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Effect of polyhouse conditions on germination and seedling growth of *Morus alba* var. Kokuso

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Abstract
The present investigation entitled "Effect of Polyhouse conditions on germination and seedling growth of *Morus alba* var. Kokuso"was carried out at Faculty of Forestry, Benihama, Ganderbal J&K.The seedling nursery of Morus specieswas raised in polyhouse as well as under field conditions. Studies conducted on nursery raising of *Morus alba* varietyKokuso revealed that raising of seedlings under polyhouse conditions were much superior than those grown in field. The performance of seedling nursery in both cases was assessed in terms of various parameters and then put to statistical analysis revealed that there was a highly significant differences in germination percentage, survival percentage, plant height, collar diameter and root length. Germination percentage (88.66%), survival percentage (80.70%), average plant height (24.66 cm), average collar diameter (5.66 mm) and average root length (10.40 cm) was recorded highest in seedlings raised under polyhouse conditions while as germination percentage (67.66%), survival percentage (58.44%), average plant height (17.20 cm), average collar diameter (4.22 mm) and average root length (7.16 cm) was recorded lowest in seedlings raised in open conditions.

Keywords: *Morus alba*, seeds, propagation, polyhouse

Introduction
The genus *Morus* of family *Moraceae* is a native to temperate Asia and is considered to be among the more evolutionary advanced groups of woody flowering plant species. According to plant scientists, the genus *Morus* includes 14- 150 species (Martin *et al.*, 2002; Srivastava *et al.*, 2006) [6, 9]. The genus *Morus* comprises of 68 species with more than 100 known cultivars distributed in Asia, especially 24 species in China and 19 species in Japan (Sanjappa, 1989). Among these species, *Morus alba* (White Mulberry), *Morus nigra* (Black Mulberry) and *Morus rubra* (Red Mulberry) have wide distribution throughout the globe. In India mulberry is represented mainly by four species, *Morus alba* L, *Morus laevigata* Wall, *Morus indica* L, *Morus serrata* Roxb (Datta, 2000) [3]. The White mulberry (*Morus alba*) is a short lived, fast growing, small to medium sized mulberry tree, which grows to 10-20 m tall. These are native to warm temperate and subtropical regions of Asia, Africa, Europe and America, with majority of species native to Asia, most especially China. *Morus alba* also called as silkworm mulberry originated from South west China (Yilmaz *et al.*, 2012) [11].
Mulberry is recognized as "Kalpa Vruksha" (wish-fulfilling tree) in India as all parts of plant have multiple uses. It produces large amount of renewable biomass in the form of branches, shoots, leaves and fruits. In sericulture it is widely used for its foliage, constituting the sole feed for silkworm, *Bombyx mori*. In most European Countries, mulberry fruits are used for human consumption either in raw form or in the form of various confectionary products such as jams, pulp, juice, wine (Soufleros *et al.*, 2004). It is also used as fodder for animals since it is highly palatable, nutritious and digestable (70-90 percent) (Benavides, 2000) [1].
Mass propagation by seeds is an efficient and economic method of plant propagation. During the past several centuries, interest in controlled reforestation has developed with the need to replace vast areas depleted of natural forests. Billions of seeds are produced yearly to fill this need (Hartmann *et al.*, 2002) [5]. Germination of seed is the initial and under some circumstances critical step in afforestation by natural or artificial means. Seeds of different species and of the same species from different provinces behave differently in their germination response and knowledge of the same is very essential for understanding plantation

programmes. Similarly a species may be found in a wide variety of climatic regions, but the germination behaviour may differ accordingly to provenance. Germination of seeds differ with the adoption of various nursery techniques. *Morus alba* is found throughout Kashmir. A number of authors have described this as being indigenous to Kashmir but there is little information available with respect to its status and distribution in Northern region of Kashmir. Besides in order to make sericulture or agroforestry or social forestry, programmes a success, availiblity of inputs particularly the planting material is important.

Materials and Methods

Experimental site; location, physiography and climate

Kashmir valley is located in the north-western extremity of India, between 33° North latitude and 75° East longitude. The valley is located in the northern most latitude of the country holds almost central position in the continent of Asia. Average altitude of Kashmir valley (valley zone) ranges between 1, 500 to 2, 300 m above sea level. The geographical expanse of kashmir is 15, 948.00 sqkm (excluding the part under Pakistan).

The experimental site Faculty of Forestry, SKUAST-Kashmir, Benihama village (Tehsil- Lar, District- Ganderbal) lies on the southern aspect at 34°16′ 4″ North latitude and 74°46′ 31″ East longitude. The study area is located at an elevation of 1, 783m (5850 feet) above the mean sea level. The study area has temperate climate experiencing four distinct seasons: a severe winter (December to Febuary), a cold spring (March to May), a mild summer (June to August) and a pleasant autumn (September to November). The site falls in a mid to high altitude characterized by hot summer and very cold winters.. The average precipitation is 690-1150 mm most of which is received from December to April in the form of snow and rains. The climate is generally temperate type, winter is severe extending from December to March. The region faces a wide temperature range from -8° c in winter to maximum of 33° c in summer. Winter frost is common and medium to heavy snowfall is also witnessed.

The seedling nursery of *Morus species* was raised in nursery beds at Faculty of Forestry Benihama/ Watlar, SKUAST-K in polyhouse as well as under field conditions. After collection, these seeds were soaked in water for 24 hours before sowing. Open beds of size (1m×1 m) were prepared. Sand and FYM was added to maintain fertility and porosity. Fresh seeds were sown in the last week of July and the beds were irrigated as and when required**.** Experimental design followed was RBD with two treatments (polyhouse and field), which were replicated 10 times. Under polyhouse conditions temperature maintained was 28 ^{0}C to 34 ^{0}C. Beds were irrigated two times daily i, e in morning and evening.

The performance of seedlings was monitored in both polyhouse as well as field conditions and the following parameters were recorded:-

1. Germination percentage: The total number of seeds which germinated were counted and expressed as percentage.
2. Survival percentage: The total number of seedlings which survived at the end of one growing season were counted and expressed as percentage.
3. Average plant height (cm): It was measured in centimeters with the help of measuring scale at the end of the growing season.
4. Average collar diameter of seedlings (mm): The collar diameter of seedling was recorded in millimeters with the help of digital calliper at the end of the active growing season.
5. Average root length (cm): The length of root was recorded in centimeters with the help of measuring scale after uprooting at the end of the growing season.

Statistical analysis

The entire data, generated from the present investigation were subjected to statistical analysis using Randomized Block Design. The statistical analysis for each parameter was carried out on mean values as per the procedure given by Gomez and Gomez (1984) [4]. The significance of 'F' &'t' was tested at 5 per cent level of significance. Software package used for analysis was "SPSS".

Results and Discussion

The seedling nursery of *Morus alba* variety kokuso through seeds was raised in polyhouse as well as in field. The performance of seedling nursery in both cases was assessed in terms of germination percentage, survival percentage, plant height (cm), collar diameter (mm) and root length (cm). The observations recorded are shown in Table 4.

Germination percentage of 88.66% was recorded in seeds sown in polyhouse. Survival percentage (80.70%), plant height (24.66 cm), collar diameter (5.66 mm) and root length 10.40 cm were recorded in seedlings raised in polyhouse.

Germination percentage of 67.66% was recorded in seeds sown in Field. Survival percentage (58.44%), plant height (17.20 cm), collar diameter (4.22 mm) and root length 7.16 cm were recorded in seedlings raised in open conditions.

The analysis of data revealed highly significant difference in germination percentage, survival percentage, plant height, collar diameter and root length. Highest germination percentage of 88.66% were recorded in seeds sown in polyhouse while as lowest germination percentage of 67.66% were recorded in seeds sown in field. Highest survival percentage of 80.70% was in polyhouse while as lowest survival percentage of 58.44% was observed in field. Significant differences were also observed in plant height (cm), collar diameter (mm) and root length (cm). Highest average plant height (24.66 cm) was recorded in seedlings which were tended in polyhouse and lowest plant height (17.20 cm) was recorded in seedlings which were germinated and tended in field. Collar diameter (5.66 mm) was also recorded highest in seedling raised nursery in polyhouse while as lowest collar diameter (4.22 mm) was recorded in seedling raised in open conditions. Root length of 10.40 cm was recorded highest in polyhouse raised seedlings while as open bed nursery raised seedlings recorded lowest root length of 7.16 cm. This may be due to the fact that under polyhouse conditions seedlings got favourable conditions for their growth. These results are in conformity with the findings of Ramdas *et al. (*2011) [7] who reported maximum germination and seedling growth of *Picrorhiza kurroa* under polyhouse conditions as compared to open field. Polyhouse plays a vital role in propagation of various seedlings in nurseries. Congenial climatic conditions under polyhouse is essential for better germination, early rooting and hardening of seedlings (Copeland and Donald, 1995) [2]. Schutz (1999) [9] reported that optimum temperature in polyhouseupto 34° C increased seed germination and seedling growth of *Carex* species. The results of present investigation are also in conformity with the findings of Tsitson (2009) [10] who reported that under

polyhouse conditions germination percentage was very high (87-90%) in *Pinus halepensis*.

Conclusion

Studies conducted on "Effect of Polyhouse conditions on germination and seedling growth of *Morus alba* var. Kokuso" revealed that seedlings raised in polyhouse were much superior to those grown in open nursery beds in open conditions.

Table 1: Nursery raising of *Morus alba* variety kokuso through seeds under polyhouse and field conditions

S. No.	Type of Nursery	Germination (%)	Survival (%)	Average plant height (cm)	Average Collar diameter (mm)	Average root Length (cm)
1	Polyhouse	88.66	80.70	24.66	5.66	10.40
2	Field	67.66	58.44	17.20	4.22	7.16
CD@5%		1.06	0.94	1.62	0.08	0.08

Polyhouse Field

Plate I: Nursery raising of *Morusalba* variety kokuso through seeds under polyhouse and Field conditions

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