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Evaluation of the Domestication Potential of Wild Plant (*Desmodium adscenden*) by Vegetative and Seeds Propagation Under Controlled Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. Authors KKD, YKJE and KNM planned the experiments, statistically analyzed the data and wrote the report, while. Authors KKFJM, NKS and KKN interpreted the results and provided advice. Author TL supervised the study. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Desmodium adscendens is a plant in the Fabaceae family. This plant is very important to humans for both agricultural and medical purposes. However, its availability is becoming increasingly rare and its collection in forests is contributing to the degradation of biodiversity due to the lack of control over its domestication. The aim of this study is to contribute to the domestication of *Desmodium adscendens* by controlling vegetative propagation by cuttings and seed sowing. Cuttings of *Desmodium adscendens* aged 3 months and three types of seed were tested, namely seeds wrapped in pods, seeds without pods and scarified seeds without pods. The seedlings were sown in trays containing sterilised soil under a shade canopy with 40% light. Emergence, recovery and morphological parameters were assessed. The reproductive cycle of *Desmodium adscendens* was also determined. The results showed that cuttings had the highest recovery rate, at 96%. Plants grown from cuttings had the best height and branching. In terms of the reproductive cycle, seedlings from cuttings had a shorter crop cycle of 66 days, compared with 140 days for other seeds. These results suggest that the best way to propagate this species quickly is by taking cuttings.

Keywords: Desmodium adscendens, multiplication, cuttings, seeds, under shade, domestication.

1. INTRODUCTION

Desmodium adscendens is a widespread plant in the equatorial zone, where it grows wild in South America and West Africa. The *Desmodium genus* comprises around 400 species of herbaceous perennial plants. It plays an important role in agronomy, medicine and the environment (Manzione *et al*., 2022; Pierre *et al*., 2015). Medicinally, *Desmodium adscendens* is used by traditional practitioners to treat a number of illnesses, including bronchial asthma, constipation, dysentery and colic (Pierre *et al.,* 2015). The leaves are also used to heal wounds, muscular pain, kidney ailments, impotence and various liver ailments including viral hepatitis (Rama *et al.*, 2020). In agronomy, it is used as a green manure and cover crop. Cover crops are widely used in tropical countries. In West Africa, and in Côte d'Ivoire in particular, *Desmodium adscendens* has been part of the cover plant collection for the last ten years and is maintained on station (Vilna, 2020). Cover crops play a variety of roles in agronomy, improving soil fertility (Hergoualc'h *et al*., 2008), reducing the risks associated with crop pests (Malezieux *et al*., 2009, Ratnadass *et al.,* 2012) and combating weed infestation. In Côte d'Ivoire, farmers use weedkillers, of which glyphosate is one of the most widely used (Benbrook, 2016). Domesticating *Desmodium adscendens* as a cover crop could be a palliative solution to the use of glyphosates. However, its availability is becoming increasingly rare and it is mainly collected in forests, thereby degrading biodiversity. This study aims to contribute to its domestication by controlling vegetative propagation through cuttings and seed sowing.

2. MATERIALS AND METHODS

2.1 Experimental Site

The Centre National de Floristique (CNF), which housed the experiments, is located at the University Felix HOUPHOUËT-BOIGNY in Abidjan (Côte d'Ivoire). It is located at longitude 5° 20‘ 51″ North and latitude 3° 59’ 01″ West.

2.2 Plant Material

The plant material used in this study consisted of *Desmodium adscendens* seeds and *Desmodium adscendens* cuttings containing four (4) buds from three-month-old plants.

2.3 Setting Up the Experiment

The soil was sampled at the *Centre National de Floristique*. The soil was sterilised in an oven set at 120°C for one hour. Three-month-old *Desmodium adscendens* plants were selected on the basis of their physiological and health status (Dembélé, 2012). A portion of stem 5 to 10 cm long, with four nodes, was removed by a clean section with pruning shears below a node

(Rosenn and Denis, 2004). Once taken, the cuttings underwent partial leaf removal (Fig. 1) (Kalingani *et al*., 2007). For the seeds, mature *Desmodium adscendens* pods were harvested from the plants and then dried in the shade for a week. The pods were divided into three batches. The first batch was the pods (Fig. 2), the second batch was seeds removed from their shells (Fig. 3) and the third was seeds scarified with abrasive sandpaper by rubbing (Fig. 4).

2.4 Experimental Set-up

The experimental design adopted was a completely randomised Fisher block with four treatments and five replicates (Fig. 5). Each block consisted of four 12.5-litre tubs, representing the four treatments. The treatments evaluated were as follows: T1 (cuttings, see Fig. 1), T2 (enveloped seeds, see Fig. 2), T3 (seeds removed from their envelopes, see Fig. 3) and T4 (scarified seeds, see Fig. 4). The tubs were placed in a shelter where shading was maintained at 40 % either $300.\ 10^5$ Lux for $500.\ 10^5$ Lux measured in full sunlight using a luxmeter.

2.5 Sowing and Care of the Plants

The seedlings were sown in trays containing sterilised soil (Fondation McKnight, 2020). The seeds were sown in the pots and then covered with a thin layer of soil. Two seeds were planted per pot, with 10 seeds per tray and 50 seeds for the experiment. As for the cuttings, they were pricked out in the soil contained in the trays with 25 cuttings for the trial, i.e. 5 per cutting per tray. All the production factors, i.e. substrate, shade level, irrigation and manual weeding, were kept uniform and at their optimum for each treatment. Each tray was watered regularly with 1 litre of water every two days.

2.6 Collection of Data

2.6.1 Germination time and germination rate

The time elapsing between the sowing of seeds and germination was recorded from the date of sowing of the seeds. This time is considered to be the germination period for seeds and the recovery period for cuttings (Diatta *et al*., 2007). For cuttings, the recovery time is the time between the appearance of the first bud and the last bud (Diatta *et al*., 2007). The number of germinated seeds was noted each day, as well as the number of cuttings that had resprouted. The maximum resprouting rate corresponds to the species' resprouting capacity or cutting capacity. The emergence rate (ER) or recovery rate (RR) was calculated by applying the following formulae:

$$\text{RR (\%)} \frac{\text{number of resprouted cuttings}}{\text{total number of cuttings}} \times 100$$

Fig. 1. Cuttings of *Desmodium adscendens*

Fig. 2. *Desmodium adscendens* seed with its shell (pod)

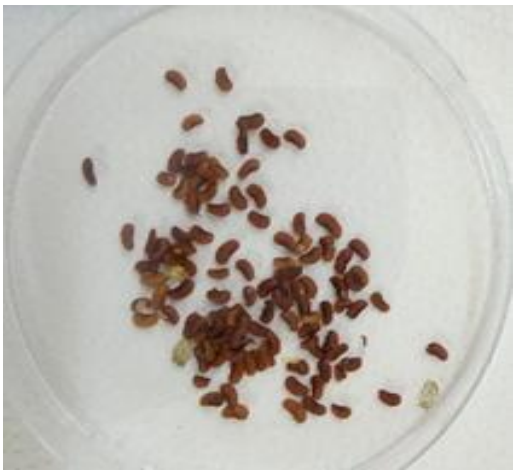

Fig. 3. *Desmodium adscendens* seeds without envelope

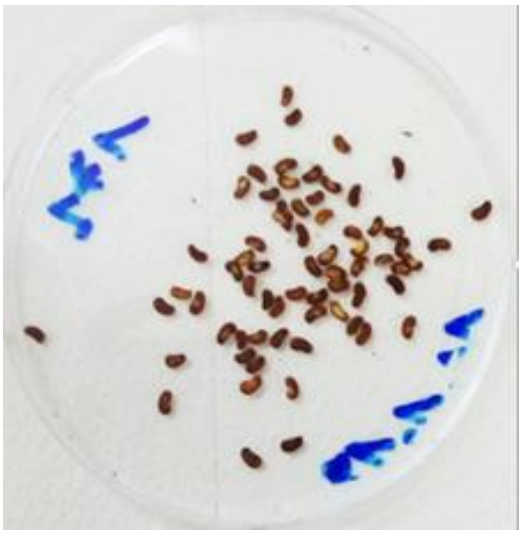

Fig. 4. Scarified *Desmodium adscendens* seeds

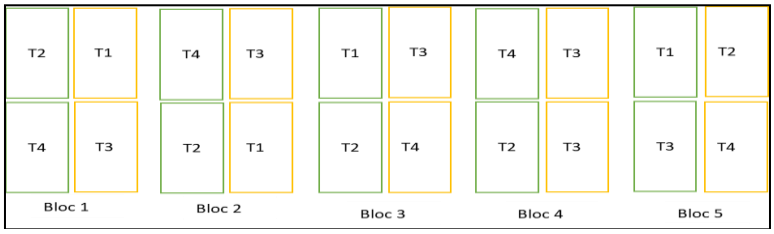

Fig. 5. Schematic diagram of the experimental set-up

2.6.2 Height, number of leaves emitted and number of branches

Plant height (L) was measured using a tape measure from the crown to the apex. The number of branches (NR) on the plants was assessed each week. The number of leaves per plant was assessed each week.

2.6.3 Biomass

At the end of the experiment, 10 plants per treatment were collected and their total above-ground and below-ground biomass was determined using a precision balance. The plants were then oven-dried at 50°C until a constant mass was obtained, which was taken as the dry mass. The ratio of dry mass to fresh mass was then calculated using the following formula:

$$\text{MD/MF (\%)} = \frac{\text{Mass of dry matter}}{\text{Mass of fresh material}} \times 100$$

This ratio indirectly reflects the amount of water present in the plants.

2.6.4 Length of growing cycle

The length of the *Desmodium adscendens* growing cycle was determined from the date the cuttings were transplanted until harvest. It considers the vegetative growth phase and the flowering/fruiting phase. The vegetative growth phase begins as soon as the cuttings are transplanted and ends at flowering. The flowering/fruiting phase follows on from the vegetative growth phase and ends when the pods are harvested. The durations are estimated in days.

2.6.5 Data analysis

All the experimental data collected were analysed using STATISTICA 7.1 software. Analyses of variance were performed on each of the parameters measured to study the effect of the different treatments used. Homogeneous groups were obtained using the Newman-Keuls test at the 5% threshold in the event of a significant effect of the factor studied.

3. RESULTS

3.1 Effect of Treatments on Germination Time and Germination Rate

Analysis of variance showed significant differences between germination rate ($F = 6.096$; $p = 0.002$) and emergence time ($F = 6.096$; $p = 0.002$). Treatment T1 had the highest germination rate (Fig. 6), estimated at 96 %, while treatments T3 and T4 had a rate of less than 36 %. The intermediate group was T2 with a rate of 66 %. In terms of germination time (Fig. 7), the pod treatment (T2) had the longest emergence time at 16 days. On the other hand, the lowest delay was observed in the T1 treatment with a delay of 4.25 days. The seed (T3) and scarified seed (T4) treatments formed the intermediate group, with emergence times of 11.5 and 9.44 days respectively.

3.2 Plant Height

The effect of the different seeds used on plant height during the vegetative growth phase is shown in Fig. 8. In the T1 treatment, plant height increased rapidly, reaching a value of over 20 cm at 8 weeks. On the other hand, the average height of plants from T2, T3 and T4 increased progressively to reach a lower value at week 8. This situation continued until the 9th week. The differences ($F = 5.124$; $p = 0.002$) between the mean heights of the plants appeared from week 4 onwards. In general, comparison of the averages showed that the average height of plants grown from cuttings was higher than that of plants grown from the other treatments.

3.3 Number of Leaves

The curves showing the variation in the number of leaves as a function of time show two phases

(Fig. 9). Analysis of the results showed curves with an increasing trend in the number of leaves as a function of the treatments. Overall, between weeks S1 and S6, the curves evolved in a similar way, ranging from a stage of one leaf to 8 leaves. From S7, treatment T3 stood out until week S10, when the number of leaves rose from 8 to 41. The other treatments had statistically identical results.

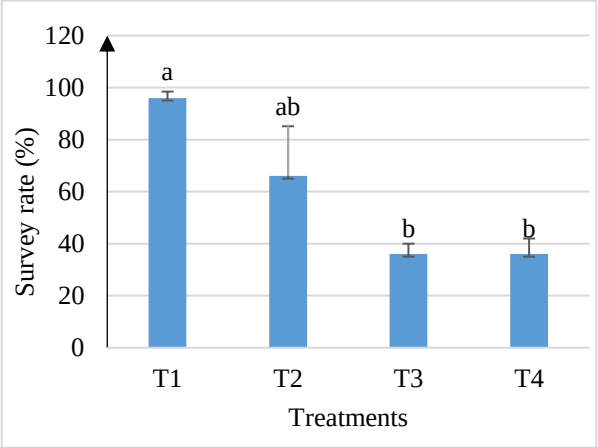

Fig. 6. Germination rate according to treatments

Bars surmounted by the same letter are not significantly different at the 5% threshold according to the Newman-Keuls test (T1= Cuttings T2=Pods containing one seed each T3=Seeds T4=Scarred seeds)

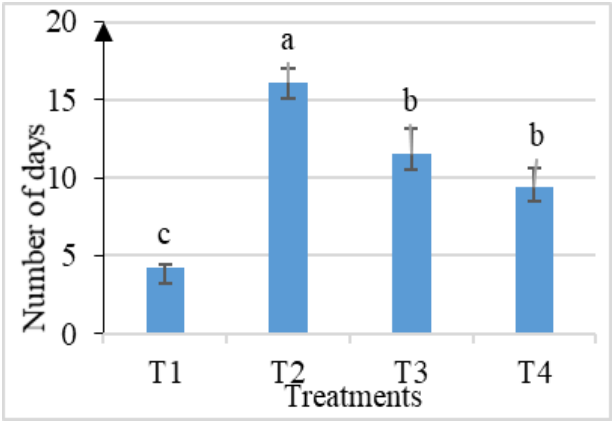

Fig. 7. Germination time according to treatments

Bars surmounted by the same letter are not significantly different at the 5% threshold according to the Newman-Keuls test (T1= Cuttings T2=Pods containing one seed each T3=Seeds T4=Scarred seeds).

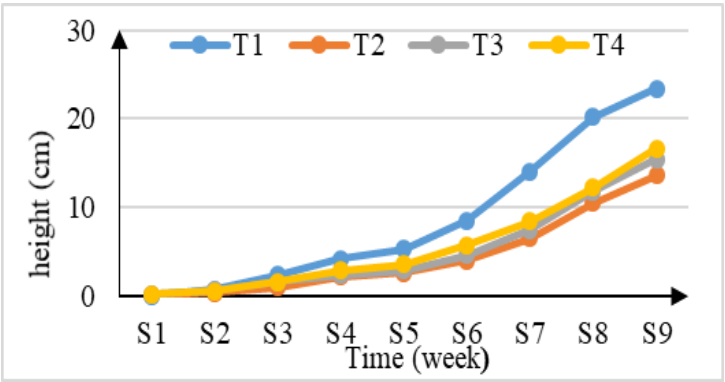

Fig. 8. Growth in plant height as a function of treatments

3.4 Number of Branches

The shape of the curves shows the same trends whatever the type of seed. The differences in the curves appeared from week 1 of the trial. The time between planting and the appearance of the first branches corresponds to the lag time. Treatment T1 had a shorter lag time, with 2 branches at S1 and up to 10 branches at S10. From S3 to S10, treatments T2 and T4 showed intermediate growth, with 11 and 9 branches respectively. Treatment T2, on the other hand, showed little change in branching and remained well below the other curves. The number of branches varied between 1 and 6 on average for T2 (Figs. 10 and 11).

3.5 Above-Ground and Root Biomass of Plants from the Treatments

Analysis of the results showed a difference between the treatments. In terms of above-ground biomass, treatment T1 produced the highest mass at 14 g/plant, while a low value of 5.22 g/plant was recorded for treatment T2. Treatments T3 and T4 had intermediate values, estimated at 7.43 g/plant. Root biomass was low, with values ranging from 0.26 to 1.1 g/plant. Treatment T1 (1.1 g) had the highest root mass. However, the other treatments had statistically identical masses. For stems, treatments T2, T3 and T4 had statistically identical masses of between 4.9 and 7.18 g/plant. Above-ground stem biomass was higher in treatment T1, with an estimated average mass of 13 g/plant (Fig. 12 and 13).

3.6 Reproduction Cycles of *Desmodium adscendens* Crops

Treatment T1 had the shortest cycle length with 66 days covering the period from transplanting of cuttings to pod ripening and harvesting. Treatment T2, on the other hand, had the longest cycle with 127 days. The development stage was more advanced in plants from treatment T1 and was late in treatments T2, T3 and T4. In terms of the time taken for cuttings to recover, treatment T1 took 4.25 days, while treatments T2, T3 and T4 took 16, 11 and 9 days respectively. As for leaf emission, treatment T1 began on the 10 th day whereas that of T2, T3 and T4 were observed on the 21 th, 16 th and 15 th day respectively. The duration of plant growth was shorter for T1 while it was longer with the T2 treatment. As regards branching, it began on day 22 for T1, whereas for plants that received treatments T4, T2 and T3, it began on day 31, 39 and 33 respectively. The T1 plants flowered on day 52th and the T2 plants flowered on day 117th. Plants from T3 and T4 flowered on days 103 and 101 respectively. With the plants from T2, flowering occurred on day 117.

4. DISCUSSION

Our results showed that growth parameters varied according to seed type.

4.1 Germination Time and Rate

The germination time was very short, only 5 days for the cuttings. This rapid recovery proves that *Desmodium adscendens Sw* cuttings have the ability to flourish and this would be due to the presence of reserve substances necessary for the formation and development of roots and shoots (Diop *et al.,* 2012). Furthermore, the seeds germinated after 14 days and the best results were recorded for scarified seeds. This can be explained by the fact that scarification lifted integumentary dormancy. The integuments limit exchanges between the embryo and the outside world, depriving it of the elements essential for germination and only allowing germination when environmental conditions are favourable (Zoulikha and Latifa 2019).

4.2 Height, Number of Leaves and Number of Branches

Plant height growth, number of leaves and number of branches were greater with cuttings. The results showed that plants grown from cuttings had the highest height growth. This could be explained, on the one hand, by the rapid recovery of the cuttings and the long recovery of the seeds. On the other hand, it would be due to the effect of 40% shade, which would be the best for ensuring stem growth and development (Silué *et al*., 2017). In fact, *D. adscendens* is a shade plant for which the low intensity of light favours significant transport and high activity of certain growth substances, including natural auxin, or IAA, which in the presence of light is photo-oxidised by a photo-sensitiser such as riboflavin. These substances encourage cell elongation and therefore the growth in height of the plants. In addition, plants from cuttings produced more branches than plants from the other treatments (Diop *et al*., 2012). In addition, the combination of reduction and shading allowed leaf growth in *Desmodium adscendens* plants from the different treatments.

All the plants from the cuttings produced the same number of leaves on average. This would be due to the fact that plants in the shade invest more in leaves in order to intercept more light than plants in the light. These results are justified by the work of Dreyer *et al* (2005) who showed that shade plants grow better in the shade than in the light by investing more in their leaves than sun species.

4.3 Biomass and Length of Growing Cycle

Above-ground, root and total biomass were highest in plants grown from cuttings. This is explained by the abundant presence of leaves, which are responsible for photosynthesis, which requires light, CO2 and mineral elements to function, resulting in high biomass production. As far as the growing cycle is concerned, the results showed that the plants grown from the seeds used completed their cycle earlier. Plants grown from cuttings had early phrenological stages, whereas seedlings had late phrenological stages. These results are corroborated by the observations of Reinhard (2010), Reinhard and Tianasoa (2010) and Sujatha and Mukta (1996) on Jatropha curcas, which show that plants from cuttings have the same genetic programme as their mother plant and enter production relatively early, following the crop calendar of the original plant.

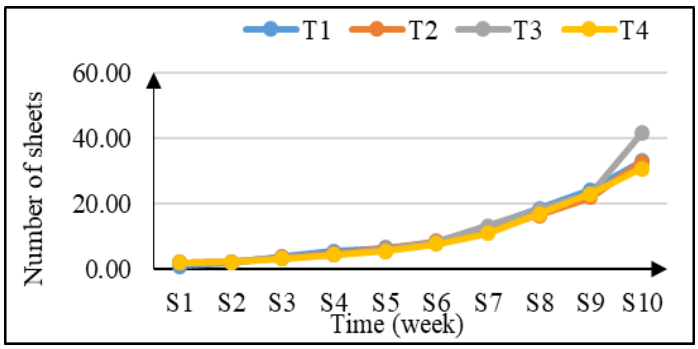

Fig. 9. Changes in the number of leaves as a function of treatments

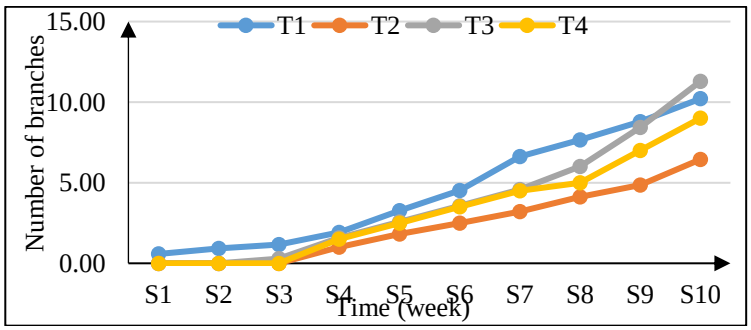

Fig. 10. Changes in branching as a function of treatments

Fig. 11. Appearance of *Desmodium adscendens* plants 60 days after sowing

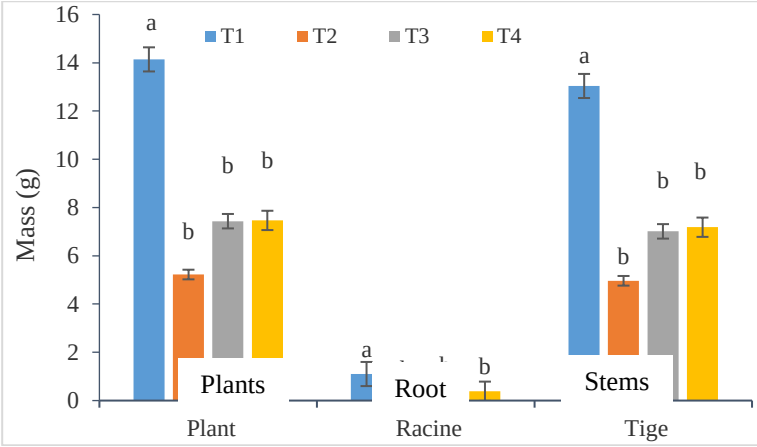

Fig. 12. Above-ground and root biomass of treated plants

Fig. 13. *Desmodium adscendens* plants aged 70 days according to treatments

5. CONCLUSION AND PROSPECTS

The study focused on the domestication of *Desmodium adscendens* by vegetative propagation and by seed. It was found that cuttings performed better than seedlings in terms of germination time, germination rate, height, number of leaves emitted, number of branches and biomass. This resulted in earlier phrenological stages and better performance in terms of growth and development parameters. Plants grown from seeds performed satisfactorily, with late phenological stages due to integumentary dormancy. In view of these results, both types of *Desmodium adscendens* seed can be recommended for domestication.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Benbrook C.M. 2016. Trends in glyphosate herbicide use in the United States and globally.

Dembélé C. 2012. Preliminary study of the potential for propagation by cuttings of Anogeissus leiocarpus (DC) Guil.ET PERR. Influence of the physiological state of cuttings and regulators, Mali, 63p.

Diatta S., Houmey V. K., Akpo L. E., Kabore-Zoungrana C. Y., Banoin M. 2007. Potential for cuttings in Maerua crassifolia Forssk., Capparaceae, a Sahelian woody forage plant. Afrique Science, 03(2): 271 – 280

Diop B., Samba A, N, S. and Léonard E. A. 2012. Morphological characteristics and growth of young plants of Jatropha curcas L. Int. J. Biol. Chem. Sci. 6(2): 677-691

Dreyer E., Collet C., Montfied P. & Sinoquet H. 2005. Characterization of the shade tolerance of young beech seedlings and comparison with associated species. The future of beech in the French forest, 57 (2): 177-180.

Kalingani A., Uwamariya A., Larwanou M. 2007. Production of agroforestry plants. ICRAF Technical Note 1. Nairobi: 47p Malezieux E, Crozat Y, Dupraz C, Laurans M, Makowski D, Ozier-Lafontaine H 2009. Mixing plant species in cropping systems: concepts, tools and models. A review Agronomy for Sustainable Development 29: 43-62.

Manzione,M. G., Herrera-Bravo, J., Sharifi-Rad, J., Kregiel, D., Sevindik, M., Sevindik, E., Salamoglu, Z., Zam,W., Vitalini, S., Hano, C., Kukula-Koch,W., Koch,W., & Pezzani, R. (2022). Desmodium adscendens (Sw.) DC.: A magnificent plant with biological and pharmacological properties. Food Frontiers, 1–12. https://doi.org/10.1002/fft2.170

McKnight Foundation, 2020. Soil Health Assessment Manual Transversal Soil Project, https://www.ccrp.org/wpcontent/uploads/2020/06/manuel_francais_versionfinal_sv2_mars2020_changesacceptees-6.pdf, 90p Hergoualc'h K, Skiba U, Harmand JM, Henault C, 2008. Fluxes of greenhouse gases from Andosols under coffee in monoculture or shaded by Inga densiflora in Costa Rica. Biogeochemistry 89:329-45.

Pierre T., Jaqueline R., Philippe L., Dominique A-D., Michel P., Claudine R., Geneviève B 2015. Desmodium adscendens. From traditional Cameroonian use against hepatitis to the accompaniment of chemotherapy. Hegel Vol. 5 No. 4.

Rama M. S., Temasoa Y., Miana L. P., Razafinirina E. I., Roukia D 2020. Evaluation of the healing activity of desmodium velutinum (fabaceae) in rats. Revue des Sciences, de Technologies et de l'Environnement (2020) Volume 2.

Ratnadass A, Fernandes P, Avelino J, Habib R, 2012. Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: a review. Agronomy for Sustainable Development 32: 273-303 Reinhard K. H. 2010. Identification, selection and multiplication of high yielding Jatropha curcas L. plants and economic key points for viable Jatropha oil production costs. Henning paper.

Reinhard K.H., Tianasoa R. 2010. The Jatropha manual for Madagascar, Marovoay; http://www.jatropha.de/documents/. Accessed 08-02-2020 Rosenn L.P, Denis R. 2004. ABC of cuttings. RUSTICA Edition, 223p.

SILUE P. A, Konan É. K, Kouadio A. D. K and Dodiomon S. 2017. Germination qualities of seeds and growth of seedlings of Isoberlinia spp. in a controlled environment (nursery). Int. J. Biol. Chem. Sci. 11(1): 93-106, February 2017 ISSN 1997-342X (Online), ISSN 1991-8631 (Print)

Sujatha M, Mukta N., 1996. Morphogenesis and plant regeneration from tissue cultures of Jatropha curcas. Plant Cell Fabric Org. Cult. 44:135-141.

Vilna T. 2020. Desmodium, an effective cover plant to control weeds in banana crops Remarkable Practical Sheet - DEPHY FERME - December 2020, https://ecophytopic.fr/dephy/prevenir/le-desmodium-une-plante-de-couverture-efficace-pour-lutter-contre-les-herbes

Zoulikha L and Latifa T 2019. Study of the germination ability and the lifting of dormancy of seeds of the perennial Saharan spontaneous species most grazed by the dromedary. Academic Master's Thesis, Kasdi Merbah Ouargla University Faculty of Natural and Life Sciences Department of Agronomic Sciences 53p

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