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EFFECT OF VARIOUS SOIL MEDIUM ON SEED GERMINATION OF *SIMMONDSIA CHINENSIS* (LINK) SCHNEIDER (JOJOBA) UNDER *IN VIVO* CONDITIONS

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ABSTRACT

The present work was conducted to elucidate the effect of different soil mediums in various ratios on seed germination efficiency and growth of seedling of *Simmondsia chinensis* under *in vivo* conditions. The highest germination (94%) was recorded for seeds cultivated in S_1 medium containing desert soil and Farm Yard Manure (FYM) (2:1) followed by S_4 medium (90%) having desert soil, clay, FYM (1:1:2), S_3 medium (76%) in 2:1:1 composition and then to S_2 medium (65%) germination in (1:2:1) ratio. Although, *S. chinensis* display better growth in desert soil, clay and FYM (1:1:2) yet *in vivo* (nursery) conditions they could raise potentially into healthy plantlets for successful establishment in the field. The present investigation could be of immense significance in selecting the soil type for commercialisation of this crop and improving their production to meet the market demand.

KEYWORDS: Clay, Desert soil, Germination, *In vivo,* Seed, Seedling, *Simmondsia chinensis*

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INTRODUCTION

Simmondsia chinensis (Link) Schneider, commonly known as jojoba or hohoba, is an oil-yielding plant, belonging to family *Simmondsiaceae*[1]. Seeds are brown in colour and wrinkled in shape[2]. The seeds contain about 50-60% of a colorless and odorless liquid-wax which is unique in plant kingdom[3]. The liquid-wax has potential applications in cosmetics[4], pharmaceutical industries[5] and bio-fuel industry[6]. It can be grown on marginal and wasteland due to tolerance of extreme range of temperature from -5 to 54 ^{o}C[7]. It is a valuable crop for soil conservation, landscaping, open natural range lands and national parks[8]. All these factors makes it a potential crop with immense significance, therefore a lots of efforts have been made for the successful establishment of this crop throughout the globe. In this context, plant biotechnology has contributed a lot and almost every aspect of jojoba has been studied. Different studies have been carried out to find the optimum conditions for maximum production of this crop. However, to our best knowledge there is no report on seed germination study using various soil medium. Desert soil is considered to be poor quality soil with low nutritional level. The poor nutritional status of soil is the major limiting factor for the production of healthy plantlets with enhanced and consistent chemical profile[9]. It is established that germination of seeds in a quality soil or a mixture of soil having good nutritional status is necessary for optimum growth of plantlets[10]. The type of soil has a significant effect on the germination efficiency of a seed[11]. Seed germination is one of the most important stages of plant growth which is controlled by environmental factors as well as physiological processes. In addition to this, water holding capacity of a soil also plays a crucial role in seed germination and it further depends on quality of soil[12]. Hence, production of healthy plantlets is a prerequisite for the establishment of this crop and to increase seed yield in order to fulfil the demand of liquid wax. Therefore, it is envisaged that the seedlings could be raised under *in vivo* (nursery) conditions in good quality soil medium which may promote the production of healthy plantlets that could be transferred to the field at later stage. Therefore the present investigation was carried out to assess the germination and seedlings growth using different types of soil mixture under *in-vivo* (nursery) conditions so that this crop could be developed in an efficient manner.

MATERIALS AND METHODS

Seeds of *S. chinensis* were obtained from Thar Nurseries Pvt. Ltd., Bikaner (Latitude 27^{o}97'43.11"; Longitude 73^{0}11'43.33") during the month of September in 2011. The seeds were transported to laboratory in Department of Environmental Sciences, Maharshi Dayanand University, Rohtak, where the seeds were air dried for 2 days on the filter paper at room temperature. The seeds were stored in plastic bags at room temperature. The experiments were carried out in the Green house of the herbal garden, Maharshi Dayanand University, Rohtak (Latitude 28^{0}52'48.87", Longitude 76^{0}37'09.97") during the year 2011. Seeds were used in the experiments after pre-soaking in water for a period of 24 h. The pre-soaked seeds were sown in following four different types of soil mixture ratios given as below:

S_1= Desert soil: Farm Yard Manure (FYM) (2:1),
S_2= Desert soil: Clay: FYM (2:1:1),
S_3= Desert soil: Clay: FYM (1:2:1), and
S_4= Desert soil: Clay: FYM (1:1:2),

The seed sowing depth was about 1 cm in small pots of size 20x20 cm. Sowing was carried out in fourth week of September with semi-arid and monsoonal climatic conditions. Radical emergence was considered as the criterion for germination and the emergence of seedling was recorded daily. The measured quantity of water was provided on alternate days in each pot to keep the soil moist. Seed germination percentage, root, shoot length and seedling height were measured after 30 days of setting of the experiments. Here, direct sowing of seeds in soil was referred as *in vivo* condition.

All experiments were performed in three replicates and each replicate consisted of 40 seeds. The germination of seeds was assessed at daily and was recorded by visual observation. All data are expressed as mean value ± standard error (Mean±SE).

RESULTS AND DISCUSSION

The present investigation was performed with different types of soil media to assess the germination percentage of seeds and various other parameters of seedling. It is evident from Figure 1 and 2 that S_1 showed the highest germination (94%) of seeds. The emergence of seed was observed in 4 days i.e., less time was required in S_1 medium, as compared to other treatments.

Figure 1

Effect of various soil medium on in vivo seed germination of Simmondsia chinensis

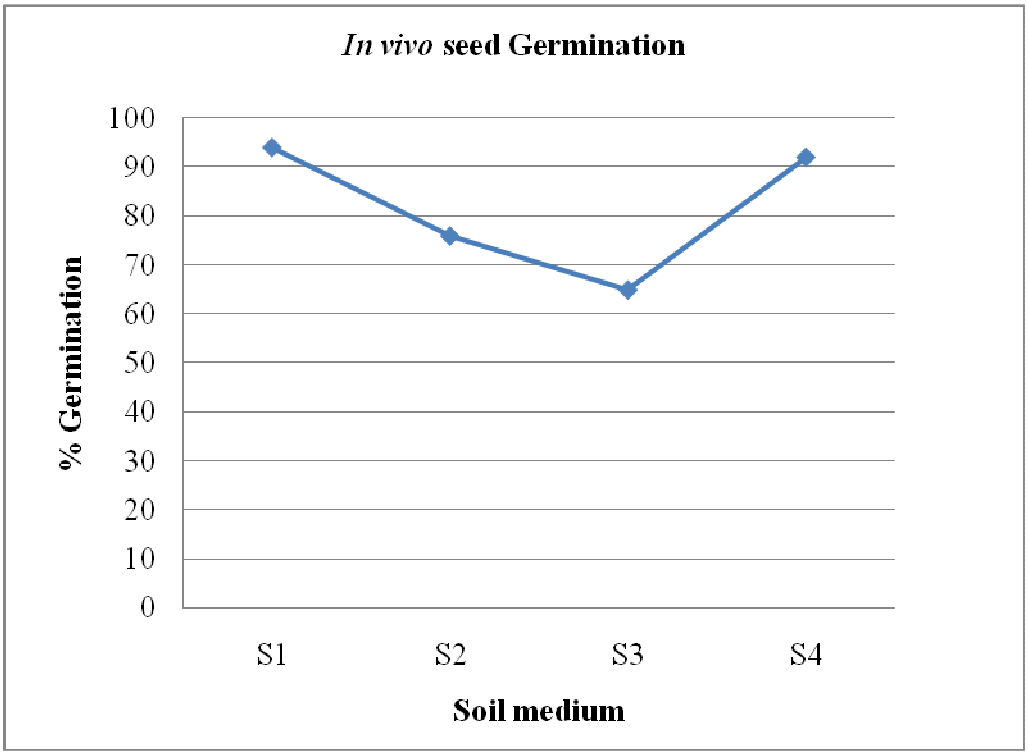


Figure 2

Effect of various soil medium on emergence of seeds of Simmondsia chinensis

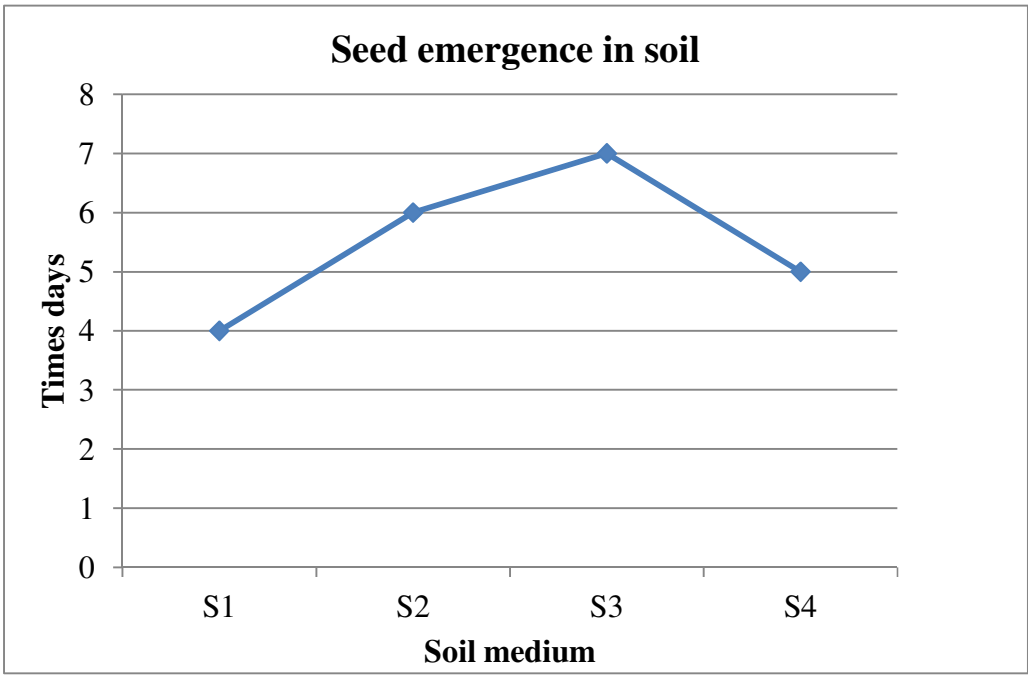
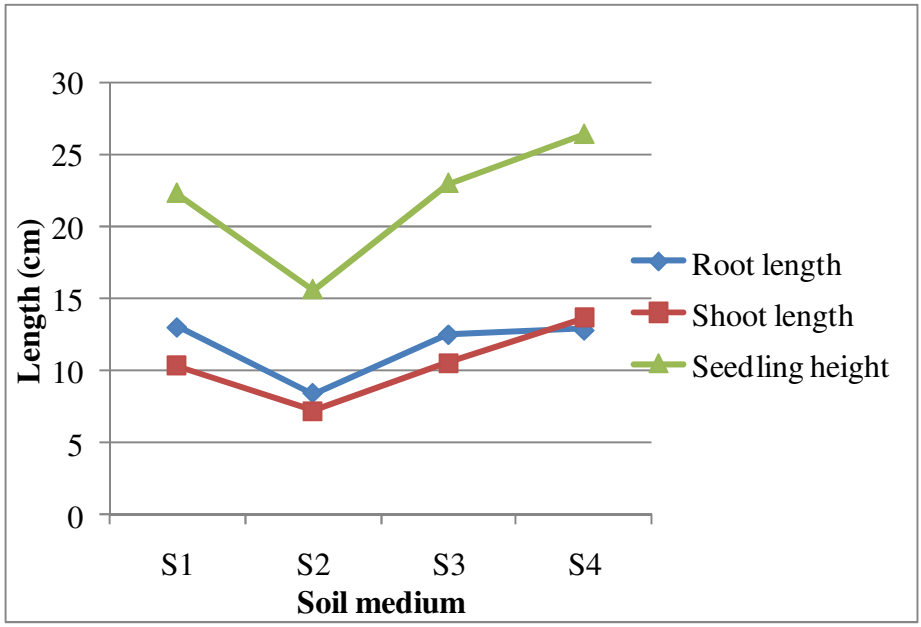


Figure 3
Effect of various soil medium on shoot, root and seedling length of seedlings of Simmondsia chinensis



Treatments with both S_1 and S_4 resulted in maximum root length 13.0 cm and 12.8 cm respectively. However, the highest shoot length (26.4 cm) was noticed in S_4 treatment (Figure 3). The results indicate that desert soil was found best for early germination of seeds in comparison to others. The desert soil was found most suitable for early germination of seeds of *Annona muricata* was revealed by Okunomo[13]. Urgessa reported that desert soil enhanced the germination percentage of seeds in *Ficus vallischaude*[14]. Desert (sandy) soil is commonly found in arid and semiarid regions as its water holding capacity is very little so favours early germination of seeds[15].The shoot length and seedling height were found highest in S_4 (1:1:2) due to presence of high ratio of FYM, although, germination of seeds were found to be 90% in S_4 medium. On this medium, also, emergence of seedling was observed after 5 days of sowing. These findings agree with the studies that farm yard manure significantly increased the seedling height and number of leaves per seedling during the stage of seed germination[16]. Our results indicated that in S_2 and S_3 treatments, seed germination percentage was found less than S_1 and S_4, because clay soil may probably inhibit the germination of seed and delayed emergence time of seedlings. The S_2 treatment resulted in poor seed germination (65%) as a high ratio of clay soil was present and probably inhibited the germination. This may be due to fact that the clay soil has tightly bounded particles which make the penetration of radical and plumule emergence difficult as well as less aeration in soil. El-Darier and Youssef evaluated that germination efficiency of seed in desert and clay soil and found that highest seed germination was achieved in desert soil while clay soil led to low germination[11]. Similar findings agreed that seed germination was higher in desert soil and decreased in soil which contained high ratio of clay as detected in *Cortaderia selloana*[17].

CONCLUSION

In conclusion, the study clearly demonstrates that *S. chinensis* have best growth of seedlings with greatest length of roots and shoots in desert soil, clay with FYM (1:1:2). Although, the highest seed germination was observed in desert soil with FYM (2:1). Therefore, *S. chinensis* seed could be prior germinated under *in vivo* (nursery) conditions to raise potentially and healthy plantlets for successful establishment in the field.

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