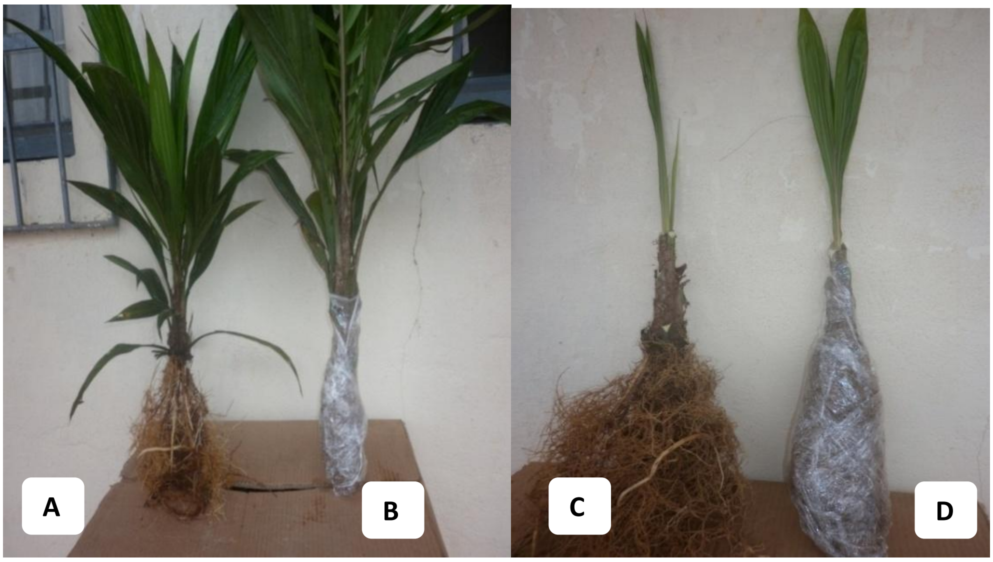

Fig. 2. Various treatments administered to oil palm seedlings in this study
A: Stripped (clod of soil removed from roots), undressed (leaves not cut) and unplasticized seedling (Dhp); B: Stripped, undressed and plasticized (DhP);C: Stripped, dressed and unplasticized seedling (DHp); D: Stripped, dressed and plasticized seedling (DHP).

The seedlings were subjected to various storage durations (0, 3, 6, 9 and 12 days) from off rooting to field planting. The treated seedlings were packaged in cartons, in batches of 20 seedlings per treatment and per repetition, then hermetically closed and deposited in an aerated room (Fig. 3). A total of 21 separate treatments were applied during this experiment (Table 1).

Fig. 3. Conditioning of seedlings in cartons after treatment

Table 1. Codes of the different treatments applied on oil palm seedlings

Treatments	Duration between stripping and planting of seedlings (days)					Total of treatments
	0	3	6	9	12	
DHP	DHP_0	DHP_3	DHP_6	DHP_9	DHP_{12}	5
DHp	DHp_0	DHp_3	DHp_6	DHp_9	DHp_{12}	5
DhP	DhP_0	DhP_3	DhP_6	DhP_9	DhP_{12}	5
Dhp	Dhp_0	Dhp_3	Dhp_6	Dhp_9	Dhp_{12}	5
dhp	dhp_0					1
Total	5	4	4	4	4	21

DHP = stripped, dressed and plasticized; DHp = stripped, dressed and unplasticized; DhP = stripped, non-dressed and plasticized; Dhp = stripped, non-dressed and unplasticized; dhp = unstripped, non-dressed and unplasticized seedlings (control).

2.2.2. Experimental design and planting

The experimental setup was a completely randomized block design.This was set up on two plots 5 m apart and in three replicates; 2 replicates on the same plot (B60) and the last on plot B70.Field planting density was 143 plants / ha. The trial covered an area of 8.81 hectares for a total of 1260 plants. Planting was done at the beginning of October 2012, which is not a suitable moment to plant oil palm in this zone. This off-season choice was made intentionally in order to expose the plants to the worst conditions of drought (soil and air) expected during the year.

2.3. Data collection and statistical analysis

Data collection began a month after the trial was set up. Only water loss of the treated seedlings was done as soon as they were taken out of the boxes for planting. Later on, the following parameters were measured: survival rate of the plants in the field, the number of plants that produced new leaves, the collar diameter and leaf area (Harden et al., 1969). The data obtained were submitted to ANOVA at 5% threshold using the R 3.00 software.

III. Results

3.1. Results of soilanalysis

The results obtained (Table 2) show that the soils are very acid with a pH close to 4, which exposes the plants to the risk of possible aluminum toxicity due to the high contents of Al^{3+}. The contents of exchangeable cations, organic matter and nitrogen are low (Anonym, 1993; Goh and Chew, 1997). This is due to the fact that this site is a replanting soil on which an old palm plantation has been for more than 30 years. The CEC was very weak, which is characteristic of a seriously altered soil where the dominant clay mineral is Kaolinite (Mapiemfu-Lamaré, 2011). Phosphorus and potassium contents were very low - almost zero despite the important role played by potassium in the resistance of oil palm to drought (Nodichaoet al., 2008). These soils are sandy in texture with a sand content greater than 80%. In conclusion, the two soils have similar parameters. There is therefore no soil effect with regard to the differences observed in the results obtained between stripped and unstripped seedlings in the two plots.

Table 2. Physical and chemical characteristics of the soils of the experimental site

Soil (plot)	pH	Ca	Mg	K	Na	P	Org C	Nt	C/N
		……cmol(+)/ kg……				ppm	%		
B60 (0-20 cm)	4.02	0.15	0.00	0.00	0.35	0.40	0.47	0.04	11.67
B70 (0-20 cm)	3.60	0.14	0.03	0.01	0.38	2.13	1.15	0.07	14.94

Soil (plot)	CEC	Al	Sand	Limon	Clay
	..Cmol(+)/ kg..		%		
B60 (0-20 cm)	4.88	2.66	80.90	2.28	16.82
B70 (0-20 cm)	3.19	3.49	81.90	1.21	16.90

3.2. Rate of water loss by treated seedlings

The results obtained show that water loss progressively increased with the storage duration. Before 6 days, the water loss is low (<5%). Beyond this period of conservation of stripped seedlings, the loss increases significantly but remains still low (<10%) after 12 days of storage (DoS) (Figure 4). The greatest water loss was recorded after 6 days with a large variation between repetitions expressed by the high standard deviation.

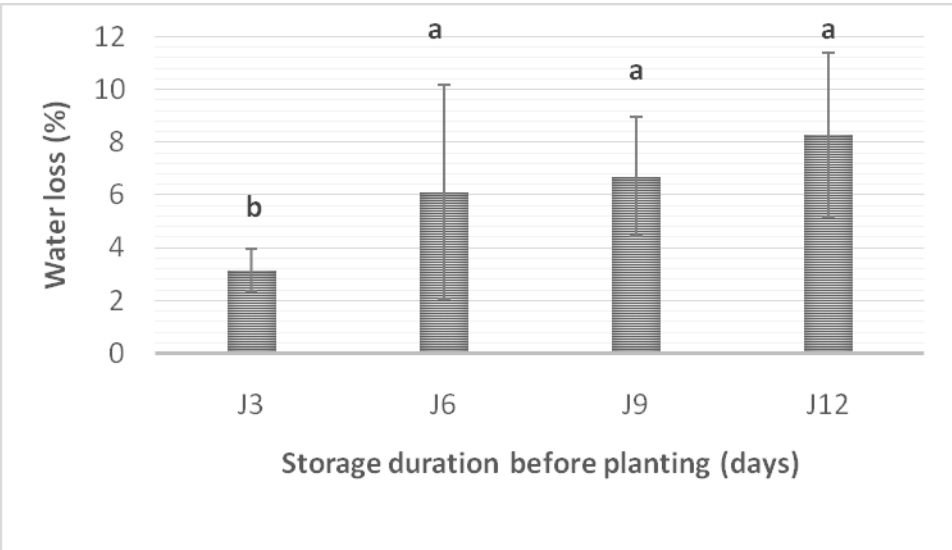

Fig. 4. Water loss of seedlings in relation to storage time (J: days)

The results show that water loss is also dependent on plant treatments. It varies from 3.33% to 7.54% respectively for DHP and DhP treatments. DHP treatment causes a loss of water (3.33%) significantly different from that of other treatments (DHp, DhP and Dhp). However, the latter are less than 10% and therefore relatively low (Fig. 5).

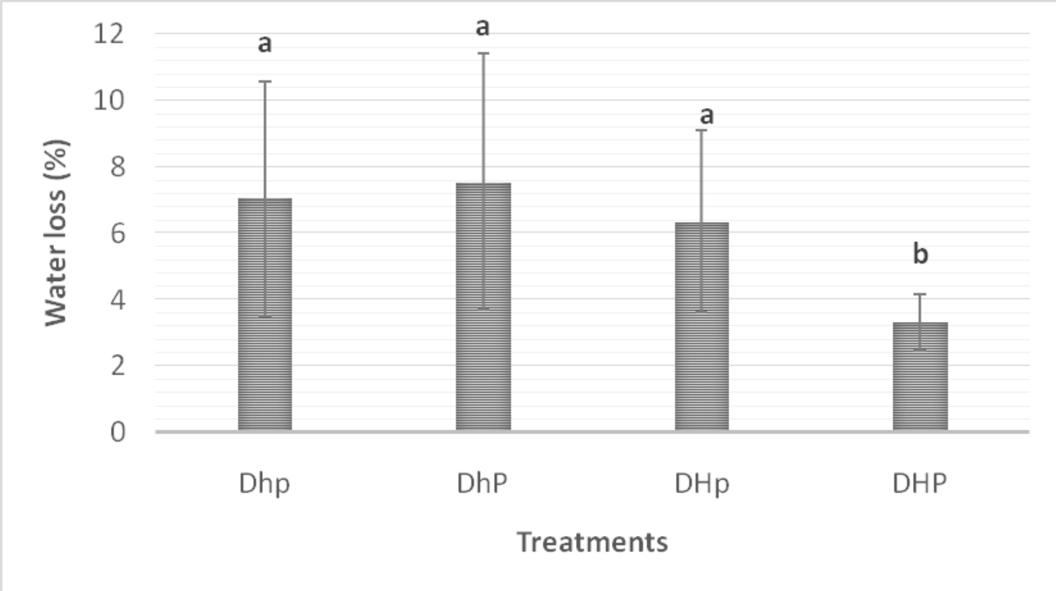

Fig. 5. Water loss of bare-rooted seedlings with respect to the type of treatment

3.3. Survival rate of seedlings in the field

3.3.1. Survival with respect to the duration of storage

The survival rate of control seedlings was approximatively of 85% (Figure 7). This rate is significantly different and greater than that of the stripped seedlings (51.13%). This results in a loss of 39% compared to control seedlings. After removal of bare-rooted seedlings, the survival rate varied from 55.33% for bare-rooted seedlings stored for 9 days before planting to 46.67% for those planted after 12 DoS. However, there was no significant difference between the different storage durations (Fig. 6).

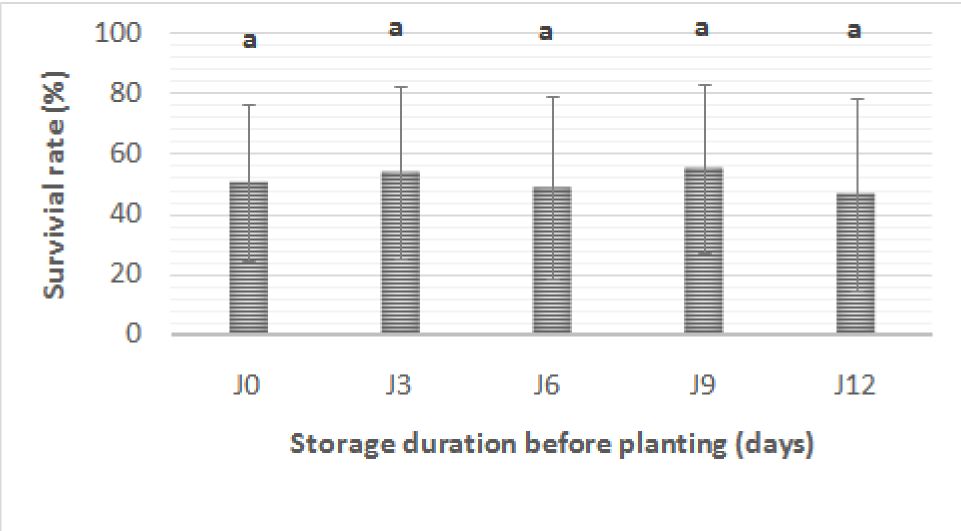

Fig. 6. Survival rate of seedlings in the field as a function of storage time.

3.3.2. Survival with respect to the treatments

The survival rate of the control seedlings (dhp) recorded in the field was 85 ± 13.23% (Fig. 7). Depending on the treatment applied (Fig. 7), the survival rate was 60% for bare-rooted, dressed (DH) against 20% for bare-rooted, non-dressed (Dh) seedlings, which confirms a significant difference at the threshold of 5% for this treatment with a loss of 66%.

In general, stripping associated with dressing result in a loss of 29% compared to control seedlings. However, this loss becomes even greater (76%) if stripped seedlings are not dressed. This leadsto theobservationof a significant difference at the 5% threshold between the control and DH on the one hand and control and Dh on the other hand.

This rate was 40% for plasticized (DP) and unplasticized (Dp) seedlings. There was no significant difference between DHP and DHp (Fig. 7), which means that plasticizing is not necessary after off rooting and dressing. Similarly, there is no significant difference between DhP and Dhp (Fig. 7), which means that plasticizing is also not useful for bare and non-dressed seedlings. In conclusion, plasticizing has no effect.

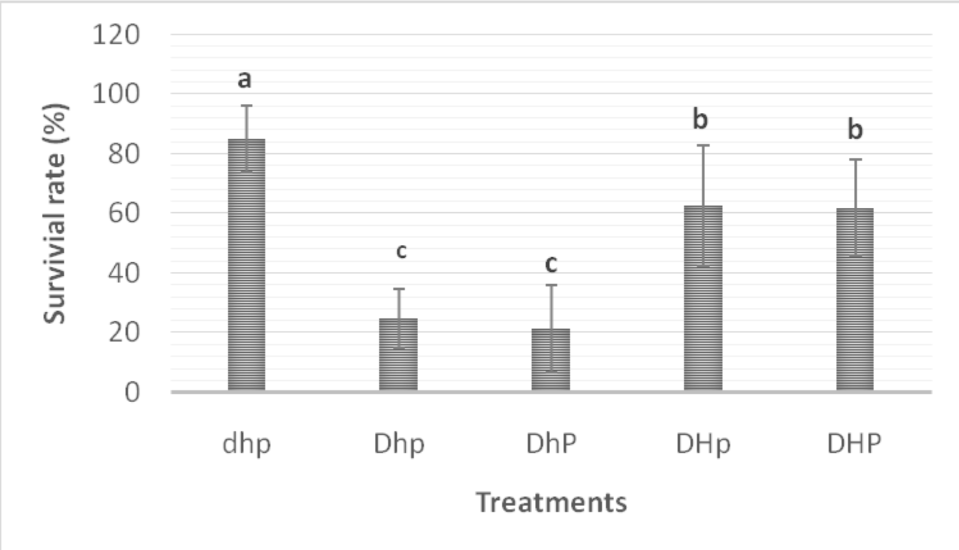

Fig. 7. Survival rate of the seedlings according to the different treatments

In both of these cases, off rooting appears to be the influential factor of plant survival. Moreover, of all treatments (DHP, DHP, DhP, Dhp), dressing limits not only the loss of water but also mortality rate of the seedlings in the field.

3.4. Number of seedlings with new leaves

3.4.1. Deployment of leaves based on storage time

Depending on the duration of storage of the treated seedlings, the rate of deployment of the seedlings varied from 44.66 to 54.66 % for the seedlings stored for 12 days and those stored for 9 days after treatment respectively. However, there was no significant difference between the different storage durations (Fig. 8).

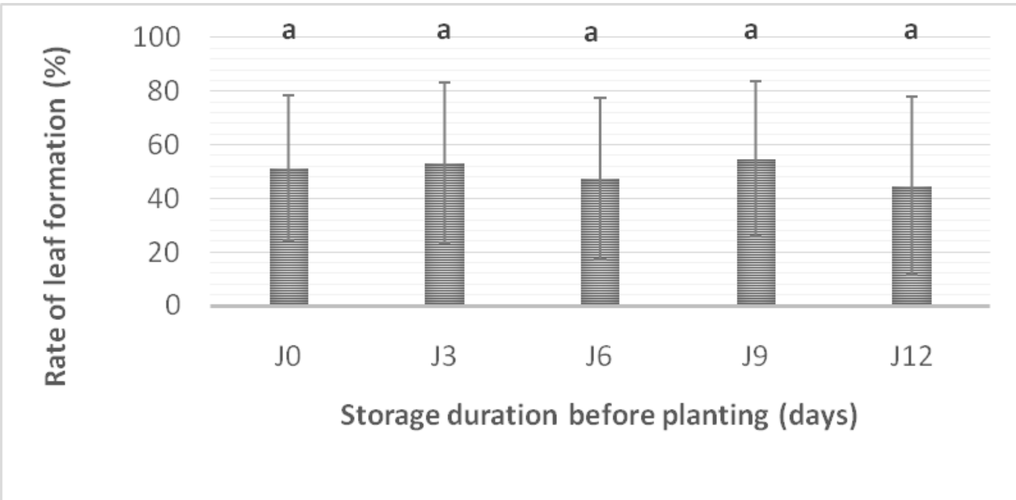

Fig. 8. Rate of leaf formation by seedlings in the field

3.4.2. Leaf development

The rate of formation of new leaves was equal to 85% for the control seedlings. For leaf treatment, bare-rooted and dressed (DH) seedlings deployed 58.83% leaves, unlike bare and non-dressed (Dh) seedlings with a deployment rate of 26.39% (Fig. 9). There was a significant difference at the 5% threshold between bare and dressed seedlings and bare and non-dressed seedlings with a 55% deficit in leave formation. Stripping associated with dressing results in 30% reduction in leaf formation compared to control, against 68% for stripped and non-dressed seedlings. As regards the treatment associated with root desiccation, the results (40%) were almost identical for plasticized (P) and unplasticized (p) seedlings respectively.

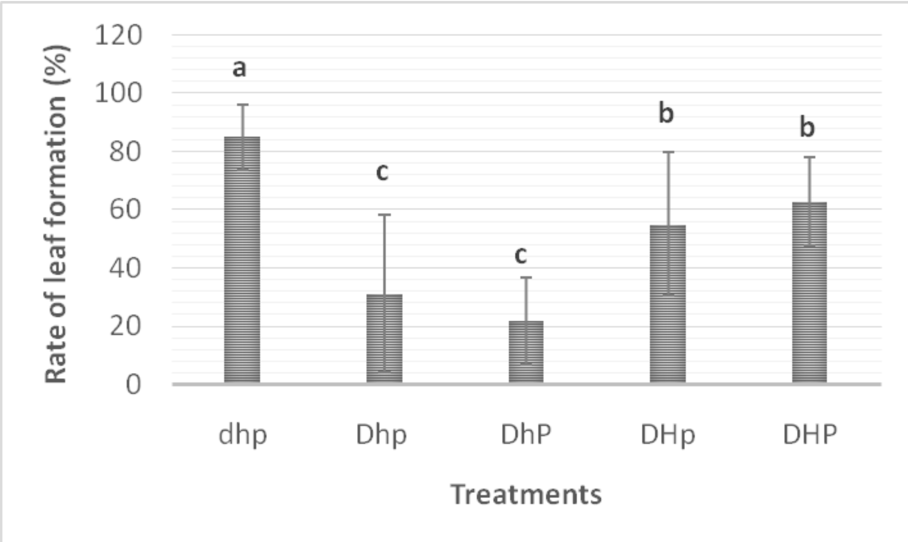

Fig. 9. Rate of leaf development of seedlings with respect to treatments

The dressing of the seedlings significantly increases the unfolding of the leaves, contrary to the plastification which does not influence this parameter.

3.5. Measurement of collar diameter

3.5.1. Depending on the storage time of the seedlings

The collar diameter values which were measured seven months after planting range from 2.99 cm for J0 to 3.32 cm for J3 and J9 (Fig. 10). The analysis of variance does not indicate any significant difference over the different storage times.

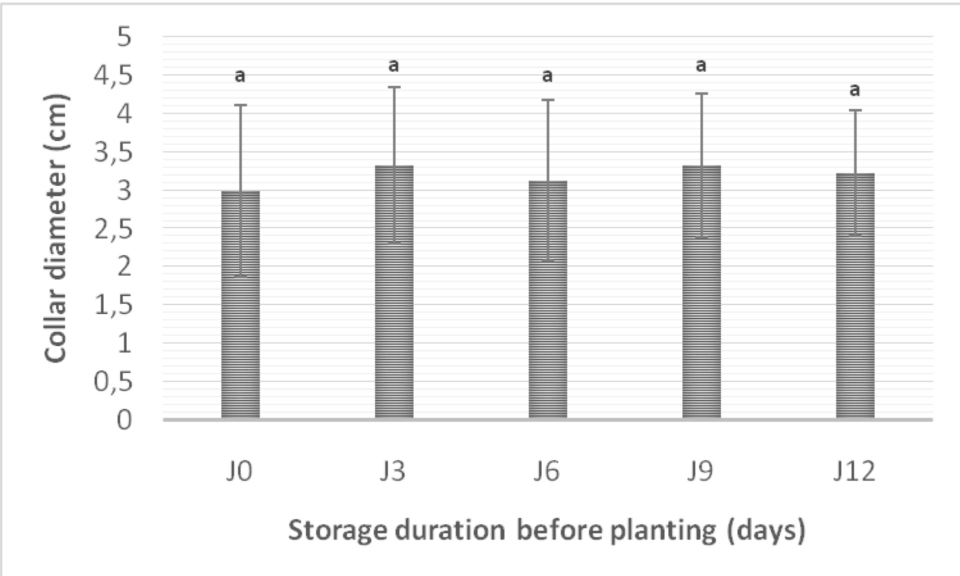

Fig. 10. Average collar diameter variation with storage duration of the seedlings

3.5.2. Depending on the treatment of the leaves

For all treatments, the average collar diameter of the treated seedlings was 3 cm compared to the control seedlings whose average diameter was equal to 5.07 cm (Fig. 11). This difference is significant at the

5% threshold between the control seedlings and the bare-rooted seedlings. Stripping causes a growth retardation of 40% compared to control seedlings.

3.5.3. Depending on the treatment against root drying

The result for collar diameter obtained was2.97 cm for both plasticized and unplasticized seedlings. Therefore, the collar diameter which is a growth parameter was not influenced by plasticizing.

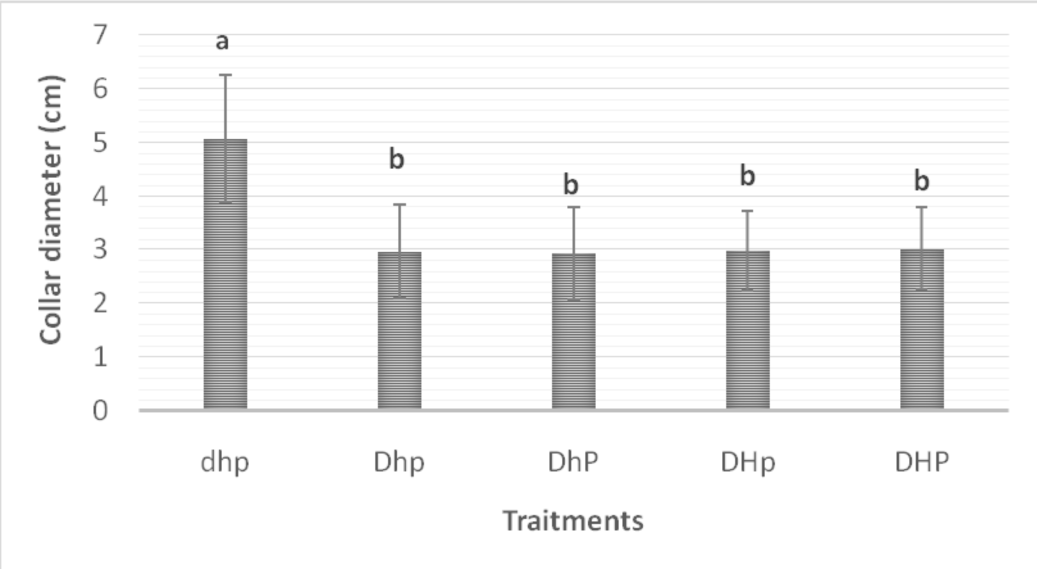

Fig. 11. Collar diameter with respect to the different treatments seven months after planting

There is no difference between the different treatments (dressing and plasticizing) and even, in terms of the storage duration of bare-rooted seedlings. Consequently, neither the dressing nor plasticizing are useful after off rooting which alone influences the collar diameter of the seedlings (Fig.11).

3.6. Leaf area

3.6.1. Depending on the storage time of the seedlings

One year after the establishment of the experiment, the control seedlings produced leaves with very large surface areas (average 3868.11 cm^2) (Fig. 13). Offrooting of the seedlings resulted in a reduction of almost half of the values recorded for all the seedlings compared to the control (Fig. 12). Leaf area values ranged from 2011.19 cm^2 to 2293.96 cm^2 for seedlings stored 12 days and 9 days respectively prior to planting.

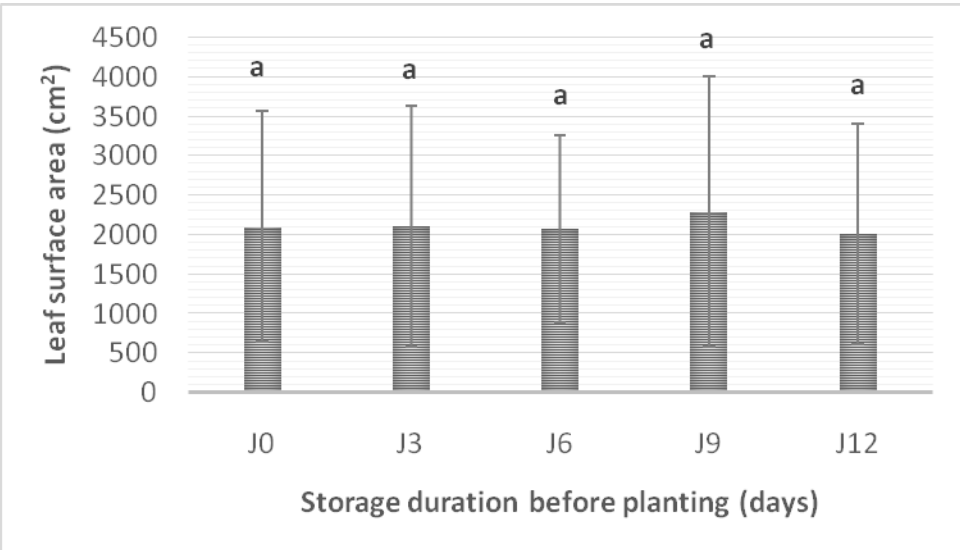

Fig. 12. Leaf area as a function of storage time seven months after planting

3.6.2. Depending on the treatment of the leaves

Results show that the leaf area values decrease by almost half compared to those of the control seedlings (3868.11 cm^2). They are identical whencompared between bare-rooted, dressed and bare-rooted, non-dressed. This shows that there is no significant difference between the treated seedlings but rather the control seedlings (Fig.12). Stripping results in a 55% reduction in leaf area compared with control seedlings for both dressed seedlings and those that are not dressed.

3.6.3. Depending on the treatment against dessication ofroots

Results obtained show that the mean values of leaf surface area vary from 1572 to 1861.44 cm^2 for plasticized and unplasticized seedlings respectively. The analysis of variance revealed no significant difference at the 5% threshold for the leaf area between plasticized and non-plasticized seedlings (Fig.13).

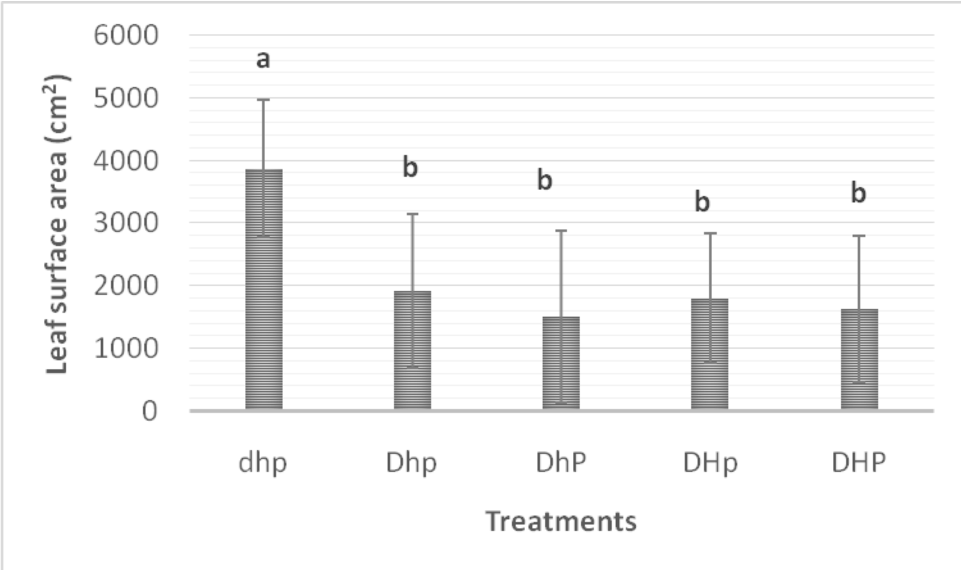

Fig. 13. Average leaf area as a function of the different treatments seven months after planting

IV. Discussion

With the overall aim of reducing transport cost during transplanting of oil palm seedlings, this study duels on the impact of soil status, root stripping and leaf dressing on seedling survival during transportation from the nursery to the plantation.

Results of soil analysis

Concerning the soil status, the chemical analysis of soil samples taken from the study area shows anoveralllow mineral contents. This does not allow the roots to cover their needs at the right time and with absorption flexibility to ensure plant growth. The low levels of phosphorus and nitrogen in soils did not favor the proper development of the root system. Water stress was probably exacerbated because of the poor water retention of soils due to their coarse texture (sandy soil). Results show that there was no soil effect with regard to the differences observed between stripped and unstripped seedlings in the two plots.

Water loss by seedlings with respect to storage duration and type of treatment

The results obtained show that, of all the treatments applied to seedlings during the test, the duration of storage has a significant effect only on the water loss unlike the offrooting whose effect is significant on all the parameters studied. Dressing has a significant effect on water loss of the plants, the number of surviving plants and the number of plants with new leaves.

This study shows that soil stripping of oil palm seedlings causes water loss regardless of the other types of treatment associated. Water loss peaks after 12 DoS of treated seedlings but remains low (8.28%). These results confirm the work of Clark and Mac-Gaig (1982), who showed that the relative water content of plants decreases as water stress increases. On the other hand, the small loss (<10%) observed even after 12 DoS could be explained by the closure of the stomata which according to Assamann et al. (2000) is one of the early responses to water deficit. This low water loss can also be due to the conditioning of treated seedlings in sealed cartons, which helps to reduce their dehydration. With regard to the different treatments, the least water loss (3.33%) recorded on the DHP treatment level is due to the dressing that slows the transpiration of the bare-rooted seedlings, probably because of the reduction in the surface area for evapotranspiration of these seedlings during the conservation period (Généré, 1997). Compared with the water loss obtained at the level of the

DHptreatment (6.35%), this significant difference is generated by the plastification of the roots which, associated with the dressing, prevents water loss.

Survival with respect to treatments and the duration of storage

For the survival rate, after a maximum of 12 DoS, the stripping of seedlings causes a loss of 39% compared to the controls. However, in a similar study carried out in the same site in June (favorable period for oil palm plantation establishment in this area), the results showed a high survival rate (80%) for all bare-rooted seedlings planted after 12 DoS, without any significant difference with the control (data not shown). These results are good and show that root stripping of seedlings does not significantly affect their physiological status. However, the results of this study are inferior to those obtained (80%) in the same site and those of Esan (1981) and Bitjoka (2008) who obtained a survival rate of 90% respectively on the bare-rooted seedlings of cocoa after 5 DoS and those of the oil palm after 12 DoS. The small loss recorded in this study can be justified by the fact that the period chosen (October) for the implementation of this experiment in the field is not indicated for the planting of the oil palm in this region; since it is close to the beginning of the long dry season marked by water deficit. But, this period was chosen intentionally to makesure that even during a long and harsh dry season, this practice is feasible. During this period, the 4th and 5th months after planting were marked by water deficit. According to Bohnert and Sheveleva (1998), drought has the effect of reducing the water potential around the roots, making the assimilation of water difficult and consequently leading to the death of plants.

Even though Cornaire et al (1994) revealed that the root system of the oil palm is drought tolerant, the observed loss can also be explained by the drying of the roots of the seedlings taken out of the carton boxes and exposed to the sun during the planting exercise. These partially dead roots as well as transplanting shock could make it difficult to mobilize available water from the treated seedlings (Aussenac and El Nour, 1986). However, some studies (Hurd, 1974; Richard and Passioura, 1981) have shown that under stress conditions, the assimilation of water by the plant is directly related to the degree of development of the root system. Cruiziat (1974), Benlaribi et al. (1990), Ali Dib and Monneveux (1992) and Matsuura et al. (1996) suggest that a long and extensive root system may confer an advantage by increasing the water supply of the aerial part. In line with this, Lebon et al (2006) also revealed that water deficit generally accelerates leaf senescence of plants.

Still on survival in the field and depending on the treatments, stripping of the seedlings causes a loss of 29% if they are dressed, against 76% if the seedlings are not dressed. This is not consistent with the work of Bitjoka (2008) who found no significant difference between the performance of dressed and undressed seedlings. This difference could be due to the fact that the dressing of seedlings makes it possible to reduce surface area and hence the total number of cells of the leaf. This decrease contributes to the conservation of water, thereby allowing the survival of the plant (Lebon et al, 2004).

Deployment of leaves based on treatments and storage time

According to Thakur and Rai (1982), water deficit causes delay in plant growth, and results in a decrease in the number of leaves produced. With regard to the deployment of new leaves by bare-rooted seedlings in this study, there is a 40% decrease in the number of plantsthat producednew leaves following planting after 12 DoS, identical to that recorded in the survival rate. The cessation of rains one month after the planting of root-stripped seedlings, for a period of 3 months was detrimental to the recovery and development of these seedlings. As soon as the roots are reconstituted,normal plant development follows. Therefore, drop in performance is probably connected to the fact that the roots faced difficulty adapting totheir new environment because of the stress caused by stripping, and are thus forced to use almost all resources for their reconstitution rather than for the absorption of water and nutrients. In fact, water deficit affects the physiological activity of the leaf, particularly photosynthesis and stomatal conductance (Lowlor, 2002; Lowlor and Cornic, 2002).

The rate of deployment of bare-rooted and dressed seedlings is 58.83% against 26.39% for bare-rooted and undressed seedlings; thus a decrease of 55%. These results are similar to those of Ronal’s (1981) work on cocoa, which revealed a significant difference between the performance of dressed seedlings and those not dressed. The high rate of deployment of bare-rooted and dressed seedlings could be explained by the reduction of transpiration and the optimization of water absorption by their roots favored by dressing (Temagoult, 2009). However, the lack of dressing speeds up cell death and tissue ageing.

Effect of treatments and storage duration on collar diameter and leaf area

Regarding seedling collar diameter and leaf area, analysis of variance revealed no significant difference between treatments and storage duration. However, this analysis reveals a significant difference of leaf area and collar diameter between control and stripped seedlings planted after a maximum of 12 DoS. These two growth parameters and the development of the plant are dependent on cell growth. The water deficit obviously affected cell functioning. In fact, Wolfe et al. (1992) noted that reduced leaf area due to reduced cell elongation is one of the consequences of water deficit. According to Thakur and Rai (1982), water deficit causes a delay in plant growth. It results in a reduction in collar diameter and a decrease in leaf area. This reduction can also be explained by the fact that only the surviving seedlings were taken into account. No significant differences were observed between bare-rooted and plasticized seedlings and unplasticized bare-rooted seedlings. This could be due to the fact that the seedlings were kept in hermetically sealed cartons and kept in a well ventilated room.

V. Conclusion

In light of this study, whose main objective is to rationally reduce the cost of transporting oil palm seedlings from the nursery to the plantation while preserving their ability to recover later, it is clear that stripping enhances less than 10% water loss for a maximum storage period of 12 days. Losses in the survival rate are of the order of 29% when the seedlings are stripped and dressed (DH) and 76% if they are not dressed (Dh) compared to control seedlings. It can thus be retained from this study that stripping is good because it generates overall low losses especially in extreme conditions. Moreover, seedling dressing significantly reduces losses by 40% compared to those that are stripped and not dressed. All surviving seedlings will resume normal growth. However, it will be interesting to test for slightly longer storage durations above 12 days. Finally, it was observed that plasticizing and soil status had no significant effect.

This experiment was conducted in an unfavorable period (October 2012). Applying the method in more favorable conditions (April - August), would guarantee an even higher survival rate (85%) with little loss and good growth of the seedlings in the field. By reducing the weight of the seedlings to be transported, this technique economically offers farmers the opportunity to reduce the cost of transporting seedlings by about 70%and also limits the spread of vascular wilt disease.

Acknowledgements

We thank the Faculty of Science of the University of Yaounde I, for helping in the elaboration of the research topic. We are also grateful to IRAD Cameroon for supplying us with plant material and for providing financial support and space for field experiments at Dibamba.

References

[1]. Ali Dib, T., Monneveux, P. (1992). Adaptation à la sécheresse et notion d'idéotype chez le blé dur. I. Caractères morphologiques d'enracinement. Agronomie, 12, 371-379.
[2]. Anonym (1993). Mémento de l'agronome 5ème édition. Ministère de la coopération et du développement, Paris, 1635 p.
[3]. Anonym. (2000). Laboratoire d'Ecophysiologie des Plantes sous stress environnementaux (LEPS). La résistance des plantes à la sécheresse. INRA Montpelier.
[4]. Anonym (2011). Document candidature du Centre spécialisé de Recherche sur le Palmier à Huile au concours pour le prix de l'excellence scientifique du président de la république. Journées d'Excellence de la Recherche Scientifique et de l'Innovation au Cameroun, p. 153.
[5]. Assmann, S. M., Snyder, J. A. & Lee, Y. J. (2000). ABA-deficient (aba1) and ABA insensitive (abi1-1, abi2-1) mutants of Arabidopsis have a wild-type stomatal response to humidity. Plant Cell Environ. 23, 387 - 395.
[6]. Aussenac, G., & El Nour, M. (1986). Reprise des plants et stress hydriques; Rev. For. Fra 3, 2.
[7]. Bates, R.C. (1954). *Electrometric pH determination*. John Wiley and sons, Inc. New York, pp. 35-38.
[8]. Belcher, B.M., Rujehan, NdanImang., &Achdiawan, R. (2004). Rattan, Rubber or Oil Palm: Cultural and Financial Considerations for Farmers in Kalimantan. Journal of Economic Botany 58 (supplement).
[9]. Benlaribi, M., Monneveux, P., &Grignac, P. (1990). Etude des caractères d'enracinement et de leur rôle dans l'adaptation au déficit hydrique chez le blé dur (*Triticumdurum*Desf.). Agronomie, 10, 305-322.
[10]. Bitjoka, P.L. (2008). Effet du déchaussement sur la reprise et la croissance des plants de palmier à huile (*Elaeis guineensis* Jacq. Var. *tenera*) en champ. Mémoire de DESS, Université de Yaoundé I, 43 p.
[11]. Bohnert, H.J., &Sheveleva, E. (1998). Plant stress adaptations--making metabolism move. Current opinion in plant biology 1 (3), 267-274.
[12]. Bray, R.H., & Kurtz, L.T. (1945). Determination of total and available forms of phosphorus in soils. *Soil Sci.*, **59:** 39 - 45.
[13]. Chapman, H.D. (1965). Cation Exchange Capacity. In Black, C.A. (ed): *Methods of Soil Analysis*, part II, Agronomy No.9; Am. Soc. of Agronomy Madison, Wisconsin, pp. 891-901.
[14]. Clark & Mac-Gaig. (1982). Existed leaf water retention capability as an indicator of drought resistance of *Triticum* genotypes. *Can. J. Plant. Sci*. 62, 571 - 578.
[15]. Cornaire, B., Daniel, C., Zuily-Fodil, Y., &Lamade, E. (1994). Le comportement du palmier à huile sous stress hydrique. Données du problème, premiers résultats et voies de recherche. Oléagineux, 49, 1-12.
[16]. Cruiziat, P. (1974). Détermination des pertes en eau subies par les différents organes d'une plante soumise au dessèchement. Ann. Agron. 25, 539-554.
[17]. Davies, W. J., & Bacon, M. A. (2003). Adaptation of roots to drought. *In*: de Kroon H. and Visser E. J. W. (Eds). Roots ecology. Ecological studies 168, Springer Verlag, Berlin, and Heidelberg, pp. 173 – 192.
[18]. Din, N., Priso, J.R., Dibong, S.D., & Amougou, A. (2008). Logging activities in mangroves forests: A case study of Douala Cameroon. African Journal of Environmental Science and Technology 2 (2), 22 - 30.
[19]. Esan, E.B. (1981). Etudes des transports des plants de cacaoyer (*Theobroma cacao*, L.) de la pépinière et transplantation à racines nues sur le terrain. In (8ème conférence international sur la recherche cacaoyère) (Eds.). Proceedingcartagena. p. 15.
[20]. Gee, G.W., &Bouder, J.W. (1986). Particle size analysis. In: Aklate (ed.) *Methods of Soil Analysis*, 2nd ed. No.9 ASA. Inc. SSSA Madison, Washington D.C. pp. 383 - 409.
[21]. Généré, B. (1997). Les facteurs influençant la qualité physiologique des plants plantés, et la prise en compte des risques climatiques après plantation. Revue forestière française, XLIX, (4): 313-323.

[22]. Goh, K.J., &Chew, P.S. (1997). Interpretations of analytical data from soil survey reports for manuring recommendations: some pointers. Annual Journal/Report 1997, Royal Johore Planters' Association, 25 - 30.
[23]. Harden, J.J., Williams, C.N., & Watson, I. (1969).Leaf area and yield in oil palm in Malaysia. ExplAgric 5, 25-32.
[24]. Hurd, E.A. (1974). Phenotype and drought tolerance in wheat. Agric. Meteoro. 14, 39-55.
[25]. Jackson, M. L. (1962). Soil Chemical Analysis. International Institute for Tropical Agriculture (IITA). Manual Series No.1, p. 70.
[26]. Kolek, J., &Kozinka,V. (1992). Physiology of the plant root system 46. Kluwer Academic publishers, Dordrecht, Netherlands, 361 p.
[27]. Kundsen, D., Peterson, G.A., &Prett, P.F. (1982). Lithium, Sodium, Potassium. In: A. L. Page, R. A. Miller, D. R. Keeney(eds.) *Methods of Soil Analysis*, Part 2 Afron. Amer. Soc. Agron. Inc. Madison Wisconsin, 5-246.
[28]. Lebon, E., Pellegrino, A., Louarn, G., &Lecoeur, J. (2006). Branch development controls leaf area dynamics in grapevine (*Vitisvinifera*) growing in drying soil. Annals of Botany 98, 175 - 185.
[29]. Levang, P., Sheil, D., &Kanninen, M. (2008). Le palmier à huile, Dr Jekill pour l'énergie, Mr Hyde pour la biodiversité. Liaison énergie-francophonie/UICN, Special Congrès mondial de la nature 2008, 26-31.
[30]. Lowlor, D.W. (2002). Limitation to photosynthesis to water stressed leaves: stomata vs. metabolism and the role of ATP. Annals of Botany, 89, 871 - 885.
[31]. Lawlor, D.W., &Cornic, G. (2002). Photosynthetic carbon assimilation and associated metabolism in relation to water deficits in higher plants. - Plant Cell Environ, 25, 275 – 294.
[32]. Mapiemfu-Lamaré, D., Thé, C., Tsoata, E., Zonkeng, C., &Mfoupou, M.Y.C. (2011). Inhibition de la croissance et du rendement du maïs (*Zeamays* L.) en sols très acides au Cameroun, et identification de critères précoces de tolerance à la toxicité. Tropicultura 29, 94 - 100.
[33]. Matsuura, A., Inanaga, S., & Sugimoto, Y. (1996). Mechanism of interspecific differences among four graminaceous crops in growth response to soil drying. Japanese J. of Crop Science, 65, 352-360.
[34]. Nelson, D.W., & Sommers, L.E. (1982). Total carbon, organic carbon and organic matter.p. 530-577. In: A. L. Pageet al (ed). Methods of soil Analysis. Part 2. 2nd ed. Manogr. 9 ASA and SSSA Madison,W.
[35]. NgandoEbongue, G.F., Etta, C, E., Ntsomboh, N, G.,&Oben, T, T., (2013). Breeding oil palm (*Elaeis guineensis* Jacq.) for fusarium wilt tolerance: an overview of research programmes and seed production potentialities in Cameroon. Int. J. Agric. Sci. 3 (5): 513-520.
[36]. Nodichao, L., Ake, S., & Jourdan, C. (2008). Développement du système racinaire chez le palmier à huile selon l'origine génétique et le régime hydropotassique du sol. Agronomie Africaine 20 (3), 277 - 289.
[37]. Ntsomboh-Ntsefong, G., NgandoEbongue, G. F., Koona,P., Bell, J.M., Youmbi, E., Ngalle H. B., Bilong, E. G., Madi G., &Anaba B. D.(2012). Control approaches against vascular wilt disease of *Elaeis guineensis* Jacq. caused by Fusarium oxysporum f. sp. elaeidis. Journal of Biology and Life Science, 3 (1): 160-173.
[38]. Ntsomboh-Ntsefong, G., Madi, G., Nyaka, N, A., Nsimi, M, A., Epoh, N, T., Kato, S. N., Lum A. F., &Ngando, E, G.F., (2015).Vascular wilt disease tolerance status of some oil palm (*Elaeis guineensis* Jacq.) progenies in relation to local strains of *Fusarium oxysporum* f. sp. *elaeidis*in Cameroon. Int. J. Curr. Res. Biosci. Plant Biol. 2015, 2 (8) 111-122.
[39]. Richard, R.A., &Passioura, J.B. (1981). Seminal root morphology and water use of wheat. II. Genetic variation. CropSci. 21, 253-255.
[40]. RonalAlvim. (1981). Viabilité du repiquage de cacaoyers à racines nues. *In* Proceedings. Cartagena, p.21.
[41]. Sandker, M., Suwarno, A., & Campbell, B. M. (2007). Will forests remain in the face of oil palm expansion? Simulating change in Malinau, Indonesia. Ecology and Society, 12 (2): [online] URL: http//www.ecologyandsociety.org/vol13/iss1/resp1/Indonesia. Ecology and Society, 12 (2), 37.
[42]. Sheil, D., Casson, A., Meijaard, I., Van Noordwjik, M., Gaskell, J., Sunderland-Groves, J., Wertz, K., &Kanninen, M. (2009). The impacts and opportunities of oil palm in South East Asia. What do we know and what do we need to know? CIFOR, Bogor, Indonesia.
[43]. Temagoult, M. (2009). Analyse de la variabilité de la réponse au stress hydrique chez des lignées recombinantes de Tournesol (*Helianthusannus* L.). Diplôme de magistère en Biotechnologies Végétales. Université Mentouri, Constantine, 106 p.
[44]. Thakur, P.S., & Rai, V.K. (1982). Effect of water stress on protein content in two maize cultivars differing in drought resistance. Biologia Plant (Praha), 24, 96 - 100.
[45]. Wolfe, D. W., Sardas, V. O., Villalobos, J., &Ferreres, E. (1992). Photosynthesis recovery from drought in relation to stress effects on leaf osmotic potential and nitrogen content. In: Proceding of the 13 th international sunflowers. Pisa, Italy, 1, 658 – 66.

*Bienvenu Désiré Anaba et al, 2018. "Facilitating Transportation and Recovery of Oil Palm (*Elaeisguineensis* Jacq.) Seedlings inthe Field by Leaf Dressing and Soil Stripping." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.6 (2018): 39-51.