International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 197-200

Received: 18-09-2018
Accepted: 19-10-2018

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Study on propagation of tree fodder seeds under laboratory and green polyhouse conditions

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Abstract
The shortage of feed particularly during the dry season is one of the major factor limiting livestock productivity in the country. The present study is an introduction, promotion and utilization of improved and interesting multipurpose tree forages seed propagation. The different methods for tree fodder seed treatment and utilization of polyhouse are studied. Different seed treatment methods like soaking in cold water, hot water and acid treatment were evaluated for germination of seeds. The ≥90% germination was observed by the hot water treatment for *Sesbania grandiflora*, *Sesbania sesban*, *Calliandra sp.* and *Leucaena leucocephala*. The *Moringa oleifera* and *Bauhinia Sp.* cold water treatment was found to be optimum. The seedlings growth was compared between laboratory and green polyhouse. The polyhouse found to be beneficial and more efficient than open laboratory. After 45 days the saplings from poly house transferred to the farm yard and observed for 3-4months for tree fodder production and used as unconventional feed resources.

Keywords: Seed germination, seedling growth, tree fodder, unconventional feed

Introduction
The livestock sector alone contributes nearly 25.6% of Value of Output at current prices of total value of output in Agriculture, Fishing & Forestry sector. The overall contribution of Livestock Sector in total GDP is nearly 4.11% at current prices during 2012-13 (APEDA, 2014) [1]. In addition to direct income benefits, livestock provides indirect benefits, such as fuel and fertilizer from animal manure and draught power for farm production (Shrestha and Sherchand, 1988) [2]. In spite of its large numbers, the country's livestock productivity is low. The animal health problems, lack of adequate quantity and quality of feed are major factor in poor livestock productivity. However, animal feed shortage remains the main constraint on productivity in both the lowlands and highlands and limiting livestock productivity in the country. Adequate nutrition is important for maintenance, growth, and reproduction of animals. Indian livestock are underfed and undernourished. India is short of dry fodder by 31%, green fodder by 23%, and concentrate feeds by 47% (World Bank, 1996) [4]. Crop residue is the main feed source for livestock in the country especially during dry season. It accounts for nearly 70 to 80 percent of total diet of the livestock. The availability of feed resources interacts with rainfall amount and distribution pattern, and season of the year.

The silvipastoral systems involve the establishment of multipurpose trees in existing pastures/grazing lands or wastelands, with grasses, legumes or cereals planted between the lines of trees. Tree fodders are cheap sources of feed for ruminants in dry season and also called as unconventional feed resource. They have ability to retain green leaves throughout the year and potential energy and protein source for the animals (Olafadehan, 2013) [5]. The tree fodders are nutritious to animal and doesn't require much management practices, fragmented land holdings and farm strips on private land was used to cultivate trees (ILRI, 2009) [6]. The natural regeneration and retained seedlings are helpful propagation of trees within a stipulated area. The feeding of proper ration is need of an hour in farming sector and sustainable feed sources throughout the year in needed. The present study, however makes an effort to establish different seed treatment methods and use of polyhouse especially for perennial forage tree fodder, being used for adoption by the farmers.

Material and methods

Site selection and development

The institutional research farm, Veterinary College Hassan, KVAFSU under instructional livestock farm complex acts as farmland. It is located at 980m above mean sea level in outskirts of Hassan city of Karnataka, representing 13°03'N latitude and 76°11'E longitude. It falls in the mid-hill zone mixed with malnad or mountainous south western Ghats of Karnataka.

A plot area of 5000 sq.ft in the institutional farm complex was identified for setting up the nursery. The Department of Livestock production and Management is key role in setting up the nursery. Establishment of shade net/polyhouse of 40 Sq. ft to have controlled environment for nursery setup. The pole and base was made using iron hollow rods and covered over with green colour shade net for preparation of poly house.

Seeds and germination rate

The tree fodder seeds in the study were *Sesbania grandiflora, Sesbania Sesban, Moringa oleifera, Bauhinia Sp., Leucaena leucocephala and Calliandra* seedlings procured from Bharathiya Agro Industries Foundation (BAIF) Research and Development, Tiptur, Karnataka. The quality of seed visualised and physical handpicked seeds used for further studies. The different seed treatment methods like soaking in cold water, hot water and acid treatment were evaluated for fodder seeds. Germination percentage was assessed by the percentage of seeds showing sprouts after 24 to 48 hours of seed treatment. All germination experiments were conducted using three replications of 25 seeds per each treatment. Seeds were placed on double layered Watman No.1 filter paper moistened with 5ml of distilled water in sterilized Petri dishes.

For hot water, seeds were soaked in hot water of around 50-60 ^{0}C for 30 minutes later rinsed in distilled water and allowed to remain soaked in room temperature overnight. For cold water, seeds were soaked in ice cold water of around 5-8 ^{0}C and allowed to remain soaked overnight. For acid treatment, seeds were soaked in 10:90 (98%sulphuric acid: Water) for 5-10 minutes later rinsed in distilled water and allowed to remain soaked in room temperature overnight. After 24 hours the seeds were calculated for germination rate for all 3 prototypes.

Formulae for calculation of germination rate

$$\text{Germination rate (\%)} = \frac{\text{no of seeds germinated}}{\text{no of seed soaked}} \times 100$$

Preparation of seedling bags and sprouting rate

The red soil, sand and farm yard manure were mixed in 50:25:25 proportion and were filled in seedling bags. The seeds that were showing germination were sown in seedling bags. The seedlings growth was assessed by observing the growth of plant and eruption of leaflets.

The comparison of laboratory sprouting and poly house was evaluated. For sprouting under laboratory condition were left open in room. For polyhouse, seed bed areas inside shade area or poly house/greenhouse under shade net in poly house facility created. Half feet depth is created and the seedling bags are kept inside tightly packed. Sowing of treated seeds and covering with polythene sheet to have control over temperature and humidity whereas one more group left open in poly house. Watering was done on alternate days. The sheet was opened only on alternate days in order to avoid fluctuation in temperature and humidity.

Formulae for calculation of sprouting rate

$$\text{Sprouting rate (\%)} = \frac{\text{no of germinated seeds sprouted}}{\text{no of germinated seeds}} \times 100$$

Preparation of fodder nursery plots in farm area and shifting of sprouted seedling bags

After 45 days the seedlings were shifted outside kept outside for seasoning. The seedlings were protected from direct sunlight for seasoning. Seedlings transplanted in bigger bags to the tree fodder plots and transplanted to College Farm. In farm, the shallow depth of 1×1 feet and depth 1.5 feet is severed and the tree fodder saplings are planted, they are watered every day. The fodder nursery plots also served as a tree fodder for the animals.

Results and discussion

Establishment of fodder nursery

The site selection was made appropriate to decrease the adverse effect from the environmental factors. The poly house preparation and necessary facility for build-up of nursery was made. The structures of green polyhouse are frames of inflated structure covered with a transparent material in which crops are grown under controlled environment conditions. Green polyhouse cultivation as well as other modes of controlled environment cultivation favors micro-climates, enable crop production possible all through the year or part of the year as required. The polyhouse covered with a green transparent material for admitting natural light for plant growth. The main components of greenhouse like structure, covering/glazing and temperature control systems need proper design for healthy growth of plants (TNAU, 2018) [3].

Standardizing the seed treatment methods

The tree fodder seeds in the study were *Sesbania grandiflora, Sesbania sesban, Moringa oleifera, Bauhinia Sp., Leucaena leucocephala and Calliandra* seedlings. The different seed treatment methods like soaking in cold water, hot water and acid treatment were evealauted. The germination of seeds was assessed visual and scoring was done as + for geminated and – for not germinated. The germination percent was calculated using formula and represented as below in table:1. For selection of best seed treatment, 90% germination and more was taken as standard. The ≥90% germination was observed by the hot water treatment for *Sesbania grandiflora, Sesbania sesban, Calliandra sp.* and *Leucaena leucocephala.* The *Moringa oleifera* and *Bauhinia Sp. By* cold water treatment was found to be optimum. The acid treatment of seed was found not be useful for our study. The acid treatment led to charred and black discoloration was observed and further seedling percentage was found less than other 2 methods. So the above experiment shows that the hot and cold treatment was found to be beneficial and further used in the following study.

The seed coat structure is thick and hard, and has phenolic compounds including pectin and suberin on the surface of seed coat that restrict water uptake into the seed (Doijode, 2001) [7]. Physical dormancy is caused by one or more water-impermeable layers of palisades (Baskin and Baskin, 2004). The pericarp has the potential to delay germination over an extended period of time (Lu *et al*., 2015) [10]. Hence, different seed treatment methods like soaking in cold water, hot water and acid treatment were tried for tree fodder seeds. Dormant

seeds which require chilling, dry storage after ripening and light as a germination stimulator, are often treated with GA3 to overcome their dormancy (Gupta, 2003) [9].

Comparison of sprouting percentage under laboratory condition and polyhouse

The germinated seeds were placed in seedling bags as described in methodology. The seedlings growth was assessed by observing the growth of plant and eruption of leaflets. Sprouting percentage studied under laboratory condition and green poly house to compare and stabilize the seedling production. Sowing of treated seeds in laboratory conditions and covering with polythene sheet to have control over temperature and humidity of poly house. Both the conditions are observed and found that poly house condition had ≥90% of germination and seedling percent compared to laboratory has ≥80% respectively. Germination substrate for herbaceous bedding plants must retain moisture, supply nutrients, permit gas exchange, and provide support for the seedling (Fonteno, 1994) [11].

Tree fodder for animal feeding

Lesleighter and Shelton (1986) [12] conducted a study on the adoption of the shrub legume (*Leucaena leucocephala*) in central and south east Queensland, Australia. They reported that poor adoption of recommended cultural practices and high level of indecision among growers on the use of leucaena period. Rao *et al.* (2002) conducted a study on recent trends in *Stylosanthes* seed production by smallholders in District. The findings were that, the seed production technology has spread from farmer to farmer with little assistance from government agencies, and now there is a need to introduce new cultivars that have higher seed and forage yields. When trees are introduced on agricultural fields, the field crops exert a considerable influence on the establishment and growth of trees in any agroforestry practice (Khybri *et al.*, 1992). Kapinga and Shayo (2004) [13] conducted a study on forage production and utilisation at the small scale holder level in Tanga district, Tanzania. The forage production and quality under the small-scale dairy farming systems is more variable than that reported at the research stations.

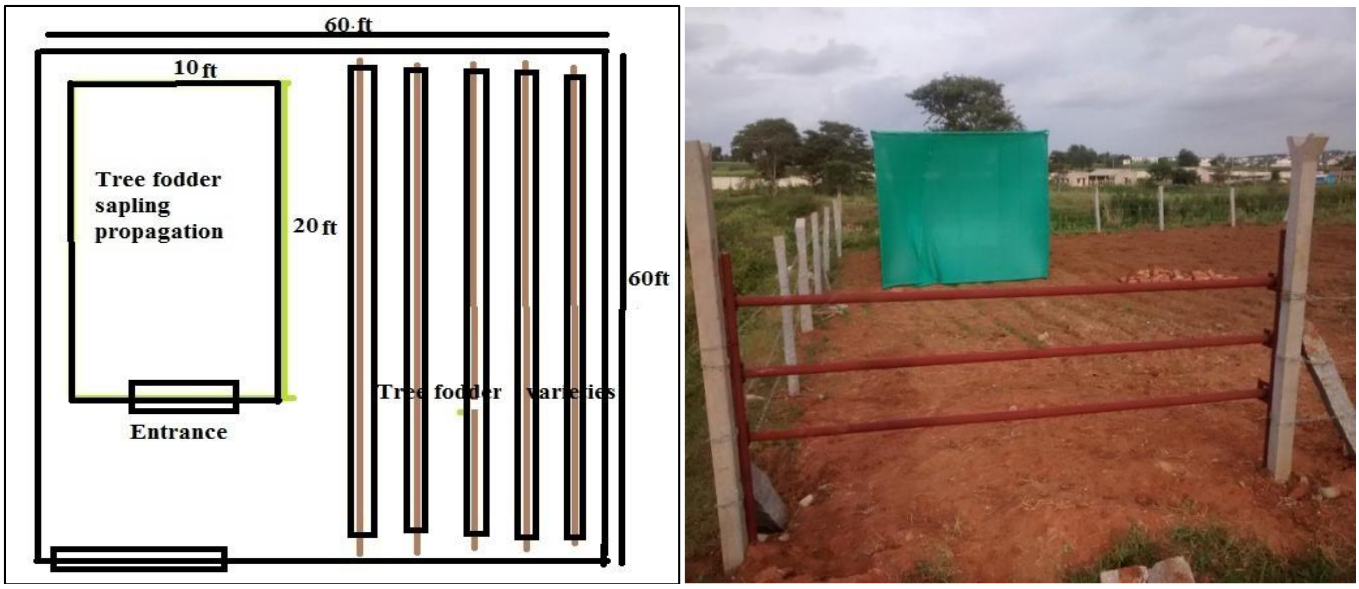

Fig 1: The schematic and pictorial presentation of project area and nursery

Fig 2: The pictorial presentation of seeds on germination and sprouting rate

Table 1: The germination percentage for various tree fodder seeds under different seed treatment technique.

Sl. No	Seed variety	Hot water	Cold water	Acid treatment
1.	*Sesbania grandiflora*	≥90%	70-80%	≤50%
2.	*Sesbania sesban*	≥90%	70-80%	≤70%
3.	*Moringa oleifera*	70-80%	≥90%	≤50%
4.	*Bauhinia Sp.,*	70-80%	≥90%	≤50%
5.	*Leucaena leucocephala*	≥90%	70-80%	≤70%
6.	*Calliandra* Seedlings	≥90%	70-80%	≤50%

Table 2: The sprouting percentage for various tree fodder seedlings under different sprouting technique.

Sl. No	Seed variety	Laboratory condition	Polythene covered in poly house	Open in poly house
1.	*Sesbania grandiflora*	≥80%	≥90%	≥80%
2.	*Sesbania sesban*	≥80%	≥90%	≥80%
3.	*Moringa oleifera*	≥80%	≥90%	≥80%
4.	*Bauhinia Sp.,*	≥80%	≥90%	≥80%
5.	*Leucaena leucocephala*	≥80%	≥90%	≥80%
6.	*Calliandra* seedlings	≥80%	≥90%	≥80%

Conclusion

The present study, explains the various mitigation method to improve the livestock production even in feed scarcity and unavailability. The ≥90% germination was observed by the seed treatment like hot and cold treatments for *Sesbania grandiflora, Sesbania sesban, Calliandra sp., Leucaena leucocephala, Moringa oleifera* and *Bauhinia Sp.* The acid treatment of seed was found not be useful for our study. The green poly house aided in ≥90% of germination and seedling percent compared to laboratory has ≥80% respectively. Tree fodder seedling production shall also serve as an income generating activity for small farmers and women. The unconventional feed resources are next level problem solving approach to enshrine the rural economy by increased production and profitability of livestock rearing alongside with agriculture. The production of tree fodder seedlings can be recommended to the farmers.

Acknowledgement

The authors sincerely thank Dean, staff and authorities of Veterinary college, Hassan for their cooperation, facilities provided and encouragement and efforts to embellish this research. The work was financially funded by Karnataka veterinary Animal and Fisheries Sciences University, Bidar under DR/KVAFSU/SRP/AniSci-09/2016-17.

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