International Journal Semiarid

EVALUATION OF SUBSTRATES IN EMERGENCE AND INITIAL GROWTH OF MERRY WIDOW (*Cryptostegia madagascariensis* Bojer ex Decne) (PERIPLOCOIDEAE, APOCYNACEAE)

Hoga Gomes de Paiva
Instituto Federal de Educação, Ciência e Tecnologia do Ceará | Campus Sobral
ORCID: https://orcid.org/0000-0001-8292-1126

Samili Pinto Ximenes
Instituto Federal de Educação, Ciência e Tecnologia do Ceará | Campus SobralA
ORCID: https://orcid.org/0000-0002-7789-6242

Francisco José Carvalho Moreira
Instituto Federal de Educação, Ciência e Tecnologia do Ceará | Campus Sobral
ORCID: https://orcid.org/0000-0001-5317-5072

Luís Gonzaga Pinheiro Neto
Instituto Federal de Educação, Ciência e Tecnologia do Ceará | Campus Sobral
ORCID: https://orcid.org/0000-0002-7485-7299

RESUMO:
C. madagascariensis é uma invasora altamente adaptada ao Semiárido, sendo amplamente disseminada através dos cursos d'água pelo vento e fomentada pelo homem, particularmente por sua popularidade como planta ornamental, devido a sua folhagem permanente ao longo do ano e floração lilás intensa. O objetivo deste trabalho foi avaliar a germinação e o desenvolvimento inicial de viúva alegre em diferentes substratos. Para tanto, montou-se um ensaio em Delineamento Inteiramente Casaualizado (DIC), com 12 tratamentos, que consistia dos tipos de substratos (areia; solo; esterco caprino; bagana; pó de coco; areia + esterco; areia + pó de coco; areia + bagana; solo + esterco; solo + pó de coco; solo + bagana e solo + esterco + bagana) em 4 repetições de 16 sementes. Utilizou-se bandejas de isopor de 128 células, contendo os respectivos substratos, sendo semeada uma semente por célula. Aos 20 dias após a semeadura, procedeu-se à avaliação final, mensurando-se: percentagem de emergência, altura da planta; número de folhas; diâmetro do caule; comprimento da raiz; peso seco da parte aérea; peso seco da raiz; índice de qualidade de Dickson. De posse dos resultados, observou-se que os substratos bagana e pó de coco proporcionaram melhores resultados para a germinação. Nos substratos simples bagana e pó de coco e nas misturas areia + esterco caprino, areia + pó de coco + solo foram observados os valores mais expressivos para todas as variáveis estudadas.
Palavras–chave: *Stand*; Planta daninha; Biotecnologia; Inibidores de proteases.

EVALUATION OF SUBSTRATES IN EMERGENCE AND INITIAL GROWTH OF MERRY WIDOW (*Cryptostegia madagascariensis* Bojer ex Decne) (PERIPLOCOIDEAE, APOCYNACEAE)

ABSTRACT: *C. madagascariensis* it is an invader highly adapted to the Semiarid, being widely disseminated through the windy watercourses and fostered by man, particularly for its popularity as an ornamental plant, due to its permanent foliage throughout the year and intense lilac flowering. The objective of this work was to evaluate the germination and initial development of a cheerful widow in different substrates. To this end, a trial was set up in A Fully Casaualizaded Design (Dic), with 12 treatments, which consisted of the types of substrates (sand; soil; goat

manure; bagane; coconut coir fiber; sand + manure; sand + coconut coir fiber; sand + bagane; soil + manure; soil + bagane and soil + manure + bagane) in 4 replicates of 16 seeds. Sofoe trays of 128 cells were used, containing the respective substrates, sown one seed per cell. At 20 days after sowing, the final evaluation was carried out, measuring: percentage of emergence, plant height; number of leaves; stem diameter; root length; dry weight of shoot; dry root weight; Dickson's quality index. With the results, it was observed that the substrates bagane and coconut coir fiber provided better results for germination. In the simple bagane substrates and coconut coir fiber and in the mixtures sand + goat manure, sand + coconut coir fiber + soil were observed the most expressive values for all variables studied.
Key-words: Stand; Weed; Biotechnology; Protease inhibitors.

INTRODUÇÃO

The Merry Widow (*Cryptostegia madagascariensis* - Apocynaceae) is a plant originally found on the island of Madagascar, Africa, and stands out mainly for the size of the fruits and the shape of the corona. It is also known as devil's nail, dog's nail, girl's nail, frog vine, widow and dandelion.

It is a latescent, shrubby and climbing plant, opportunistic, developing branches that can reach considerable heights, appropriating other plants as support (VIEIRA et al., 2004). They have tipsian top inflorescences, flowers with five green sepals, five rose petals and five corona elements. Its fruits are dry, deiscent, with a longitudinal dehiscence and the seeds as comosas, with the wind as the main disperser (LORENZI; SOUZA, 1999).

In a wide-ranging review conducted by Klackenberg et al. (2001) it is reported that latex of *C. madagascariensis* has been used in India in Madagascar for the production of rubber articles; in addition, its fibers have been used to make threads and cables for the manufacture of fishing nets. Another important information is that due to the production of this milky latex in abundance, there are reports of poisoning of animals, such as cattle and horses.

The insertion of these species in Brazil will begin with the colonial process of America by European sailors. He arrived in Brazil for ornamental purposes, but soon became a problem due to its rapid dispersion. According to Grice (1996) he points out that in a reproductive episode this species can disperse 8,000 seeds and more than 90% of them can germinate in favorable environments in northern Australia. In studies conducted in the state of Ceará, Lopes et al. (2018) found that the fruits of a cheerful widow presented an average of 115 seeds, with viability greater than 85%; in addition, another troubling information brought by Araújo et al. (2019), this is the fact that the seeds of a cheerful widow were tolerant to the three salts (NaCl, KCl and $CaCl_2$) in the studied salinity levels (0.0; 1.5; 3.0; 4.5 and 6.0 dsm^{-1}), which refers to a concern regarding its germination potential and dissemination even in adverse conditions, in which many of the native plants of the region do not achieve the same feat and end up not doing.

Due to its milky sap, it was believed in its potential for rubber production, and due to its ability to disperse anemocoria, its aggressiveness and ease to adapt, it quickly prosated and puts at risk native species (SARAIVA, 2016). The latex produced by *C. madagascariensis* has been used for the production of rubber articles in India and Madagascar, where fibers have been used to make threads and cables for the manufacture of fishing nets (KLACKENBERG, 2001, *apud*. NUNES, 2014)

In Brazil, the plant occurs mainly in the northeastern states, especially in Ceará, Maranhão and Pernambuco (ARAUJO, 2011; SOUSA et al., 2013). The invasion of the species is worrisome in humid areas, such as river banks and flooded areas. This same environment is occupied by carnauba (*Copernicia prunifera*), a palm tree with significant economic importance, especially for low-income rural populations, and it also has cultural and environmental importance (CARVALHO, 2008, *apud*. SARAIVA, 2016).

Characteristics such as drought resistance, flooding and even to places with high salinity make this species an invasive with high capacity to proliferate in several ecosystems. Even in places with low light availability, *C. madagascariensis* can modify its form of biomass growth and translocation to adapt to the environment (BRITO, 2015 *apud*. SARAIVA, 2017)

As man-made exotic species manage to form self-sustaining populations they are now called established species. Some of the established species become able to advance on natural and altered environments, becoming invasive alien species (ZALBA, 2005). Invasive alien species exhibit high capacity for competition and adaptation. Competition with native species benefits from the fact that the invasive species does not find in the new environment the predators, parasites and competitors it had in its area of origin (ZILLER, 2002).

In recent years, there has been an intensified interest in the propagation of both native and exotic adapted species, due to the need for recovery of degraded areas and recomposition of the landscape. However, there is not enough knowledge for the management and analysis of the seeds of most of these species, in order to provide data that can characterize their physical and physiological attributes. There is also a need to obtain basic information about the germination, cultivation and potential of these species, aiming at their use for the most diverse purposes (ARAÚJO NETO et al., 2003).

In a test observed the germination and initial growth of bean data from different alternative substrates, it can be concluded that the use of mixtures with two substrates: sand + goat manure, soil + manure, sand + coconut and goat coir fiber and soil + coconut coir fiber provided excellent emergence and seedlings of *Dimorphandra mollis* developed with greater vigor (MOREIRA et al., 2019).

In another test carried out that aimed to evaluate the percentage of emergence of seedlings of jealousy (*Calotropis procera*) and its initial growth different substrates in order to determine which substrate presents the best behavior for this species, after the tests we can conclude that the substrates when combined with coconut fiber, bagane and goat manure provided better conditions of vigor and better development of the aerial part of the jealousy plants (MOREIRA et al., 2017).

The germination process begins with the absorption of water by the seed and ends with the beginning of embryonic axis elongation, and can be identified by the protrusion of the radicle of the embryo (BEWLEY; BLACK, 1994). Temperature, together with substrate moisture and light, are the main factors that influence seed germination.

Despite the considerable increase in data on seeds of native species, however, many still lack basic information regarding the ideal germination conditions. This statement can be verified in the Rules for Seed Analysis (Brazil, 2009), where few recommendations or prescriptions for analysis of native species are found. Figliolia et al. (1993) pointed out that these analyses are of paramount importance, because they provide data that express the physical and physiological quality of the seeds. In this case the species *C. madagascariensis* is included, in which the optimal substrate for germination is unknown, which impairs the evaluation of seed quality, especially when it is necessary to compare results obtained in different laboratories or lots.

Among the main aspects of relevance for seedling formation, the substrate is one of them. There are different types of organic materials that can be used as substrates, as an example we have corral manure, rice husk, among others. However, we will have some difficult to obtain when it comes to large-scale production, besides being sources of inoculars and weed vectors. These factors will directly influence germination due to its structure, aecization, water retention capacity, propensity and among others. These factors may influence or impair seed germination. It constitutes the physical support on which the seed is placed and has the function of maintaining the appropriate conditions for germination and seedling development. Therefore, the type of substrate used should be appropriate to the physiological requirements of germination, size and shape of the seeds (BRASIL, 2009).

The substrate for plants can be understood as the means in which the roots of plants grown outside the soil in situ are developed, having as its primary function, to provide support to the plants grown in it (KÄMPF, 2000; RÖBER, 2000), and can also regulate the availability of nutrients and water (FONTENO, 1996). In this context, it is recommended in agricultural production the use of artificial substrates as a means of rooting, growth and production of plants. Therefore, when seed propagation is performed, the substrate is extremely important for seedling formation (MOREIRA et al., 2019).

Seed germination can happen in any material that provides sufficient water reserve for the germination process, however, the results obtained can be varied according to each methodology in substrate in its simple form or in mixtures (LAVIOLA et al., 2005). However, it should provide ideal conditions for germination and development of the root system of the plant, present easy availability, absence of pathogens, richness in essential nutrients, adequate pH, good texture and structure (SILVA et al., 2001).

According to Vale et al. (2004), the substrate plays a fundamental role in the production of quality seedlings, since it has a marked influence on root system architecture and plant nutritional status. The best substrates should present, among other characteristics, absence of pathogens, richness in essential nutrients, adequate texture, structure and pH, in addition to easy acquisition and transport (SILVA et al., 2001). Plus, that, Smiderle; Minami (2001) also recommend that a good substrate should also have water retention and porosity to provide oxygen diffusion necessary for germination and root respiration.

The germination test is the main parameter used to evaluate the physiological quality of the seeds and allows to know the germination potential of a lot under favorable conditions, the results of the tests are used to determine the sowing rate, for the comparison of the value of lots and for commercialization, because it allows obtaining comparable results between laboratories (CARVALHO; NAKAGAWA, 2000).

In view of the above, the objective of this work was to evaluate seed germination and the initial development of *C. madagascariensis* in different substrates.

MATERIAL AND METHODS

The test was carried out in Green House and at the Laboratory of Plant Health and Seeds, at the Federal Institute of Education, Science and Technology of Ceará, Sobral campus, located in the geographical coordinates (Latitude - 03°4" S and Longitude - 40°14" W). The climate is classified according to Köpeen as, semi-arid rainy hot tropical with average annual rainfall of 854 mm, average temperature of 30 °C and altitudes of 70 meters. The trial was conducted from January 24 to February 14, 2018.

Ripe fruits were collected in cultivated areas, where these plants are considered weeds, in the district of Gado Bravo, municipality of Marco-CE, in January 2018. After collection, the fruits were taken to the Plant Health and Seeds Laboratory of IFCE, in Sobral, where the seeds were manually extracted, cleaned, selected and stored in a refrigerator until the beginning of the experiment.

The seeds were placed to germinate in 12 types of substrates, which are: 1. sand; 2. Soil; 3. Goat manure; 4. Bagane; 5. Coconut coir fiber; 6. Sand + manure; 7. Sand + coconut coir fiber; 8. Sand + bagane; 9. Soil + manure; 10. Soil + coconut coir fiber; 11. Soil + bagane; 12. Soil + manure + bagane. Sofoe trays of 128 cells were used, containing the respective substrates, sown one seed per cell.

At 20 days after sowing, the final evaluation of the test was performed, in which the following were measured: percentage of emergence (%EMER), which was calculated according to Labouriau & Valadares (1976), the emergency velocity index (IVE) according to Maguire (1962) and the mean time of emergence (TME) was calculated according to Labouriau (1979). Of the development variables, analyzed: plant height; number of leaves; stem diameter; root length; dry weight of shoot; dry root weight; Dickson's quality index.

The trial was conducted in a Completely Randomized Design (IHD) with 12 treatments, which are: 1. sand; 2. Soil; 3. Goat manure; 4. Bagane; 5. Coconut coir fiber; 6. Sand + manure; 7. Sand + coconut coir fiber; 8. Sand + bagane; 9. Soil + manure; 10. Soil + coconut coir fiber; 11. Soil + bagane; 12. Soil + manure + bagane, with 4 replicates of 16 seeds each.

The data obtained were tabulated in an Excel spreadsheet©. With the means, the Variance Analysis and the F test were performed for the comparison of the means. When the results showed significance, the means were compared by the Tukey test at 1.0% probability. The results were expressed in Tables.

RESULTS AND DISCUSSION

This seed lot presented a weight of 1,000 seeds of 17.35 g and moisture of 11.2%. The weight of 1,000 seeds is considered as an important data that provides an indication of the quality of a given seed lot and generates information to calculate the sowing density. This variable has greater importance within seed analyses and serves as a base value, which allows quality control for batch evaluation (Santos et al., 2014). While the water content of seeds is one of the factors that most interfere in the maintenance of pure physiological quality, the lower the lower the seed longevity (ANTUNES et al., 2010).

Table 1 shows the summary data of the analysis of variance of emergence percentage (%E), plant height (AP), number of leaves (NF), stem diameter (DC), root length (CR),

International Journal Semiarid

Dickson quality index (DQI), shoot dry mass weight (PMSPA) and root dry mass weight (PMSR), as a function of 12 substrates studied, in which it was observed that the treatment with the substrates was significant (p≤0.01) for all variables studied.

Table 1. Summary of Variance Analysis with mean squares and CV (%) of the variables percentage of emergence (%E), plant height (AP), number of leaves (NF), stem diameter (DC), root length (CR), Dickson quality index (IQD), shoot dry mass weight (PMSPA) and weight of root dry mass (PMSR), as a function of 12 substrates studied. IFCE - *campus* Sobral, Sobral-CE, 2022.

Sources of variation	GL	Medium Squares							
		%E	AP	NF	DC	CR	IQD	PSPA	PSR
Substrates	11	1928,850**	2,90401**	2,37322**	0,29731**	6,68402**	0,00048**	0,01624**	0,00184**
Residue	36	90,6030	0,39661	0,27463	0,04766	0,36550	0,00008	0,00261	0,00015
Total	47	-	-	-	-	-	-	-	-
CV (%)	-	12,87	17,22	18,84	15,48	17,66	36,81	25,16	24,80

** - values to 1.0 by F-Test.

According to Nassif et al. (2004), seed germination is influenced by environmental factors, such as temperature and substrate, which can be manipulated in order to optimize germination, as well as speed and uniformity, resulting in obtaining more vigorous seedlings and reducing production costs.

Figure 1 shows the germination behavior of cheerful widow seeds in the 12 substrates evaluated (1. sand; 2. Soil; 3. Goat manure; 4. Bagane; 5. Coconut coir fiber; 6. Sand + manure; 7. Sand + coconut coir fiber; 8. Sand + bagane; 9. Soil + manure; 10. Soil + coconut coir fiber; 11. Soil + bagane; 12. Soil + manure + bagane).

Figure 1. It presents the cheerful widow plants on the respective substrates, as follows the order. 1. sand; 2. Soil; 3. Goat manure; 4. Bagane; 5. Coconut coir fiber; 6. Sand + manure; 7. Sand + coconut coir fiber; 8. Sand + bagane; 9. Soil + manure; 10. Soil + coconut coir fiber; 11. Soil + bagane; 12. Soil + manure + bagane. Photo: F. J. C. Moreira (2018).

In the observation of Table 2, we verify the average data of the variables percentage of emergence (%E), plant height (AP), number of leaves (NF), stem diameter (DC), root length (CR), Dickson quality index (DQI), shoot dry mass weight (PMSPA) and weight of root dry mass (PMSR), as a function of 12 substrates.

It was observed that the substrates tested isolated, bagane and coconut coir fiber and in the composition of mixtures sand + goat manure, sand + coconut coir fiber and soil + coconut coir fiber were observed the most expressive values for all variables studied.

The substrates and mixtures most satisfactory to the germination of the seeds of the merry widow can be attributed to the low density of these materials and the good water absorption capacity, thus not requiring daily reumding, according to (LIMA et al., 2011).

Table 2. Mean values of the variables percentage of emergence (%E), plant height (AP), number of leaves (NF), stem diameter (DC), root length (CR), Dickson quality index (DQI), shoot dry mass weight (PMSPA) and root dry mass weight (PMSR), as a function of 12 substrates. IFCE - *campus* Sobral, Sobral-CE, 2022.

Substrates	Variables analyzed							
	%E	AP	NF	DC	CR	IQD	PSPA	PSR
Sand – A	81,3bc	3,71a	3,3a	0,66b	4,02a	0,0316a	0,2102a	0,0666a
Soil – S	46,9e	2,75bc	2,2ab	0,48b	2,51b	0,0189bc	0,1425b	0,0383bc
Goat manure - EC	60,9cd	3,20ab	2,2ab	0,44b	2,02b	0,0127bc	0,1240b	0,0266c
Bagane - B	93,8a	4,62a	3,4a	0,48b	3,30b	0,0178bc	0,2318a	0,0392bc
Coconut fiber - PC	100a	4,69a	3,5a	0,71b	4,93a	0,0355a	0,2972a	0,0768a
A + EC	85,9ab	4,01a	3,3a	0,48b	3,74b	0,0187bc	0,1960a	0,0433b
A + PC	82,8bc	4,23a	3,4a	1,95a	4,98a	0,0422a	0,2616a	0,0651a
A + B	78,1bc	2,24bc	1,5b	0,26b	1,76bc	0,0119bc	0,1580b	0,0235c
S + EC	20,3f	2,38bc	1,3b	0,36b	1,57bc	0,0089d	0,0838c	0,0205c
S + PC	85,9ab	4,39a	3,4a	0,71b	5,32a	0,0376a	0,2535a	0,0879a
S + B	73,4cd	4,19a	3,0a	0,64b	2,91b	0,0264b	0,2494a	0,0517b
S + EC + B	78,1bc	3,49ab	2,8a	0,61b	4,03a	0,0267b	0,2269a	0,0493b
DMS	7,86	1,55	1,29	0,53	1,49	0,0218	0,1259	0,0300

Averages followed by the same letters in the columns do not differ by the Tukey test ($p \leq 0{,}01$).

One of the advantages of coconut coir fiber is that it has excellent physical and chemical qualities when used as substrate, such as high moisture retention, resistance to degradation, uniformity, being free of pathogens and weeds.

The presence of organic matter in the composition of the substrate is fundamental for the role it plays in the formation and stabilization of aggregates, improving porosity, benefiting aerobic conditions, drainage and water storage. Therefore, the use of organic materials in the composition of a substrate improves permeability, contributing to the aggregation of mineral particles and to acidity correction (MOREIRA et al., 2010).

It is notepoint that the substrate with this characteristic of being easily drainable is more effective, because it provides less difficulty to break the physical barrier, through the plight and also the radicle. In this sense, the results observed for coconut coir fiber and carnauba bagane and for the mixtures sand + goat manure, sand + coconut coir fiber and soil + coconut coir fiber confirm this hypothesis.

In an experiment carried out with 4 types of substrates: soil, washed sand, goat manure and wood sawdust, in proportional combinations. It was found that the variable plant height was higher in the substrate treatment corresponding to 50% manure, 25% soil and 25% sand, obtaining a value of 46.47 cm, possibly due to the chemical, physical and microbiological benefits provided by organic matter from manure and the soil itself present in the substrate, increasing plant growth. (NUNES, 2014).

Therefore, it is noted that *C. madagascariensis* has preference for substrates with higher levels of organic matter, in which it can settle in these environments more quickly. On the other hand, there was zero growth in the treatment composed of 100% sawdust, emphasizing the plant's requirement for good substrate conditions for this variable. According to Burés (1997), substrates with a high percentage of sawdust in their composition may present problems of excessive moisture retention, which decreases water availability and hinders seedling germination and development (NUNES, 2014).

For the number of leaves, a significant effect was found for the substrate and container factors at 1% probability by the F test. On the other hand, the lowest value was obtained in the substrate with 100% sawdust.

The root diameter was higher in the treatment containing 75% goat manure and 25% sand. However, two possibilities can be raised, the first is that this combination may have balanced the macro and micropore relationship resulting in better conditions for growth in root diameter, and the second is that the observed growth may be a result of root stress (TAIZ; ZEIGER, 2006). However, organic matter positively modifies soil physical characteristics, promoting aggregation of elementary particles, increasing structural stability, water permeability and reducing evaporation (CAVALCANTI, 2008 *apud* NUNES, 2014).

The treatment with 50% goat manure, 25% soil and 25% sand presented plants with the highest number of leaves, 10.6 per plant. On the other hand, the lowest value was obtained in the substrate with 100% sawdust. Several factors may be involved in favoring leaf emission, including the availability of nutrients that favor vegetative development, increasing the number of leaves per plant.

A better development of the stem diameter was noticed in the treatments: 50% soil, 25% sand, 25% manure; 50% manure, 25% soil, 25% sand; 75% manure, 25% soil; 75% manure, 25% sand and 100% manure substrate. It is important to highlight the presence of manure in all treatments, in this sense, this component may have contributed to water retention and nutrient availability (NUNES, 2014).

In the root length, a significant effect of the substrate x volume interaction was observed. It is observed that the highest value was observed in the composition of the treatment composed of 50% of soil, 25% of goat manure and 25% of sawdust in the highest volume of substrate. Possibly, sawdust improved aecization and water retention. According to Lima et al. (2006), substrate aecization is one of the most important factors involved in root growth. Klepper (1990) adds to us that the ability of the roots to explore the soil depends heavily on the chemical characteristics of the soil. The combination of organic matter with a uniform and homogeneous material provides the plant with good conditions of root development, favoring its fixation and subsequent dissemination of invasive in the environment (NUNES, 2014).

In another experiment carried out with jealousy (*Calotropis procera*), Moreira et al. (2018) evaluating substrates (sand, soil, goat manure, bagane, coconut fiber, sand + manure, sand + coconut fiber, sand + bagane, soil + goat manure, soil + coconut fiber, soil + goat manure + bagana), observed that the substrates that exhibited the best behavior for the species were these: sand; soil; bagane; sand + manure; soil + bagane; soil + goat manure + bagane, showed no differences between seedlings emerged in sand. The best percentage was obtained in the coconut fiber substrate. Which will ratify its adaptation in sandy soils. For plant height there were no significant differences between the substrates of sand and goat manure, which will be repeated in the substrates of sand + goat manure, soil + goat manure and soil + goat manure + bagane. The plants that obtained a higher number of leaves were recorded in the substrates (sand + bagane, soil + bagane and soil + goat manure + bagane), which indicates that the substrates that were mentioned did not offer variability for this variable. Thus, it can be affirmed that such substrates are convenient for the cultivation of this species in the semi-arid environment, where it can be used as a forage support for sheep feeding, since its leaves are rich in proteins (TORRES et al., 2010).

It was also found that root growth was higher in substrates corresponding to sand + bagana and soil + coconut fiber, which is linked to the granulometric conditions of the substrates. Because pores have a larger diameter, water is easily drained, a phenomenon in which it stimulates root growth. The lowest root growth was found in the goat manure substrate. According to Zietemaan and Roberto (2007), the substrate is intended to sustain the plants during rooting and serve as a source of nutrients for the plants, in addition to providing adequate aerunner, and satisfactory fluid retention capacity to obtain adequate moisture from the seedlings.

It was also observed that the highest values of development quality (DQI) were found in the substrates: sand, soil + coconut fiber and soil + bagana. This behavior is mainly due to the fact that the substrates presented higher percentages of aecization, which directly influences the morphology of the seedlings. The substrate that presented the lowest (DQI) was goat manure, which shows that the substrate mentioned cannot be used purely for the production of seedlings, because it has elements in its composition that instill the growth of jealousy.

Thus, it was proven that the substrates when combined with coconut fiber, baganand goat manure provided better conditions of development of the aerial part of the plants. The substrates not ideal for the emergence of jealousy plants are goat manure and soil + goat manure.

It is emphasized the importance of raising awareness among the viveiristas in the use of local raw materials, such as rice husk, sugarcane bagasse, pine husk, waste of paper production, fiber and coconut coir fiber, carnauba baganne, cotton and castor bean residues, among others. Fiber and coconut coir fiber, as well as carnauba bagane are abundantly found in Ceará, being important from an economic, social and environmental point of view.

CONCLUSIONS

The substrates bagane and coconut coir fiber were the ones that provided the best results for the germination of the seeds of a cheerful widow, reaching 93,8 and 100%, respectively;

The mixtures of substrates sand + goat manure, sand + coconut coir fiber + soil also provided excellent results for germination, reaching an average of 84%;

In the simple bagane substrates and coconut coir fiber and in the mixtures sand + goat manure, sand + coconut coir fiber + soil were observed the most expressive values for all variables studied.

ACKNOWLEDGMENTS

We thank the Federal Institute of Education, Science and Technology of Ceará – IFCE - *campus* Sobral and the Laboratory of Plant Health and Seeds for their support in conducting this essay.

REFERENCES

ANTUNES, C.G.C.; PELACANI, C. R.; RIBEIRO, R. C.; GOMES, H. L. R.; CASTRA, R. D. Influence of storage on physiological quality of *Caesalpinia pyramidalis* Tul seeds. Tree Magazine, v. 34, n. 6, 2010. DOI: https://doi.org/10.1590/S0100-67622010000600005

ARAÚJO NETO, J. C.; AGUIAR, I.B.; FERREIRA, V. M. Effect of temperature and light on seed germination of *Acacia polyphylla* D.C. Brazilian magazine of Botany, v. 26, n. 2, p. 249-256, 2003. DOI: https://doi.org/10.1590/S0100-84042003000200013

ARAÚJO, B. A.; ARAÚJO, D. A.; LOPES, A.A.S.; SILVA, M. E. S.; MOREIRA, F. J. C. Germination of cheerful widow (*Cryptostegia madagascariensis*) (Apocynaceae) under the effect of frogs. In: BRAZILIAN SYMPOSIUM OF NATURAL RESOURCES OF THE SEMI-RICH, 4 - IV SBRNS. **Annals**... (ISSN: 2359-2028), Crato, CE, UFC, 2019. Available in: https://drive.google.com/file/d/1tccL6Z1Hxug6_7i7--eEhjEtGVH27ZCs/view. Accessed: May 2022.

ARAÚJO, B. A.; MOREIRA, F. J. C.; GUEDES, F. L. Emergence and initial growth of guandu beans as a function of substrates and salinity of irrigation water. **Academic Agrarian Journal**, v. 2, n. 4, p. 90–101, 2019. Available in: https://agrariacad.files.wordpress.com/2019/07/rev-agr-acad-v2-n4-2019-p90-101.pdf. Access: jun. 2022.

BEWLEY, J. D.; BLACK, M. **Seeds**: physiology of development and germination. New York: Plenum Press. 445p. 1994.

BRAZIL. **Rules for seed analysis.** Ministry of Agriculture and Agrarian Reform - MAPA. Brasilia: LAVARV/ SNAD, 365p. 2009. Available in:

https://www.gov.br/agricultura/pt-br/assuntos/insumos-agropecuarios/arquivos-publicacoes-insumos/2946_regras_analise__sementes.pdf. Accessed: May 2022.

CARVALHO, N. M.; NAKAGAWA, J. **Seeds**: science, technology and production. 4ed. Jaboticabal: FUNEP, 588p. 2000.

FIGLIOLIA, M.B.; OLIVEIRA, E. C.; PIÑA-RODRIGUES, F. C. M. **Seed analysis**. In: AGUIAR, I. B.; PIÑA-RODRIGUES, F. C. M.; FIGLIOLIA, M. B. (Ed.). Tropical forest seeds. Brasília, DF: ABRATES, p. 37-74. 1993.

FONTENO, W. C. Growing media: types and physical/chemical properties. In: REED, D. W. (Ed.). **A growers' guide to water, media, and nutrition for greenhouse crops**. Batavia: Ball, p. 93–122. 1996.

IPECE - INSTITUTE OF RESEARCH AND ECONOMIC STRATEGY OF CEARÁ. Municipal basic profile - Sobral. Department of Planning and Management (SEPLAG). 18p. 2012. Available in: https://www.ipece.ce.gov.br/wp-content/uploads/sites/45/2013/01/Sobral.pdf. Accessed: May 2022.

KÄMPF, A. N. **Selection of materials for use as substrate**. In: KÄMPF, A. N.; FERMINO, M. H. Plant substrates: the basis of plant production in containers. Porto Alegre: Genesis, p. 139-146. 2000.

KLACKENBERG, J. **Revision of the genus *Cryptostegia* R. Br. (Apocynaceae, Periplocoideae)**. Adansonia, série 3, 23 (2): p. 205-218, 2001

LABOURIAU, L G. **Seed Germination**, Scientific Monographs, Washington, USA, 170p. 1983.

LABOURIAU, L. G.; VALADARES, M. B. **On the germination of seeds of *Calotropis procera***. Anais da Academia Brasileira de Ciências. v. 48, p.174-186. 1976.

LAVIOLA, B.G.; LIMA, P.A.; WAGNER JÚNIOR, A.; MAURI, A.L.; VIANA, R. S.; LOPES, J. C. Effect of different substrates on germination and initial development of jiloeiro (*Solanum gilo* Raddi), cultivar Verde Claro. **Science and Agrotechnology**, Lavras, v. 30, n. 3, p. 415-421, May/Jun., 2006. Available in: https://www.scielo.br/j/cagro/a/nMKrq7YdbkQhJfdzRPvG3wk/?lang=pt&format=pdf#:~:text=Para%20Toledo%20(1992)%2C%20um,loads%20positive%20to%20a%20plant. Access: jun. 2022.

LIMA, C. R.; PACHECO, M. V.; BRUNO, R. L. A.; FERRARI, C.S.; JUNIOR BRAGA, J. M.; BEZERRA, A. K. K. Temperatures and substrates in the germination of Seeds of *Caesalpinia pyramidalis* Tul. Brazilian Seed Magazine, vol. 33, no. 2, p.21-222, 2011. DOI: https://doi.org/10.1590/S0101-31222011000200003

LOPES, F. G. N.; ARAÚJO, D. A.; ARAÚJO, B. A.; SOUZA, A. A. L.; MOREIRA, F. J. C.; MARQUES, O. M. Biometrics of fruits and seeds of devil's nail (*Cryptostegia madagascariensis* Bojer ex Decne) (Periplocoideae: Apocynaceae). In: NORTH NORTHEAST CONGRESS OF RESEARCH AND INNOVATION, 12, XII CONNEPI. Annals... Recife, PE, IFPE, 2018.

LORENZI, H.; SOUZA, H. M. **Ornamental plants in Brazil**. 3. Ed. New Odessa: Plantarum Institute, 1120p. 1999.

MAGUIRE, J. D. Speed of germination aid in selection and evaluation for seedling emergence and vigor. **Crop Science**, Madison, v. 2, n. 2, p.176-77, 1962.

MIRANDA, S.C.; RIBEIRO, R. L. D.; RICCI, M.S.F.; ALMEIDA, D. L. Evaluation of alternative substrates for the production of lettuce seedlings in trays. Technical Communication, Ministry of Agriculture and Supply - MAPA. Brazilian Agricultural Research Company - EMBRAPA-Agrobiology. No. 24, Dec./98, p.1-6. Available in: https://ainfo.cnptia.embrapa.br/digital/bitstream/CNPAB-2010/27149/1/cot024.pdf. Accessed: May 2022.

MOREIRA, F. J. C.; LOPES, F. G. N.; SOUZA, A. A. L.; MARQUES, O. M.; ABREU, A. M. S.; PINHEIRO NETO, L. G. Initial growth of Fava D'anta (*Dimorphandra mollis* Benth.) in different alternative substrates**. Academic Agrarian Journal**. v. 2, n.6, Nov/Dec (2019). Available in: https://agrariacad.com/wp-content/uploads/2019/12/rev-agr-acad-v2-n6-2019-p101-110.pdf. Accessed: May 2022.

MOREIRA, F. J. C.; MENEZES, A. S.; NASCIMENTO, F. M. O.; SILVA, M. E. S.; PINHEIRO NETO, L. G. *Calotropis procera* (Ait.) Apocynaceae grown on organic substrates. **Green Journal of Agroecology and Sustainable Development**, v. 13, n. 2, p.260-264, 2018. Available in: https://www.gvaa.com.br/revista/index.php/RVADS/article/view/5645. Access: jun. 2022.

MOREIRA, M. A.; DANTAS, F.M.; BIANCHINI, G.G.; VIÉGAS, P. R. A. Production of eggplant seedlings using coconut coir fiber. **Brazilian Journal of Agroindustrial Products**, Campina Grande, v.12, n.2, p.163-170, (Supplement - CD Rom). July 2010.

NUNES, R. C. R. **Initial growth of the invasive *Cryptostegia madagascariensis* Bojer ex Decne. different substrates**. 33f. Monograph. Graduation in Agronomic Engineering. Sand, Center for Agrarian Sciences, UFPB, August 2014.

RÖBER, R. **Horticultural substrates: possibilities and limits of their composition and use: examples of research, industry and consumption**. In: KÄMPF, A. N.; FERMINO, M. H. (Eds.). Substrates for plants: the basis of plant production in containers. Porto Alegre: Genesis, p.209–215. 2000.

SANTOS, J. C. C.; SILVA, C. H.; SANTOS, C. S.; SILVA, C.S.; MELO, E. B. Moisture content, weight of one thousand seeds and germination of catingueira. **Revista**

Verde (Mossoró - RN), v. 9, n. 2, p. 364 - 367, 2014. Available in: https://www.gvaa.com.br/revista/index.php/RVADS/article/view/2347. Accessed: May 2022.

SARAIVA, J. G. O. **Ecophysiology of *Cryptostegia madagascariensis* Bojer ex Decne submitted to water restriction**. 50f. Dissertation. Master's degree in Phytotechnics - Federal Rural University of semiarid - UFERSA. Pro-Rectory of Research and Graduate Studies, February 2016.

SILVA, R. P.; PEIXOTO, J. R.; JUNQUEIRA, N. T. V. Influence of several substrates on the development of sour passion fruit seedlings (*Passiflora edulis* Sims *f. flavicarpa* DEG). **Revista Brasileira de Fruticultura**, Jaboticabal, v. 23, n. 2, p. 377–381, 2001. DOI: https://doi.org/10.1590/S0100-29452001000200036

SMIDERLE, O. S.; MINAMI, K. Emergence and vigor of guava seedlings in different substrates. **Revista Científica Rural**, Bagé, v. 6, n. 1, p. 38–45, 2001.

VALE, L. S.; COSTA, J. V. T.; SON ANNUNCIATION, C. J.; LIMA, R. L.S. **Effect of different substrate mixtures and container size in the production of maulifel seedlings**. In: BARBOSA, J. G.; MARTINEZ, H. E. P.; PEDROSA, M. W. Nutrition and fertilization of plants grown on substrate. Viçosa: UFV, p. 385. 2004.

VIEIRA, M. F.; LEITE, M. S. O.; GROSSI, J.A.S.; ALVARENGA, E. M. Reproductive biology of *Cryptostegia madagascariensis* Bojer Ex Decne. (Periplocoideae, Apocynaceae), an ornamental and exotic species in Brazil. **Bragantia**, Campinas, v. 63, n. 3, 2004. DOI: https://doi.org/10.1590/S0006-87052004000300002

ZALBA, S. M. Adaptive management of biological invasions: a tool for reducing uncertainty and improving diagnosis and effectiveness of control. **XIX Meeting of the Society for Conservation Biology**. Brasília, Brasil, 2005.

ZILLER, R.R.; GALVÃO, F. A. Degradation of the Grass-Woody Steppe in Paraná by Biological Contamination of *Pinus elliotti* and *P. taeda*. Forest Magazine, Paraná, v. 32, n. 1, p. 41-47. 2002. DOI: http://dx.doi.org/10.5380/rf.v32i1.2348