“ASSESSMENT OF PRE–SOWING GERMINATION TREATMENT AND SEEDLING VIGOR IN *Melia dubia* (Cav.)”

THESIS

Submitted to

Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola
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BY

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DECLARATION OF STUDENT

I hereby declare that the experiment work and its interpretation of the Thesis entitled **"ASSESSMENT OF PRE-SOWING GERMINATION TREATMENT AND SEEDLING VIGOR IN *Melia dubia* (Cav.)"** or part of there of neither been submitted for any degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

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CERTIFICATE

This is to certify that the thesis entitled **"ASSESSMENT OF PRE-SOWING GERMINATION TREATMENT AND SEEDLING VIGOR IN *Melia dubia* (Cav.)"** submitted in partial fulfilment of the requirement for the degree of "**Master of Science in Forestry (Silviculture and Agroforetsry)** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **GAWAI NIKITA GAUTAM** under my guidance and supervision.

The subject of the thesis has been approved by the Student's Advisory Committee.

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%	-	Percent
/	-	per
o	-	Degree Celsius
m	-	Meter
cm	-	Centimetre
G.B.H.	-	Girth at Breast Height
et al.	–	et alia (and others)
etc.	–	et cetera
Fig.	–	Figure
g	-	Gram
hrs.	–	Hours
v/v	–	volume/volume
pH	–	Hydrogen ion exponent (a unit symbol for the degree of alkalinity or acidity)
Sig.	–	Significant
NS	–	Non-significant
SE	–	Standard Error
SE m	–	Standard Error mean
CD	–	Critical Difference
CV	–	Coefficient of variation

(E) THESIS ABSTRACT

a.	Title of thesis	:	**"ASSESSMENT OF PRE-SOWING GERMINATION TREATMENT AND SEEDLING VIGOR IN *Melia dubia* (Cav.)"**
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c.	Name and address of Major Advisor	:	**Dr. V.P. Mane** Associate Professor Department of forestry, PGI, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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ABSTRACT

The present investigation entitled, "Assessment of pre-sowing germination treatment and seedling vigor in *Melia dubia* (Cav)" was carried out during the year 2021-22, at Department of Forestry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola. An experiment was laid out Randomize

block design with an objective to study the effect of seed treatment on germination of *Melia dubia* (Malabar Neem), to study the effect of seed treatment on seedling vigor of *Melia dubia*, to find out suitable seed treatments for better germination in *Melia dubia*. A total of 13 treatments with 3 replications were executed in a nursery for study purpose. Several combinations of treatments such as soaking in tap water treatment (12hrs), soaking in tap water treatment (24hrs), soaking in hot water $80^{O}C$ (12hrs), soaking in hot water $80^{O}C$ (24hrs), impregnate in cow dung (5days), impregnate in cow dung (7days), immersion in gibberellic acid-300 ppm (12hrs), immersion of gibberellic acid-300 ppm (24hrs), immersion in gibberellic acid-500 ppm (12hrs), immersion in gibberellic acid-500 ppm (24hrs), soaking in cow urine (12hrs), soaking in cow urine (24 hrs) and control were executed in nursery.

The observation based on the various morphological characters such as, days to initial germination, days to 50% germination, days final germination, germination percentage, seedling vigor index, seedling length (cm), collar diameter (mm), no of leaves, no of branches, fresh weight of shoot (g),shoot length (cm), dry weight of root (g), fresh weight of root (g), root length (cm) were observed based on means of 3 replications was also a part of study.

From the results of present investigation entitle, “Assessment of pre-sowing treatment and seedling vigor of *Melia dubia* (Cav.)” the responses of seed treatment were found to be significant.

Amongst the different seed treatment, the seed treated with Cow dung i.e. (soaking it for 7 days) prior to sowing give the maximum germination percentage.

The seedling growth parameters viz. seedling vigor index, collar diameter, no. of leaves, no. of branches, seedling length and germination percentage of seedling registered and recorded maximum in seed treated with treatment T_6 i.e. impregnated in Cow dung for 7 days and it is followed T_5 i.e. Impregnated in Cow dung for 5 days and T_{10} i.e. GA_3-500 ppm for 24 hours. Hence, it could be concluded that, seed treated with above treatment gave maximum germination with optimum vegetative growth and germination percentage of seedling.

CHAPTER I

INTRODUCTION

1.1 Background Information

Forest are important entity bestowed upon us by nature. They are regularly providing us with food, wood, air to breathe, and other essential services. They are also home for several living organisms. Forest acts as a natural atmospheric purifier. They help in managing climate, soil erosion, and controlling noise pollution. Forests do contain some herbs which are used in making up medicines. Without forests, we cannot imagine our life and other activities. Tree plays a significant role in keeping the earth's temperature moderate livable. According to National Forest Policy, 1952 one-third, or 33% of the total land area should be under forest cover. The India state of forest report, 2019 reveals that India's forest cover is 24.56% of the total landmass. According to WWF (2020), forests are home to 80% of the world's terrestrial biodiversity. The industrial revolution in the world has affected the world's forest heritage to a large extent. Deforestation is the main cause of the reduction of forest area day by day. Many beautiful animal species have been extinct, and many are on the verge of extinction due to deforestation. Cutting down of forests leads to major problems like global warming, climate change, floods, droughts etc. planting more trees, developing new forests and protecting the existing one helps us to safeguard from future disasters. The less forest area coupled with the low productivity of Indian forest has ushered in a total mismatch between the demand and supply of both domestic and industrial wood requirement besides creating environmental disequilibrium (Parthiban *et al.*, 2011). The current supply of raw materials for industries like pulpwood, plywood, and furniture and biomass energy in the country is far behind the demand. Not only the forest wealth of the country is poor but also its productivity in terms of MAI is also one of the lowest. The MAI of Indian Forest is a meager of 0.5-0.7 m^3 ha^{-1} compared to the global average of 2.1 m^3 ha^{-1} (Srivastava, 2005).

India is likely to face severe shortage of supply of timber to meet its requirement from both domestic and international front. Global demand for wood is increasing at an annual rate of 1.7% (South, 1999). It is estimated that the demand for timber is likely to grow from 58 million cubic meters in 2005 to 153 million cubic meters in 2020 (Saravanan *et al.,* 2014). At the same time, planted forest resources are insufficient to meet current demands. The scope for expansion of forested areas is limited (Gregory *et al.*, 2002). This trend creates economic pressure that encourages the commercial exploitation of natural forests unless supply can be increased through the establishment of high yielding plantations. The use of fast growing, elite trees enable early harvest and so it helps to improve yield. However, considering the acute shortage of suitable raw material, the industries have to establish plantation of suitable species to achieve maximum yield within a short rotation period.

Today the agro-industry and agriculture sector is passing through difficult times due to ever increasing input costs, non availability of labor, soil degradation and climate change issues. The land values are increased and income from agriculture is reduced due to various unfavorable conditions resulting in that the farmers are selling away their lands, shifting in to other fields and migrating to urban habitations. Since many of the short term crops are risky, less remunerative and uncertain, it is time to cultivate medium to long term agro-forestry crops *like Melia dubia,* Sandalwood, Red Sanders, Casurina, Eucalyptus etc. which are cost effective also guaranteed better revenue. The agro forestry is one of the rapid increasing sector provide excellent income and the agro-forestry is the best option and solution for the above said problem. Agro-forestry is a sustainable land management system which increases the overall yield of the lands. The agro-forestry crops can be done along with the agricultural crops and livestock on the same land either simultaneously or sequentially. *Melia dubia* (Malabar Neem) is a promising tree highly suitable for farm forestry and agro-forestry for generating higher income in the semi-arid regions. As the present scenario the timber demand in India is very high and the high-tech cultivation system under the management of expert agro professionals can fetch good amount of tax free income through *Melia*

dubia plantations. It can fetch good income with assured buyback and it is low maintenance crop. This combines and sustainable land use system. In addition, these plantations are helpful to the planet in preventing raising temperature and checking gas emission into the atmosphere.

Due to its wider adaptability, it can be planted successfully in most of parts of India (Shah *et al.,* 2016). The trees grow well in sandy loam, red and lateritic soils with an annual rainfall of 800 mm and above. Temperature ranges between minimum of 0-15°C and maximum of 30-43°C. It is found to grow normally in areas with heavy rainfall of 1000 mm and relative humidity of 50-90%. The tree is deciduous to semi-evergreen in nature, which grows up to 25 m tall with wide spreading branches of handsome foliage. Bark is dark brown, fibrous which peels off in long strips of rectangular shape. The young branches are scurcy-tomentose and branchlets are terete, glabrous when mature. Found growing in the deciduous forests and in the country sides on wastelands. Leaves shed during December - January and the new leaves appear in February - March along with flowers. Inflorescence is an auxiliary panicle, 12-20 cm long; flowers are small, greenish white, honey scented, appearing in bunches with new flush of leaves. Fruit is a drupe, ovoid or ellipsoid with longitudinal ridges, pulpy and yellowish on ripening with a sweet smell. Fruit ripes in cold season (October - February), each consisting of 3-4 seeds.

More than 80% of the world's population presently uses herbal medicines for their primary health care as alternative system of medicine (Valentina *et al.*, 2013). Demand for herbal drug is increasing throughout the world due to growing recognition of natural plant based products, being non-toxic, having no side effects, easily available at affordable price (Kalia, 2018). The various parts of *Melia dubia* plant were observed to be used by local tribes of Nilgiris for various infections. *Melia dubia* tree in addition to use in wood industry have many potential medicinal properties. Oxidative stress is one of the key factors for several diseases like cancer, diabetes, arthritis, inflammation, etc (Khan *et al.,* 2008). The phenolic compounds derived from the plants viz., tannins, flavonoids, alkaloids, terpenoids etc. are known to be potent antioxidants. Valentina *et al.* (2013) had reported that the solvent extracts of *Melia dubia*

exhibited excellent antioxidant activity by Nitric oxide radical scavenging method, evidenced by lower IC50 (16.89 µg ml^{-1}) value in the ethanolic extract.

The antioxidant properties of leaf and fruit extracts of *Melia dubia* had also been reported by many other researchers (Ahmad *et al.,* 2008; Charde *et al*., 2010; Ahmad *et al*., 2012; Shah *et al.,* 2016). The fruit extract of *Melia dubia* established a significant scope to develop a broad spectrum use in herbal medicine and as a base for the development of novel potent drugs against the oxidative stress related health disorders in human beings (Kumar and Chauha, 2019). Silver nano-particles using the plant extract of *Melia dubia* were synthesized and characterized by using UV– visible, XRD and SEM–EDS (Karthiravan *et al.,* 2014). *Melia dubia* has been tested for their antimicrobial activity against ten different pathogenic microorganisms responsible for human pathologies using standard antimicrobial assays. *Melia dubia* leaf essential oil exhibited bacteriostatic and fungistatic activities against Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae and Fusarium oxysporum and Candida albicans, respectively (Nagalakshmi *et al.,* 2003).

The extract of *Melia dubia* fruits in alcohol was found to be most effective as a hypoglycaemic agent (Susheela *et al.,* 2008).The study was conducted by Mamun-or-Rashid *et al.* (2014); Nojima *et al.* (1998); Makheswari *et al.* (2012); Schwab *et al.* (2006) also demonstrated the importance of *Melia dubia* in the treatment of diabetes.

Importantly, numerous compounds with pesticidal potency are present in different parts of *M. dubia*. Accordingly, many extracts of various parts of this plant show pesticidal properties. Refined bark consists 60-70% of too sandanin that can be used to control Helicoverpa armigera (Koul *et al.,* 2002) and this compound is a strong antifeedant and growth inhibitor against Pierisrapae larvae (Shin-Foon, 1989). Limonoids from Meliaceae have the potential to control a variety of insect pests effectively without harming the environment (Carpinella *et al.,* 2002). Many different extracts of *Melia dubia* have ovicides (Malarvannan *et al.,* 2009), larvicides (Karthikeyan *et al.,* 2014), growth inhibitors, antifeedants, stomach poisons

and cause moulting disorders and morphological defects in a number of pests (Bhuiyan *et al.,* 2001).

1.2 Importance and Need of Study

The majority of the world's wood supply is sourced from native forests, which are not sustainably managed. Even though large areas of plantations have been established in many countries, the rate of planting has been insufficient to meet current and projected future demand. As the present scenario the timber demand in India is at very high hence, the need of commercial agro-forestry is ever increasing. *Melia dubia* is one of the fastest growing species among timber varieties on this planet. *Melia dubia* originates from the Meliaceae family and is an indigenous species to India. These trees can be cultivated in all types of soil and requires less management practices.

The total area of industrial plantations suitable for commercial wood production globally is around 94 million hectares, of which over 70% is softwood. Plantation grown wood is estimated to account for 3% of the world's forest resources, according to Food and Agriculture Organization's Statistical region data. Plantation wood supplies 10% of fuel wood and around a third of industrial wood used today, reported by Global Forest Resources Assessment 2020. The significance of environmental degradation issues and effects of climate change it is need of the hour to promote agro-forestry towards sustainable development. The economic benefits of timber investments will also provide relatively high returns for the low risk they carry.

Wood is the most preferred material for various end uses ranging from fuel wood to composite products. Thus wood can be replaced by wood itself which is considered an energy efficient material. The emphasis is to shift the source from natural forests to plantation timbers. The choice of species for different end uses is also changing from durable primary conventional timber species to short-rotation, fast-growing plantation species. Large number of wood based industries such as sawn wood and composite panel product manufacturers presently face acute

shortage of raw materials and the supply–demand gaps are increasing day by day in alarming proportion.

Melia dubia originates from Meliaceae family and is an indigenous species of tree to India, south east India and Australia, where it has been cultivated as a source of firewood. *Melia dubia* is commonly is commonly found in the hill station elevations ranging from 600-1800 meters and grows well in rainfall areas of 25'' to 35'' (625mm to 875mm). It is fast growing tree and is used for reforestation purposes. The wood of this tree is used majorly in plywood industry, and also pencil, photo frames, match box sticks, packing cases etc. (Nataraj pencil company using the *Melia dubia*). The seedlings production is very difficult because its germination percentage is as low as 10% and seed germination started from 32 days of sowing continued up to 64 days. Moreover due to sluggish and poor seed germination there is a threat of its gene pool exclusion from the natural habitat. *Melia dubia* is a large tree, attaining a height of 20 meters with a spreading crown and a cylindrical straight trunk of 9 meters length X 1.2-1.5 m girth. About 400 trees can be planted in an acre which fetches Rs. 10-12 lakhs in 6 – 8 years time. It occurs in the tropical moist deciduous forests which yields useful timber and found in Kerala, Karnataka, Sikkim, Himalayas, North Bengal, Upper Assam, Khasi Hills, Hills of Orissa, N. Circars, Deccan and Western Ghats at altitudes of 1500-1800 meters. It is occasionally planted for ornament and makes a handsome avenue tree and a shade tree.

Melia dubia is a short rotation and fast growing species which is suitable for manufacturing plywood and partical board. The use of this converted wood itself reduces the pressure of wood and conservers the natural and protected forest and helps in helping to reduce the illicit felling of timber. This the problem of *Melia dubia* is the natural regeneration due to its less germination.

Taking above point of view, the present study will be under taken with the following objectives identify the suitable treatment for improving the rate of germination in *Melia dubia*.

1.3 Objectives

1. To study the effect of seed treatment on germination of *Melia dubia* (Malabar neem).
2. To study the effect of seed treatment on seedling vigor of *Melia dubia.*
3. To find out suitable seed treatments for better germination in *Melia dubia.*

1.4 Hypothesis

The use of seed treatment has become very common for improving the germination and enhancing subsequent seedling growth. Different pre sowing treatment are used to enhance the rate, uniformity of emergence and germination in many tree crops. These treatment include Control (untreated seeds), Soaking in tap water 12 and 24 hours, Soaking in Hot water 6 and 12 hours, Soaking in cow dung for 5 and 7 days, soaking in Gibberellic acid (GA_3) at concentration of 300ppm for 12 and 24 hours, Soaking in Gibberellic acid at concentration of 500ppm for 12 and 24 hours, soaking in cow urine for 12 and 24 hours.

Using these treatments it would possible to enhance germination of *Melia dubia* .

1.5 Scope and limitation of the study

Melia dubia is a fastest growing tree species as well as multipurpose tree species, finding use as raw material for plywood , fodder for livestock, and a secondary timber due to its fast growing it is also known as money spinner tree. Large scale planting is hampered by poor seed (less than 10%) germination despite producing abundant quantities of fruit year but due to lack of package of practices thereby making planting stock is unavailable.

Looking to the above stated facts for obtaining a greater number of plants the present study was undertaken to evaluate the pre- treatment studied to improve germination in *Melia dubia* at Department of Forestry, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola.

The intensity of seed treatment in respect of concentration of growth hormone and duration of treatment affect the seed germination and growth of seedling. Higher concentration of seed treatment growth hormones may adversely affect the seed germination and desirable seedling growth the chemicals which are proved to be good for seed treatment in other crops are not so effective for *Melia dubia* seed treatment.

In view of the above the investigation was carried out on pre-seed treatment studies to improve germination in *Melia dubia* with different seed treatment during year 2020-21.

CHAPTER II

REVIEW OF LITERATURE

Melia dubia (Malabar Neem) is a fastest growing as well as valuable multipurpose forest tree. It is native to India. The natural regeneration through seeds is difficult due to seed dormancy and long gestation period, is the limiting factor for seed germination and thus it caused prolongation in seed germination. The seed of *Melia dubia* is impermeable seed coats, mechanically resist seed coats, rudimentary and physiological immature embryo.

For establishing large scale plantation of any tree species, the information on nursery establishment, especially on seed biology and standardized pre-sowing treatment are essential for producing quality timber and cost effective planting material.

In this literature pertaining these aspects which is relevant to the objectives of this study such as pre sowing treatment and vigor of seedling studies done by earlier workers is reviewed. Since the information on *Melia dubia* is scanty, studies related to other species are also reviewed.

2.1 Review on different treatment for seed germination of *Melia dubia*

Gour (1980) observed that walnut seeds have better seed germination (84-87%) when seeds treated with Gibberellic acid at concentration of 125 to 250 ppm for 24 hours.

Gopikumar *et al.* (1993) found that highest germination was found in *Terminalia tomentoso* and *Terminalia paniculate* when seeds are soaked in Gibberellic Acid 250 ppm for 2 hours whereas in Jackfruit (*Artocarpus heterophyllus*) and *Artocarpus hirute* when seeds are treated with cold water in Trichur (Kerala) conditions.

Viswanath *et al.* (1995) observed that pre-soaking of Teak seeds in GA_3 100ppm solution for 12 hours had given germination percentage.

Patel *et al.* (1996) observed that, significantly maximum seed germination found in cow dung soaking treatment for 24 hours over control and other treatment in Khirnee.

Claudia *et al.* (1997) observed that, soaking in cow dung slurry germination percentage increase 31% as compared to control in *Prosopis flexuosa*.

Khan *et al.* (2000) stated that Alternate soaking in cold water and sun drying at 24 hours interval continued upto seven days showed best germination success in Teak (*Tectona grandis*).

Kiran *et al.* (2001) stated that seeds of *Gevotia rotteriformis* exhibited the higher germination when treated with GA_3 at 1000 and 2000 ppm as compared to negligible germination in control.

Mohommed Alamir and Mohommed Kamal Hossain (2005) conducted study in Institute of Forestry and Enviromental science University of Chittagong, Bangladesh on pre-sowing treatments on germination & initial seedling development of *Albizia saman*. In which they observed that Nail chipping in one side of the seed T_4 provides the highest (50%) followed by seeds immersion in cold water (24 hrs) (42%).

Alamgir and Hossian (2005) they noted that seeds treated with boiled water for 30 sec followed by 24 hours in cold water immersion provide highest seed germination. Followed by seed treated with boiled water of 1 min and 24 hours cold water immersion and these treatment are recommended for maximum and initial vigor seedling growth of *Albizia procera* in the nursery.

Sharma and Rana (2007) assessed the effect of growth media, size, and weight of seeds and depth of the seed sowing on *Jatropha carcus* and revealed that germination percentage (80.5%), final seedling stand before planting (75.6%), seedling height (90.50cm) and number of branches per seedling, collar diameter and many more. Bold seeds sown at 3 to 4 cm depth produced significantly superior in terms of growth and quality parameter and improve economics over the normal seeds.

Kumar (2007) noted that there is no significant difference between fresh seed sown and storage seeds. Freshly collected seeds were

grouped in 3 sub lots viz. larger seeds; medium seeds; small seeds. Large size fresh seeds showed high germination percentage as compared to medium and small. Small size seeds showed significantly maximum number of leaves and total biomass followed by medium and large sized seeds after 35 days of storage. All these finding suggested that any grade of fresh neem seeds can be sown. If sowing is slightly delayed then small and medium size seeds may be preferred for sowing to get better seed and seedling performance.

Kadam (2009) revealed that maximum seedling length and number of leaves per plant GA_3 150 ppm in Kagzi Lime.

Dhaka and Pal (2009) observed that seed treated with GA_3 500ppm for 40 hours before sowing also increased the length of seedlings (8.94 cm) compared to GA_3 450 ppm in Lime.

Salim *et al.* (2010) revealed that a germination experiment of pre-treated seeds of *Melia azedarach* was conducted in the nursery were they revealed that highest germination success (80%) was found in scarification with sand paper followed by 74% and 69% in immersion in H_2SO_4 and hot water respectively.

Tadros *et al.* (2011) studied the effect of different pre-sowing seed treatments on germination of *Leucaena leucocephala* (Lam.) and *Acacia farnesiana* in which they stated that blade scarification increased *A. farnesiana* seed germination to 56% seeds of *Leucaena leucocephala* soaked in 70 degree/c water for 20 min and the soaked for 24 ,48 or 72 hrs had germination rate above 97%.

Harshvardan (2011) observed that soaking the seed in GA_3 100 ppm for 24 hours resulted in higher percentage of germination (77.3%) in Jackfruit.

Azad *et al.* (2011) observed that different sowing treatments on seed germination percentage and growth performance of *Acacia auriculiformis* in which they observed that highest germination (80%) was found in hot water and followed by 78% in scarification with sand paper, 75% with immersion in H_2S0_4.

Dhoran and Gudadhe (2012) found that GA_3 had a significant effect on germination rate as compared to control.

Anand *et al.* (2012) studied different pre sowing treatment effect on germination on seed of *Melia dubia* and seedling growth. Where, seeds are subjected to seven pre-sowing treatments. The results showed that cow dung slurry treatment for seven days had significantly enhanced germination and seedling growth. Seed germination started 32 days after sowing and continued upto 66 days. The highest germination percentage was observed in the soaking of seeds in cow dung for seven days, followed by 100ppm gibberellic acid for 24 hours. And lowest germination percentage was obtained from control.

Darane (2013) studied the effect of pre-sowing treatments on seed germination and seedling vigor of Shikakai (*Acacia concinna* D.C.) observed that seed treated with acid treatment (dipping in 20% con. H_2SO_4 for 10 min) gave maximum germination with optimum vegetative growth & survival of seedling (66.67). Followed by dipping in 20% con. H_2SO_4 for 5 min (58.00).

Suresh *et al.* (2013) studied various causes of poor seed germination in *Melia dubia* and efforts to overcome and found that among various seeds treated with GA 100ppm ,showed maximum germination of 30.0% ,followed by 16.6% in GA 200 ppm treatment respectively, while other treatment show little response. Under complete aspetic conditions seed showed highest germination of 61%. So high rate of germination seen under controlled condition clearly indicate the role of light, temperature and nutrients on germination apart from hormones and morphometric characters.

Ralte (2014) noted the effect of pre sowing treatments on germination and performance of *Swietenia macrophylla* King in which he stated that cold water treatment for 24 hours is superior to any other treatment and alternate wetting and drying (24 hours wetting and sun dry for 24 hours).

Girhe (2014) studied the effect of pre-sowing treatments on germination and vigour of Reetha. (*Sapindus laurifolius* Vahl.) observed that dipping in 20% concentrate H_2SO_4 for 6hrs (74.00%) followed by dipping in 20% con. H_2SO_4 for 3hrs. (64.00%).

Botsheleng *et al.* (2014) observed the effects of pre-treatments methods on germination of pod mahogany and Mukusi seeds. They studied different seed pre-treatments (mechanical, concentrated sulphuric acid for 3, 6, 9, 12 min., hot water treatment for 3,6,9,12 minutes) to overcome the seed dormancy of mahogany pod and Mukusi. Conducted their research between January and March 2013.

Haider *et al.* (2014) studied that the germination percentage of *Acacia catechu* seed. Germination tests were conducted in germination tray as well as nursery bed. *A catechu* seed in cold water for 14 hours is suggested for nursery raising.

Naguri and Tank (2015) observed that Mango stones treated with cow dung for 24 hours and GA_3 100ppm for 10 minutes showed increased germination upto 70-72%.

Omakha *et al.* (2015) studied that *Masobotrya barteri* seeds when treated with hydrogen peroxide (H_2O_2) has given highest germination percentage (66%) while untreated seeds which had the lowest germination of 20.4%.

Sujatha *et al.* (2015) reported positive effects of KNO_3 (Potassium nitrate) solution in enhancing germination percentage and other germination related parameters. They found that the seedling height and seedling vigor of *Melia azerdarach* were also maximum in KNO_3 solution at the end of germination period.

Francoline Jong Nkemnkeng *et al.* (2016) observed that partial manual removal of the Pappus (T_1) and followed by total removal of Pappus (T_2) while (T_4) Roosting for 4 minute and (T_5) Roosting for 6 minutes are least in *Echinops giganteus* C.D. Adane.

Kumar (2016) stated that water soaking of the seed of 24hrs produced the highest germination in *Terminalia bellirica* (Gaerth.) ROXB

Priya (2016) recorded minimum number days to germinate (12.67 ± 0.033) when walnut seeds are treated with combination of cracking ± GA_3 at 200 ppm concentration.

Khaimngamang Pama *et al.* (2017) reported that highest germination (43.3%) was observed in T_3 (Alternate wet and drying) followed by T_5 (H_2SO_4 20min – 33.3%) was recorded in T_2, T_4, T_{12},

(sunlight cow urine and HNO_3 15min) respectively in seeds of *Tectona grandis* under nursery condition.

Rusdy (2017) observed that best results in soaking in sulphuric acid for 20 minutes for highest germination percentage, plant height, number of leaves.

Vijaylaxmi and Rangnayaki (2017) observed that soaking in water 48 hrs treatment recorded better germination percentage as compared to acid scarification in seed of Red sanders.

Lucches *et al.* (2018) studied analysis of seed vigor and germination of *Toona cilita* M. Roem. Var. australis. The objective was to determine basic information about temperature and photoperiod for the germination test and the imbibitions time and volume of water for electrical conductivity. In the germination test the seeds were incubated at 15, 20, 25 and 30 degree Celsius with 0, 12 and 16 h of light .The electrical conductivity was evaluated upto to 18 h after immersion of the seeds in 50 and 100 ml of deionized water. It also showed a stronger correlation between normal seedlings, being a promising vigor evaluation test for this species.

Singh and Dhillon *et al.* (2018) investigated the influence of pre-sowing seeds and pre planting cutting treatment on germination and growth of *Melia composita* wild. under nursery condition for 2 years found that highest germination was recorded in half cut drupe treatment in both years. Significant effect of pre-planting cutting treatment and rooting media was observed on sporting and rooting percentage. During spring season, maximum rooting was reordering cutting treated with IBM 3000 ppm which was significantly higher than all the other pre-planting cutting treatment.

Bhawar (2018) stated immersion in GA_3 20 ppm for 10 min gives highest germination percentage (68.7%) and least was found in Hot water for 12 hrs (38.8%) in seeds of Arjun (*Terminalia arjuna* ROX_6.)

Singh *et al.* (2019) studied the enhancing germination indices of Neem seeds during pre-sowing treatments in laboratory conditions i.e. seed coating with gum, clay, paraffin wax and seed storage under wet

conditions and low temperature (10℃, 15℃, 20℃) and sun drying for 12 and 24 hours. The sugar and starch content of seeds in the seed priming treatment and unprimed seeds were compared. Result showed that seed treatment had positive effect on final germination percentage, moisture content and uniformity of germination.

Omokhua *et al.* (2019) assessed the effect of pre germination treatments on seed germination and early seedling growth performance of *Carapa procera*. The experiment was laid out in a completely randomized design involving analysis of variance. The treatment used were hot water soaking, mechanical scarification, cold water treatment, and the control. Mechanical scarified seeds produced the highest performance for all growth parameter studied followed by control when compared to the other pre-treatment methods. It is recommended that seeds of *Carapa procera* be mechanically scarified before sowing. Although other treatment can be used to enhance germination, they may not be required foe seedling growth since seedlings from untreated seeds produced higher growth parameters after scarification treatment.

Abubakar *et al.* (2019) stated germination rate of *Acacia senegal* were observed acid treatment (85.6%) while moderate germination were recorded in hot water (77.8%) lowest was observed cold water treatment (74.4%) similarly in *Azadirachta indica* highest germination was founded in using acid treatment while least germination was found in cold water (63.3%)

Matoor Mohsin Gilani *et al.* (2019) stated that the maximum survival percentage was observed in hot water followed by cold water and mechanical treatment. Maximum germination percentage was (76.2%) and it was observed in *A*. *nilotica* whereas minimum (12.6%) was observed in *F*. *albida*.

Sayli (2020) observed that highest germination percentage was given by that immersion *Terminalia tomentosa* seeds in GA_3 40 ppm for 6hrs (73.33%) followed by soaking in con. H_2SO_4 5% for 10 min. (71.67%) while least germination is seen in control type.(28.33%)

Pooja (2020) stated that soaking in tap water (12 hrs.) wrapping dry grass till emergences has given highest germination percentage (72.50%) followed by soaking in H_2S0_4 (2% for 20 min) which is 69.50% while least was found in control treatment (32.50%) in *Pterocarpus marscpium* Raxb.

Sanap (2021) studied influence of different pre-sowing treatments on seed germination and seedling growth of Sandalwood in which he stated that highest germination percentage was found in Thiourea (2% for 24 hrs.) (37.77%) followed by GA_3 (1000 ppm for 12 hrs.) (35.55%) and least germination percentage was obtained in control treatment (14.44%)

Ajay *et al.* (2022) they revealed that, cow dung treated with 7 days had enhanced germination upto 32.46% and viability percentage 45.71% in Malabar Neem.

Ebeid *et al.* (2022) studied the effect of some pre- sowing treatments on seed germination seedling growth of *Melia azdarch* L. and *Tamarindus indica* L. highest germination percentage was recorded in 2 species treated with mechanical scarification followed by immersion in H_2SO_4 for 20 and 10 minutes. The lowest value of germination percentage in control, followed by soaking in GA_3 at 1000ppm compared to other treatments.

CHAPTER- III

MATERIAL AND METHODS

Seeds of many tree species germinate readily when subjected to favorable condition of moisture and temperature. Many other species posses some degree of seed coat dormancy, where seed coat is hard some form of pre-treatment is essential in artificial re-germination, in order a reasonably high germination in a short time.

Pre-treatment to germination seed coat dormancy and seed up germination is thus one important type of pre-treatment. Keeping in view the same, investigation on the studies on “Assessment of pre sowing germination treatment and seeding vigor in *Melia dubia* (Cav.)” was carried out at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2020-2021. The details about material and methods adopted during the course of investigation are given in this chapter.

3.1 Material

3.1.1 Climate and weather condition

Akola is a city in Vidarbha region in the state of Maharashtra in central India. Geographically, Akola is located at latitude 20.7’ North and longitude 77.07’ east. It is at an altitude of 925 ft (284 m) above sea level. Akola has a tropical savanna clim41ate (Koppen climate classification Aw), and people predominately wear cotton clothes. Akola has a National Weather Station which serves as the local weather centre. Annual temperatures range from a high of 44.9°C to a low of 16.9°C. Akola lies on the Tropic of Cancer and becomes very hot during the summer, especially in May. Although it can be very hot in the day, it is cooler at night. The annual rainfall averages 706 mm. Most of the rainfall occurs in the monsoon season between June and September, but some rain does fall during January and February.

3.1.2 Seed Source

The seeds were collected from trusted seed source from Kerala (plate 1 and 2). The selection of mother tree was based on observation. Tree height (m), age (yrs), Girth (D.B.H. in cm), Canopy(m), Estimated seed yield/tree(kg), month of flowering, Time of fruiting, Average no. of fruits/ bunch, 100 seed weight (g), number of branches, seed size. The details of mother trees are at Appendix I.

3.1.3 Preparation of potting mixture

For filling polybags, potting mixture of soil : sand : FYM in the ratio of 3:1:1 and before sowing, the seeds were treated with fungicide to control fungal attack. The germination of the seeds and seedlings performance was observed.

3.1.4 Sowing of seeds

After completion of treatments, the treated as well as untreated seed were sown in poly bags during the first week of April, after sowing the seeds were lightly covered with thin layer of soil. Labels specifying each treatment and replication were fixed up immediately as per layout of the experiment.

3.1.5 Irrigation

Irrigation was provided to seed sown in poly bags using water can in order to maintained the proper moisture level. The poly bags were watered as per requirement. The treatment to be given are as follows :

Sr.No.	Treatment Name	Treatment Detail
1.	T0	Control (Untreated seeds)
2.	T1	Soaking in Tap water (12 hrs)
3.	T2	Soaking in Tap Water (24 hrs)
4.	T3	Soaking In Hot Water (80°C) for 12 hrs
5.	T4	Soaking in Hot Water (80°C) for 24 hrs
6.	T5	Impregnate in Cow Dung (5 Days)

Plate 1. *Melia dubia*

Plate 2. Seeds of *Melia dubia*

7.	T6	Impregnate in Cow Dung (7 Days)
8.	T7	Immersion in Gibberellic Acid 300ppm (12 hrs)
9.	T8	Immersion in Gibberellic Acid 300ppm (24 hrs)
10.	T9	Immersion in Gibberellic Acid 500ppm (12 hrs)
11.	T10	Immersion in Gibberellic Acid 500 ppm (24 hrs)
12.	T11	Soaking in Cow Urine (12 hrs)
13.	T12	Soaking in Cow Urine (24 hrs)

3.2 Methodology

In present investigation study an experiment was conducted in Randomized Block Design (RBD) with thirteen treatment and three replications.

Sr.no.	**Experimental Name**	**Experimental Details**
1.	Botanical Name	*Melia dubia*
2.	Family	Meliaceae
3.	Location of Study	Department of Forestry, Dr. P.D.K.V., Akola
4.	Year of the Experiment	2021
5.	Experimental Design	Randomized Block Design (RBD)
6.	Number of Replication	3
7.	Number of Treatment	13
8.	Number of seed per Treatment	30
9.	Container used	Polybags
10.	Size of Polybags	20 x 8.5 cm

Sowing of *Melia dubia*

Initial germination

Seedling of *Melia dubia*

Plate 3. Days to early recruits

3.2.1 Details of experiment

3.2.2 Statistical analysis

The data collected on various parameters during the course of investigation were statistically analyzed using computer software Microsoft excel to explore the possible treatment variations. The analysis variance (ANOVA) and AGRISTAT software were used for the analysis as described by Panse and Sukhatme, 1967.

3.3 Observation recorded

3.3.1. The observation were taken on the following parameters

3.3.1.1. Germination Parameter

Sr.No.	Germination Parameters
1)	Days to initial germination
2)	Days to 50% germination
3)	Days to final germination
4)	Germination percentage
5)	Vigor Index.

3.3.1.2. Growth Parameter.

Sr.No.	Growth Parameter
1)	Seedling length (cm) at 120 DAS
2)	Collar diameter (mm) at 120 DAS
3)	No. of leaves at 120 DAS
4)	No. of Branches at 120 DAS
5)	Fresh weight of shoot (g) at 120 DAS
6)	Dry weight of shoot (g) at 120 DAS
7)	Fresh weight of Root (g) at 120 DAS
8)	Dry weight of Root (g) at 120 DAS
9)	Root length (cm) at 120 DAS
10)	Shoot length (cm) at 120 DAS
11)	Seedling fresh weight (g) at 120 DAS

GROWTH PARAMETERS

Plate 4. Seedling height

Plate 5. Collar Diameter

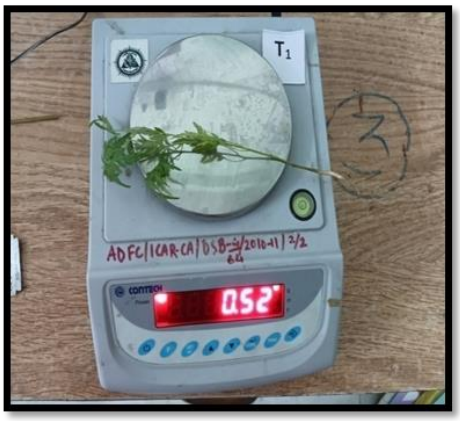


Plate 6. Seedling fresh weight (g)

Shoot Fresh Weight (g)

Shoot dry weight (g)

Plate 7. Shoot fresh and dry weight (g)

The Observation for seedling growth performance was taken 120 days after sowing to quantity the difference in the performance of the seedling due to different treatment.

3.3.1.3 Observation on germination parameters

1. Day to initiation of germination: The polybags were observed daily, for seedling emergence. The days on which the first seedling emerge was expressed as days to initial germination.

2. Days to 50% germination : A number of days taken for 50% of the seeds to germinate in entire lot were considered as 50% germination.

3. Days to final germination: A number of days taken for final germination of the seeds of the entire lot were considered as final germination.

$$\text{Survival Percentage \%} = \frac{\text{Number of seedlings survived}}{\text{Total number of seed sown}} \times 100$$

4. Germination % : The number of normal seedling produced in each treatment were counted and average was expressed in percent.

$$\text{Germination \%} = \frac{\text{Number of seed germinated}}{\text{Total number of seed sown}} \times 100$$

5. Vigor Index: The vigor index (VI) was computed using the following formula and express as whole numbers.

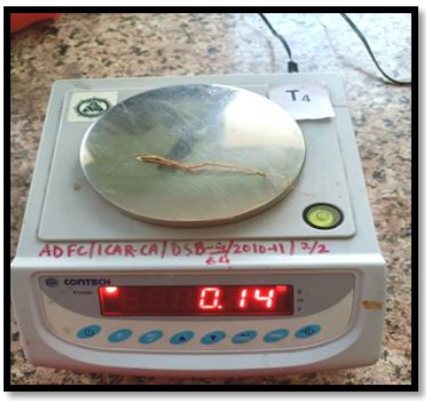
Seedling Vigor Index = Germination percentage x dry weight (g/seedling).

6. Seedling height (cm): The seedling height was measured in centimeter from the grown level to the grown tip with the help of measuring scale.

7. Seedling fresh weight of plant (g): The seedling fresh weight of plant was measured with the help of weighing balance.

8. Collar diameter (mm): The diameter of the seedling was measured in millimeter at 2cm above the ground level with the help of Vernier caliper.

9. Fresh weight shoot (g): After separating seedling shoot fresh weight was measured with the help of weighing balance.



Root fresh weight (g)

Root dry weight (g)

Plate 8. Root fresh and dry weight (g)

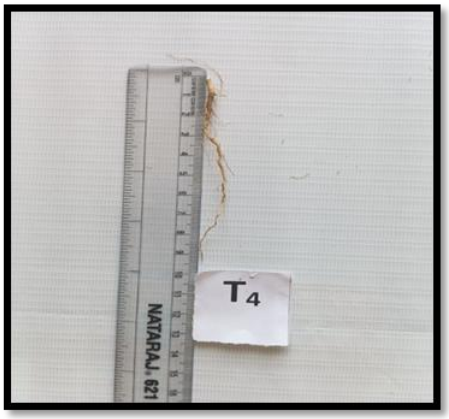


Plate 9. Shoot length (cm)

Plate 10. Root length (cm)

10. Dry weight shoot (g): The weighted fresh shoot of plant was placed in brown paper bag properly label and drying in oven.

11. Shoot length (cm): The shoot length was measured by scale in centimeter whenever it separates from root.

12. Fresh weight Root (g): After separating root from seedling root fresh weight was measured with the help of weighing balance.

13. Dry weight Root (g): After separating root from seedling root was placed in brown paper bag properly labeled and drying in oven, weight was measured with the help of weighing balance.

14. Root length (cm): The Root length was measured by scale in centimeter whenever it separates from root.

15. Number of leaves: The number of leaves per plant were counted from the randomly selected plant & after computing mean; calculated as an average number of leaves per plant.

16. Number of branches per seedling: The number of branches per plant were counted from the randomly selected plant & after computing Mean; calculated as an average number of branches per plant.

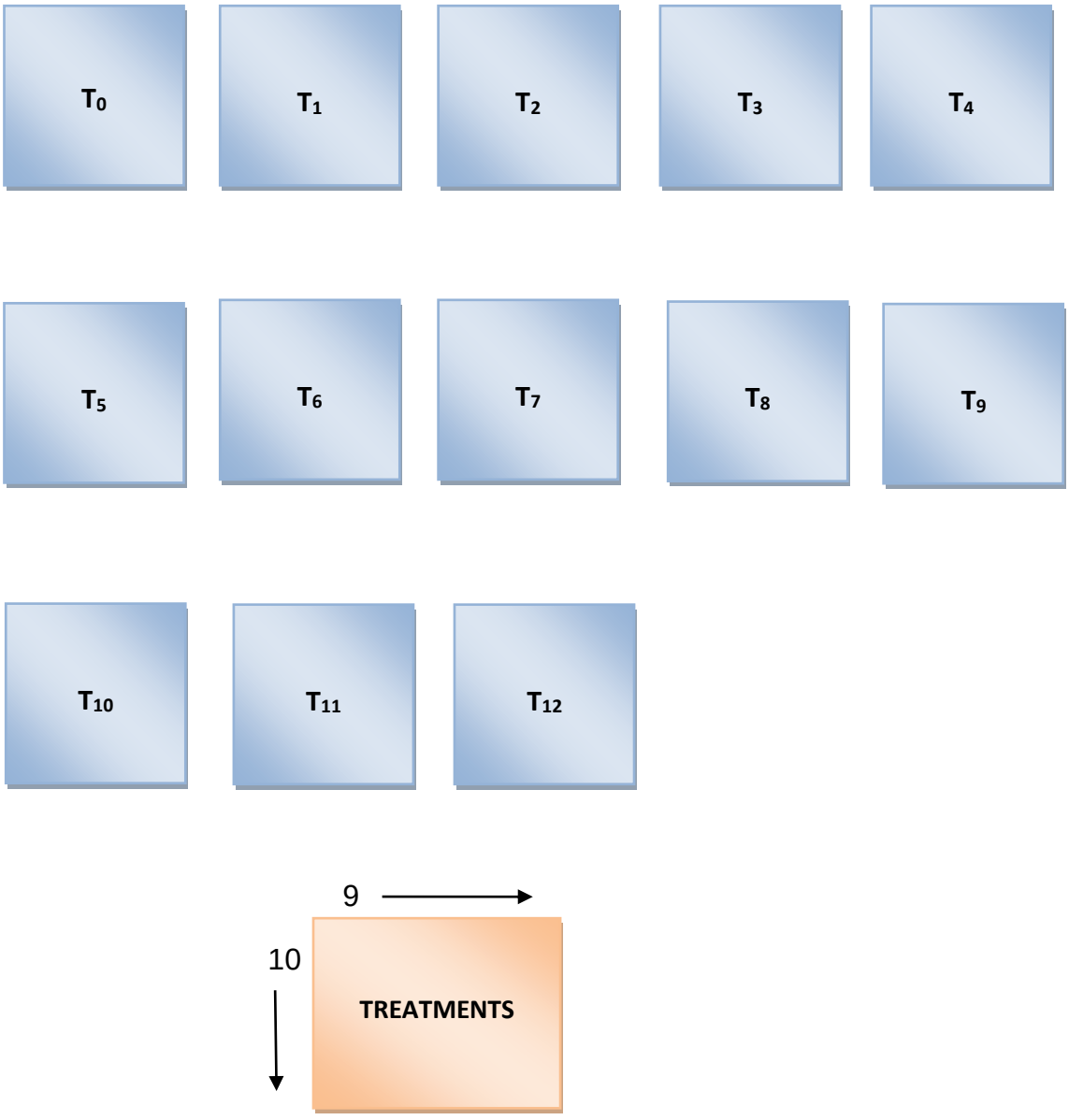


Plate 11. Layout of the research field

CHAPTER IV

RESULT AND DISCUSSION

The result of an experiment entitled, “Assessment of pre-sowing germination treatment and seedling vigor in *Melia dubia* (Cav.)” was carried during year 2021-22 under Department of Forestry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola with following observation.

The result of the experiment are based on various observations viz., days to initial germination, days to 50% germination, days to final survival percentage, germination percentage, vigor index, seedling length (cm), collar diameter (mm), no of leaves, no of branches, fresh weight of the shoot (g), dry weight of shoot (g), shoot length (cm), root length (cm), root fresh weight (g), root dry weight (g), seedling fresh weight (g) are presented an discussed in this chapter under the following heading and subheadings.

4.1 Effect of seed treatments on days to initiation germination, days to 50% germination, days to final germination, Germination Percentage.

Seed are an integral part of any tree improvement strategy. The suitability and availability of seeds have the potential to seriously impact the regeneration rates in either natural or artificial conditions. Hence, a tree breeder is usually interested in collecting seeds from different provenances or progenies in order to make recommendations based on results of germination trials for proper selection for large-scale afforestation or plantation establishment.

Table 1. Effect of seed treatments on days to initiation germination, days to 50% germination, days to final germination, Germination Percentage.

Seed treatment	Days to initiation germination	Days to 50% germination	Days to final germination	Germination Percentage
T_{0}- Control (Untreated seeds)	53.65	58.03	85.98	15.55 (23.22)*
T_{1}- Tap water (12 hrs.)	51.24	57.65	82.79	16.66 (24.09)*
T_{2}- Tap water (24 hrs.)	50.12	55.81	79.25	18.88 (25.75)*
T_{3}- Hot water (12 hrs.)	48.56	54.23	78.32	21.11 (27.35)*
T_{4}- Hot water (24 hrs.)	47.33	52.00	76.57	22.22 (28.12)*
T_{5}- Cow dung (5 days)	36.23	40.08	68.13	30.00 (33.21)*
T_{6}- Cow dung (7 days)	35.00	39.00	67.78	31.10 (33.90)*
T_{7}- GA_{3} 300 ppm (12 hrs.)	46.05	51.79	75.13	23.33 (28.88)*
T_{8} - GA_{3} 300 ppm (24 hrs.)	44.67	50.39	74.05	24.44 (29.63)*
T_{9} - GA_{3} 500 ppm (12 hrs.)	39.00	42.31	70.70	27.77 (31.80)*
T_{10} - GA_{3} 500 ppm (24 hrs.)	38.89	41.66	69.53	28.88 (32.51)*
T_{11}- Cow urine (12 hrs.)	42.18	49.32	72.92	25.55 (30.36)*
T_{12}- Cow urine (24 hrs.)	40.11	45.66	71.78	26.66 (31.09)*
F – Test	Sig	Sig	Sig	Sig
SE(m)±	1.354	1.319	2.133	0.628 (0.908)*
C.D. at 5%	3.975	3.872	6.264	1.843 (2.665)*

The value in brackets () are angular transformation value.

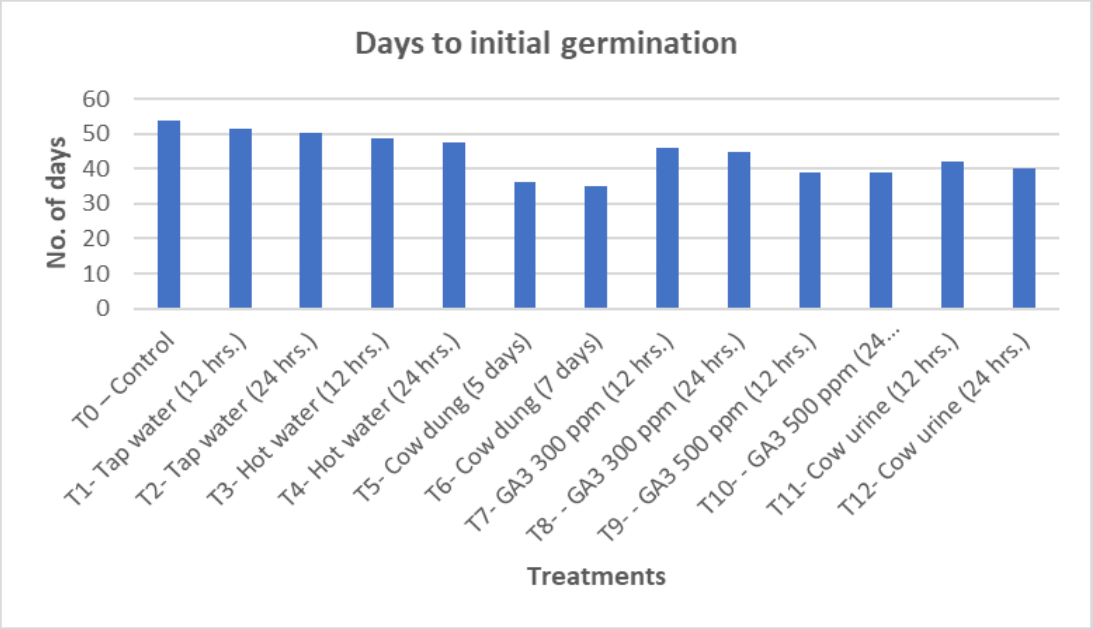


Fig 1. Effect of seed treatments on days to initial germination

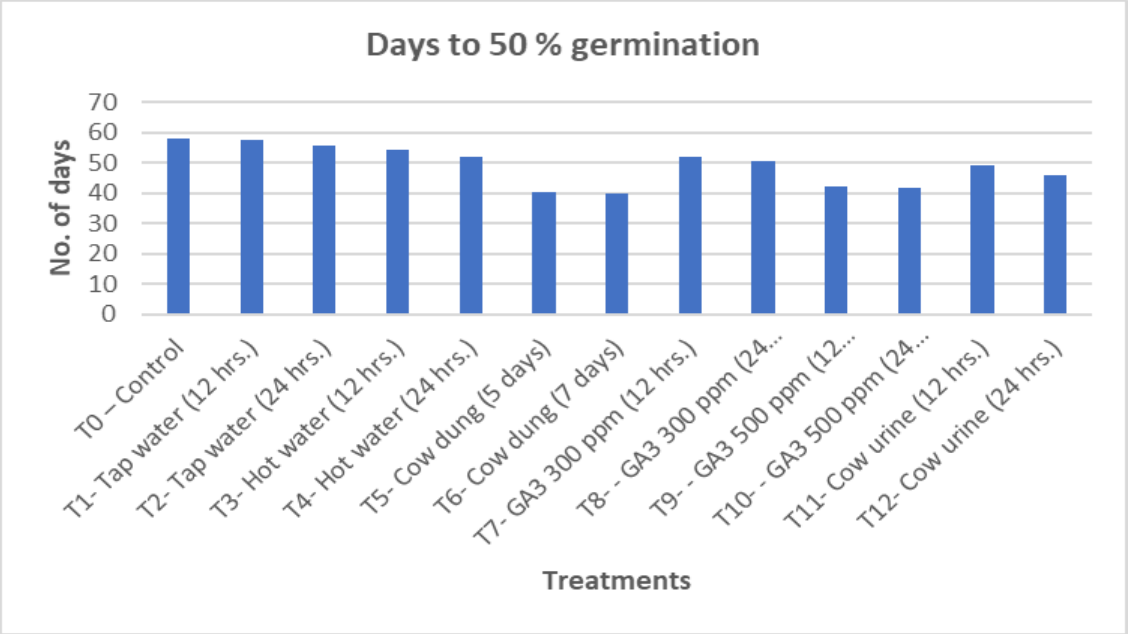


Fig 2. Effect of seed treatment on days to 50 % germination

Data on germination was tabulated in Table 1 and also depicted in Fig.1. It revealed that seed treatment significantly influenced on day to initiation germination for seed germination of *Melia dubia*.

The minimum days required for initial seed germination of *Melia dubia* was observed in T_6 (35.00 days) i.e. Soaking in cow dung (7 days) and followed by T_5 (36.23 days) i.e. Soaking in Cow Dung (5 days) and T_{10} (38.89 days) i.e. GA_3- 500 ppm (24 hrs) followed by treatment T_9 (39.00 days) and T_{12} (40.11 days) i.e. GA_3 -500ppm (12 hours) and cow urine (24 hours) respectively. However, the maximum days required for initial seed germination was recorded in T_0 (53.65 days) i.e. Control Treatment.

The above results of days required for initial seed germination are minimum in T_6 i.e Impregnated in cow dung for 7 days which is due to increased microbial population, presence of anaerobic condition and moderate temperature which triggers the germination percentage. The results are in conformity with Anand B. et al (2012) their study revealed that, Cow dung slurry treatment for seven days had significantly enhanced germination and seedling growth.

4.2 Effect of seed treatment on days to 50% germination

Seed germination is the sum of events that begin with hydration of the seed and culminate in emergence of the embryonic axis from the seed coat.

The data in Table 1 and depicted in Fig. 2, indicated that seed treatments was significantly influenced the days required for 50% germination of *Melia dubia*.

The minimum days required for 50% seed germination was observed in treatment T_6 (39.92 days) i.e. Impregnate in Cow dung (7 days) and followed by treatment T_5 (40.08 days) i.e. Impregnate in Cow dung (5 Days) and T_{10} (41.66 days) i.e. GA_3 -500 ppm (24 hrs). However, the maximum days for 50% seed germination of *Melia dubia* was recorded in T_0 (58.03 days) i.e. Control Treatment.

4.3 Effect of seed treatment on final germination

As regarding to, days required for final germination, the data presented in the treatment Table 1 and depicted in Fig. 3 indicated that, seed treatments was significantly influenced the days required for final germination of *Melia dubia*.

The minimum days required for final seed germination was observed in treatment T_6 (67.78 days) i.e. Impregnate in Cow dung (7 days) and followed by treatment T_5 (68.13 days) i.e. Impregnate in Cow dung (5 Days) and T_{10} (69.53 days) i.e. GA_3 -500 ppm (24 hrs). However, the maximum days for final seed germination of *Melia dubia* was recorded in T_0 (85.98 days) i.e. control treatment.

Above results clearly indicate that, the *Melia dubia* seeds treated with treatment T_6 i.e. impregnate in cow dung (7 days) showed minimum days required for germination. As compared to other treatment combination. This might be due to fact that cow dung is an ideal fermentation medium for amylase production in solid-state fermentation by *Bacillius cerus* similar kind of results were recorded by Shinde and Malshe, 2020 which helps in increasing the rate of germination.

4.4 Effect of seed treatment on Seed Germination percentage after 120 DAS

As regarding to the germination percentage the data presented in Table 1 and depicted in Fig. 4 indicated that, seed treatment significantly influenced the Seedling vigor index of *Melia dubia*.

The maximum germination percentage was observed in treatment T_6 (31.10%) i.e. Impregnate in Cow dung (7 days) and followed by treatment T_5 (30.00%) i.e. Impregnate in Cow dung (5 Days) and T_{10} (28.88%) i.e. GA_3 -500 ppm (24 hrs). However, the maximum days for 50% seed germination of *Melia dubia* was recorded in T_0 (15.55%) i.e. control treatment.

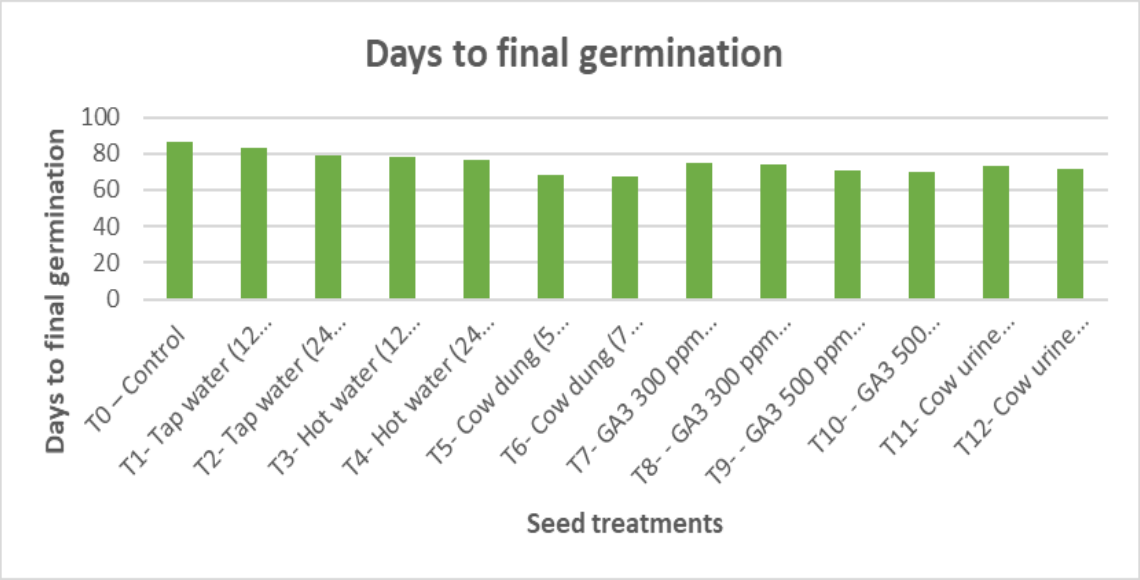


Fig 3.Effect of seed treatment on days to final germination

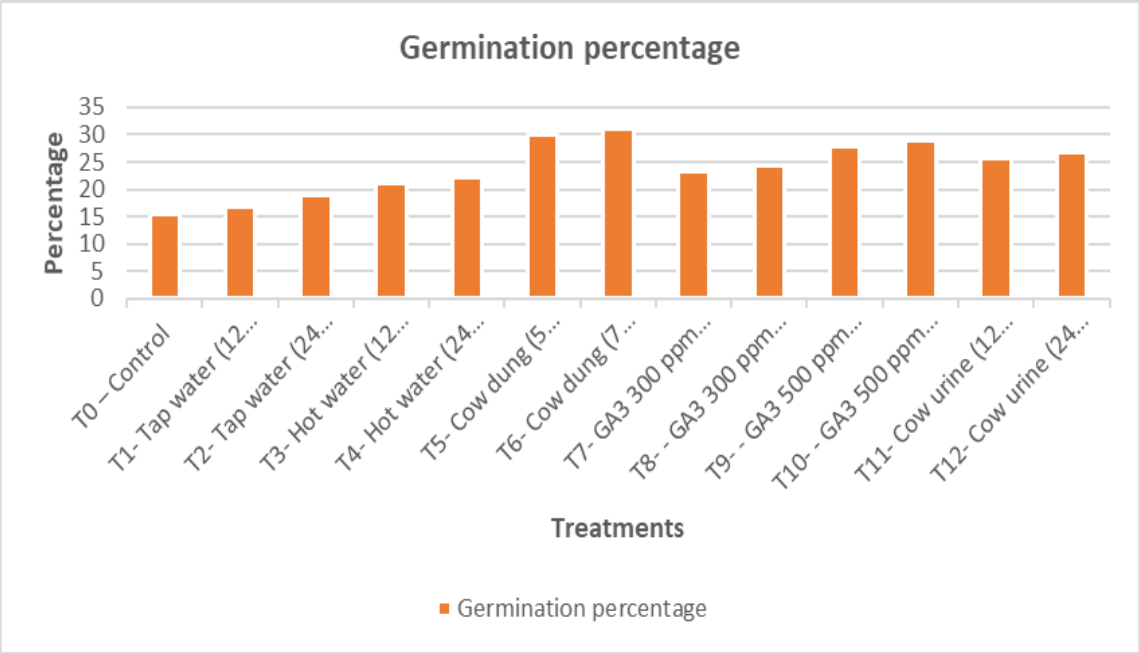


Fig 4. Effect of seed treatment on germination percentage

The above result clearly indicate that, highest germination might due the presence of growth promoting substances (auxin) and nutrition (Shinde and Malshe 2015). Auxin is one of the classic phtyo-hormones effective during tropism growth and tissue differentiation. In recent studied it is found that auxin possesses positive effects on seed dormancy, which suggests that second phtyo-hormone that induced seed dormancy, beside ABA. The similar results were reported by Naguri and Tank in 2015 that soaking the seed of mango stones cow dung slurry for 24 hours showed increased germination upto 70-72%. Hence, cow dung had significant effect on breaking the seed dormancy and germination of the seed.

The result of germination percentage is in conformity with the soaking of *Melia dubia* seeds in cow dung slurry for 24 hours reported by Anand *et al.*, 2012.

4.5 Effect of seed treatments on seedling vigor index at 120 DAS

As regarding to the seedling vigor index the data presented in Table 2 and depicted in Fig. 5 indicated that, seed treatment significantly influenced the Seedling vigor index of *Melia dubia*.

Table 2. Effect of seed treatment on seedling vigor index at 120 DAS

Seed treatments	Seedling vigor index
T_0 – Control	0.93
T_1- Tap water (12 hrs.)	2.50
T_2- Tap water (24 hrs.)	6.04
T_3- Hot water (12 hrs.)	9.29
T_4- Hot water (24 hrs.)	12.44
T_5- Cow dung (5 days)	49.50
T_6- Cow dung (7 days)	63.44
T_7- GA_3 300 ppm (12 hrs.)	14.00
T_8- GA_3 300 ppm (24 hrs.)	19.31
T_9- GA_3 500 ppm (12 hrs.)	33.32
T_{10}-GA_3 500 ppm (24 hrs.)	40.43
T_{11}- Cow urine (12 hrs.)	24.02
T_{12}- Cow urine (24 hrs.)	46.12
F – Test	Sig
SE(m)±	1.183
C.D. at 5%	3.474

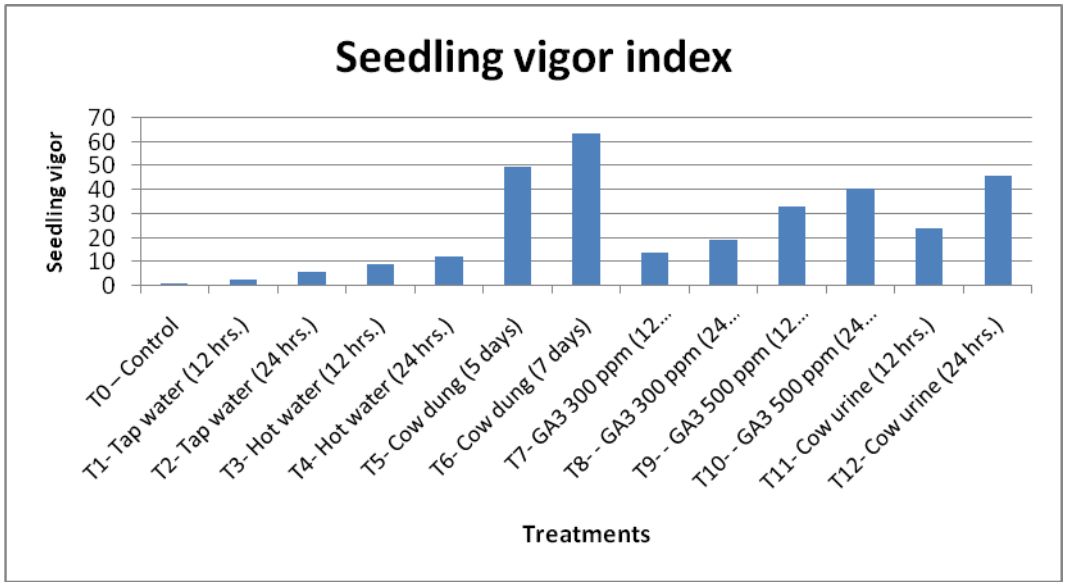


Fig 5. Effect of seed treatment on seedling vigor index at 120 DAS

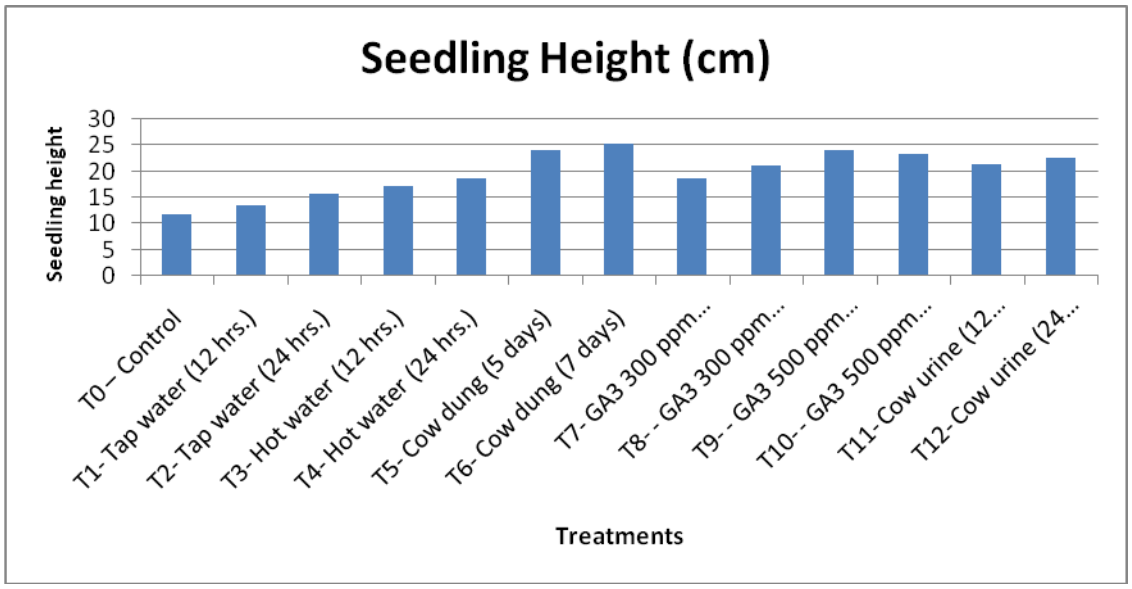


Fig 6. Effect of seed treatment on seedling height at 120 DAS

The maximum seedling vigor index was observed in treatment T_6 (63.44) i.e. impregnated in cow dung for 7 days and followed by T_5 (49.5) i.e. Impregnated in cow dung for 5 days and T_{10} (40.43) i.e. GA_3 500 ppm (24 hrs). However, minimum seedling vigor index of *Melia dubia* was recorded in T_0 (0.933) i.e. control.

In present investigation, the highest vigor of seedling due to auxin and various nutrients like nitrogen, phosphorus, potassium present in cow dung pre –soaking can be co-related with higher seed germination , higher shoot length and root length and number of leaves has lead to over all assimilation and distribution of food material with the plant. The results are in conformity with the finding of Ajay *et.al* (2022) and Anand B *et.al* (2012).

4.6 Effect of seed treatments on seedling height after at 120 DAS

The seedling height in Table 3 and depicted in Fig. 6 indicated that, seedling height of *Melia dubia* recorded at monthly interval was significantly influenced by the seed treatment.

Table 3. Effect of seed treatments on seedling height after at 120 DAS

Seed treatment	Seedling Height (cm)
T_0 – Control	11.71
T_1- Tap water (12 hrs.)	13.60
T_2- Tap water (24 hrs.)	15.74
T_3- Hot water (12 hrs.)	17.30
T_4- Hot water (24 hrs.)	18.57
T_5- Cow dung (5 days)	24.00
T_6- Cow dung (7 days)	25.34
T_7- GA_3 300 ppm (12 hrs.)	18.73
T_8- GA_3 300 ppm (24 hrs.)	21.21
T_9- GA_3 500 ppm (12 hrs.)	23.99
T_{10}-GA_3 500 ppm (24 hrs.)	23.40
T_{11}- Cow urine (12 hrs.)	21.35
T_{12}- Cow urine (24 hrs.)	22.60
F – Test	Sig
SE(m)±	0.665
C.D. at 5%	2.002

The seedling height recorded at 120 days after sowing was found maximum in treatment T_6 (25.34 cm) i.e. (Impregnate with cow dung impregnate seeds for 7 days) and followed by T_5 (24.00 cm) i.e. Cow Dung (soaking 5 days) and T_{10} (23.40 cm) i.e. GA_3 500 ppm (24 hrs) However; minimum seedling height of *Melia dubia* was recorded in T_0 (11.7 cm) i.e. control.

Above result clearly indicates that, the Malia dubia seeds treated with treatment T_6 i.e. Impregnate with Cow dung slurry for 7 days showed maximum seedling height as compared to other treatments. This might due to the presence of growth promoting substances (auxin) and nutrition in Cow dung slurry which helps in improving the germination of the seeds. Auxins are a powerful growth hormone produced naturally by plants. They are found in shoot and root tips and promote cell division, stem and root growth. They can also drastically affect plant orientation by promoting cell division to one side of the plant in response to sunlight and gravity.

4.7 Effect of seed treatments on number of leaves at 120 DAS

The data presented in Table 4 and depicted in Fig. 7 indicated that, seed treatment significantly influenced on number of leave of *Melia dubia*.

Table 4. Effect of seed treatments on number of leaves at 120 DAS

Seed treatment	Number of Leaves
T_0 – Control	6.30
T_1- Tap water (12 hrs.)	11.90
T_2- Tap water (24 hrs.)	13.17
T_3- Hot water (12 hrs.)	13.83
T_4- Hot water (24 hrs.)	16.17
T_5- Cow dung (7 days)	20.07
T_6- Cow dung (5 days)	21.25
T_7- GA_3 300 ppm (12 hrs.)	16.28
T_8- GA_3 300 ppm (24 hrs.)	16.29
T_9- GA_3 500 ppm (12 hrs.)	19.28
T_{10}-GA_3 500 ppm (24 hrs.)	19.58
T_{11}- Cow urine (12 hrs.)	16.84
T_{12}- Cow urine (24 hrs.)	18.30
F – Test	Sig
SE(m)±	0.430
C.D. at 5%	1.263

The number of leaves at 120 days after souring was found maximum in treatment T_6 (21.25 no of leaves) Cow dung during (Impregnate it for 7 days) and followed by T_5 (20.07 no of leaves) i.e. impregnate in cow dung for 5 days and T_{10} (19.58 no of leaves) i.e.GA_3 (24 hrs). However, mimimum of leaves of *Melia dubia* was recorded in T_0 (6.304) i.e control.

Above results clearly indicated that maximum number of leaves per seedling was obtained in treatment T_6 i.e. Impregnate in Cow dung for 7 days. This might be due to as well as in Cow dung contains 3% nitrogen , 2% Phosphorus and 1% potassium. Nitrogen is so vital because it major component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon-dioxide. It ultimately helps in increasing the biomass of the seedling. It the right type of fertilizers which help in increasing growth and number of leaves in *Melia dubia*. The above results is conformity with Naguri and Tank (2015) in Mango stones.

4.8 Effect of seed treatments on no of branches at 120 DAS

The data presented in Table 5 indicated that, seed treatment significantly influenced on number of branches of *Melia dubia*.

Table 5. Effect of seed treatment on number of branches at 120 DAS

Seed treatment	Number of branches
T_0 – Control	3.00
T_1- Tap water (12 hrs.)	3.14
T_2- Tap water (24 hrs.)	3.25
T_3- Hot water (12 hrs.)	3.50
T_4- Hot water (24 hrs.)	3.66
T_5- Cow dung (5 days)	5.00
T_6- Cow dung (7 days)	5.13
T_7- GA_3 300 ppm (12 hrs.)	4.00
T_8- GA_3 300 ppm (24 hrs.)	4.14
T_9- GA_3 500 ppm (12 hrs.)	4.80
T_{10}-GA_3 500 ppm (24 hrs.)	4.90
T_{11}- Cow urine (12 hrs.)	4.27
T_{12}- Cow urine (24 hrs.)	4.53
F – Test	Sig
SE(m)±	0.114
C.D. at 5%	0.334

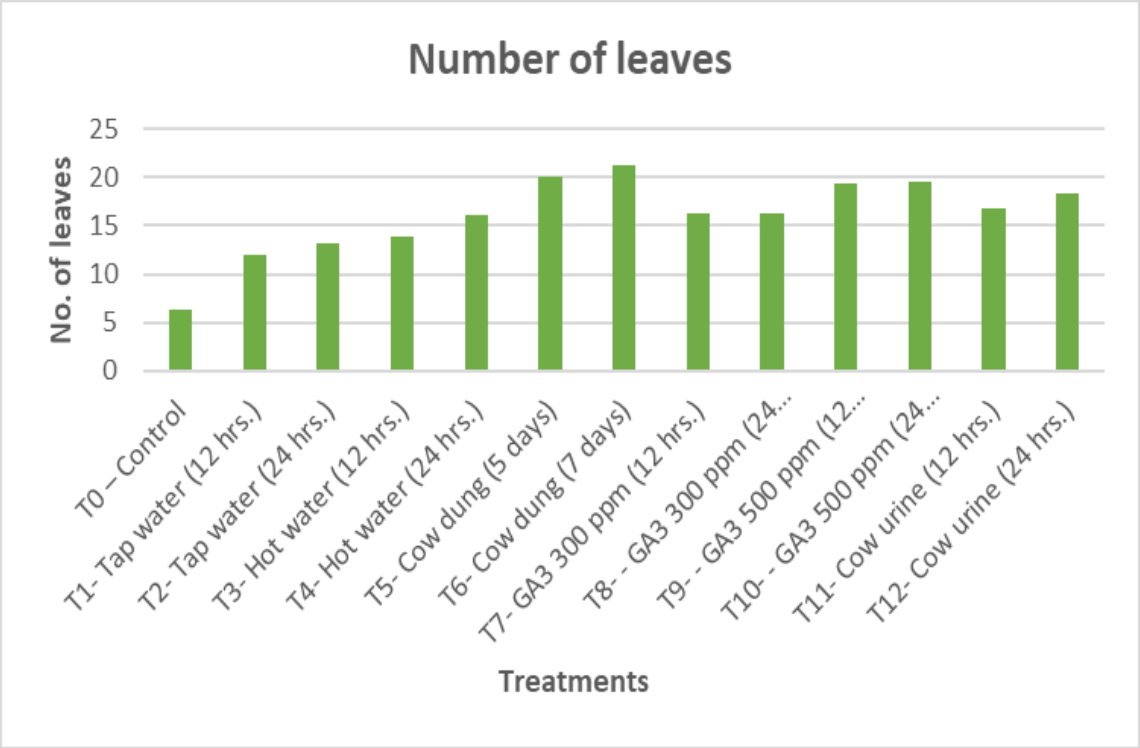


Fig 7. Effect of seed treatment on number of leaves at 120 DAS

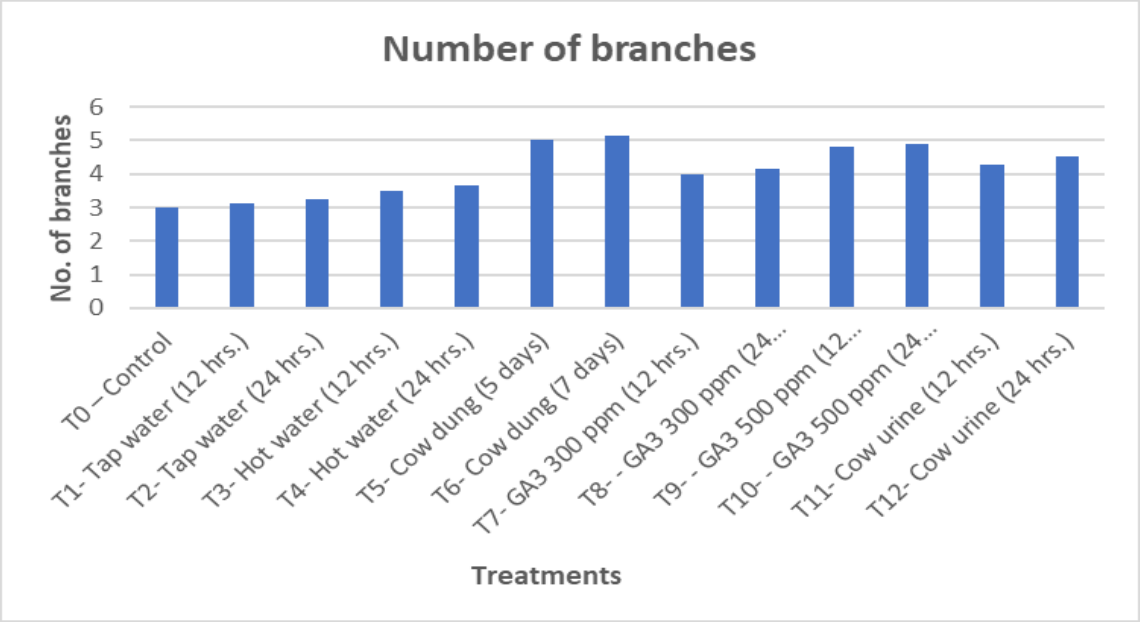


Fig 8. Effect of seed treatment on number of branches at 120 DAS

The number of branches at 120 days after sowing was found maximum in T_6 (5.13 no. of branches) i.e. impregnate in Cow dung for 7 days followed by T_5 (5.00 no. of branches) i.e. impregnate in cow dung for 5 days and T_{10} (4.9 no. of branches) i.e. GA_3 500 ppm (24 hours.) However, minimum branches in *Melia dubia* was found in T_0 (3.00 no. of branches) i.e. control.

4.9 Effect of seed treatments on collar diameter of seedling at 120 DAS

The data presented in Table 6 and depicted in Fig. 9 indicated that, seed treatment significantly influenced on collar diameter of *Melia dubia*.

Table 6. Effect of seed treatment on collar diameter at 120 DAS

Seed treatment	Collar diameter (mm)
T_0 – Control	0.60
T_1- Tap water (12 hrs.)	0.80
T_2- Tap water (24 hrs.)	1.03
T_3- Hot water (12 hrs.)	1.15
T_4- Hot water (24 hrs.)	1.17
T_5- Cow dung (5 days)	1.46
T_6- Cow dung (7 days)	1.51
T_7- GA_3 300 ppm (12 hrs.)	1.25
T_8- GA_3 300 ppm (24 hrs.)	1.28
T_9- GA_3 500 ppm (12 hrs.)	1.37
T_{10}-GA_3 500 ppm (24 hrs.)	1.40
T_{11}- Cow urine (12 hrs.)	1.30
T_{12}- Cow urine (24 hrs.)	1.31
F – Test	Sig
SE(m)±	0.039
C.D. at 5%	0.116

The collar diameter at 60 days after souring was found maximum in treatment T_6 (0.793 mm) i.e. impregnate with cow dung for 7 days followed

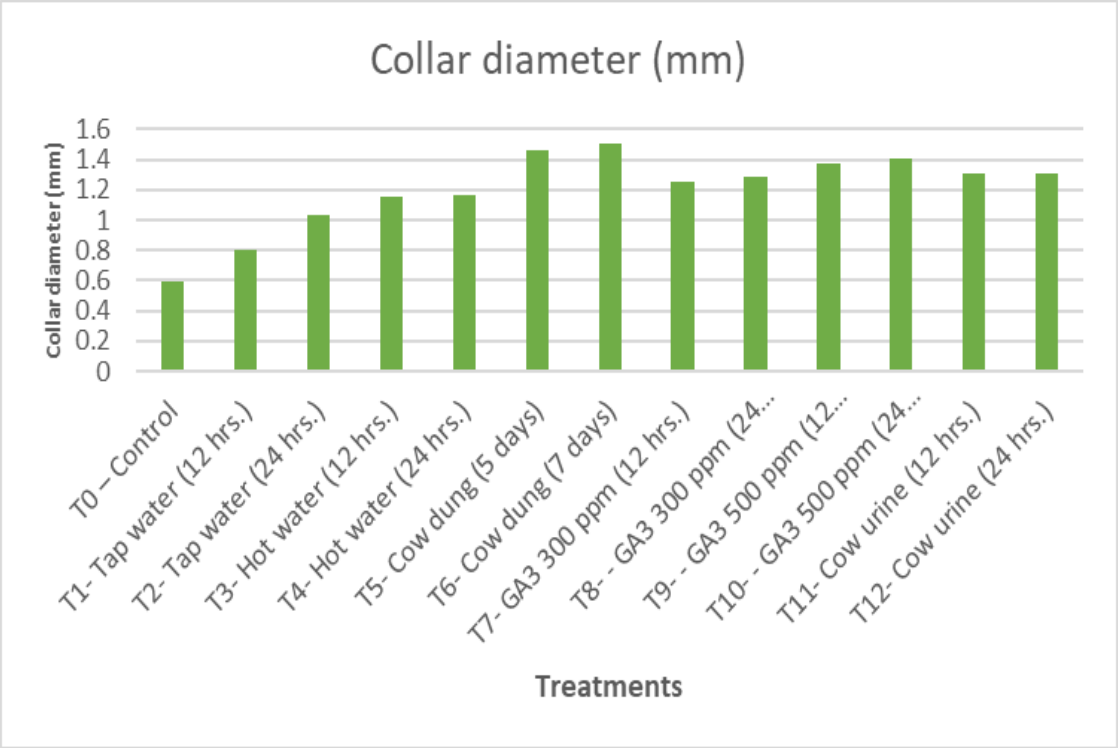


Fig 9. Effect of seed treatment on collar diameter (mm) at 120 DAS

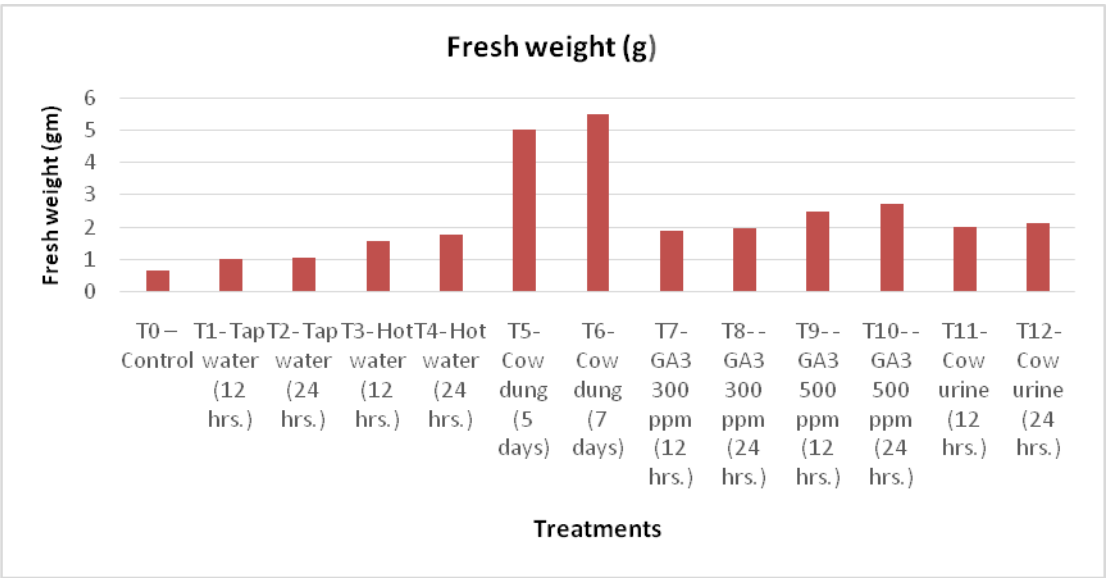


Fig 10. Effect of seed treatment on seedling fresh weight (g) at 120 DAS

by T_5 (0.7mm) i.e. impregnate with Cow dung for 5 days and T_{11} (0.673mm) i.e. Soaking in Cow urine for 12 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (0.130mm) i.e control.

The data presented in Table clearly indicates that, maximum collar diameter of seeding was obtained in T_6 i.e. impregnate with cow dung for 7 days. This might be due the fact that, cow dung is excellent fertilizer highly rich with organic matter which help to improve aeration and break up compacted soil. It supply primary nutrients (nitrogen, phosphorus and potassium) and micronutrients for plant growth. Maximum collar diameter found in Cow dung soaking in khirnee. (Patel et al.1996)

4.10 Effect of seed treatment on seedling fresh weight 120 DAS

The data presented in Table 7 and depicted in Fig. 10 indicated that, seed treatment significantly influenced on seedling fresh weight of *Melia dubia*.

Table 7. Effect of seed treatment on seedling fresh weight at 120 DAS

Seedling fresh weight in (g)	
Seed treatments	**Fresh weight (g)**
T_0 – Control	0.66
T_1- Tap water (12 hrs.)	1.02
T_2- Tap water (24 hrs.)	1.05
T_3- Hot water (12 hrs.)	1.58
T_4- Hot water (24 hrs.)	1.77
T_5- Cow dung (5 days)	5.00
T_6- Cow dung (7 days)	5.50
T_7- GA_3 300 ppm (12 hrs.)	1.89
T_8- GA_3 300 ppm (24 hrs.)	1.99
T_9- GA_3 500 ppm (12 hrs.)	2.50
T_{10}-GA_3 500 ppm (24 hrs.)	2.73
T_{11}- Cow urine (12 hrs.)	2.00
T_{12}- Cow urine (24 hrs.)	2.15
F – Test	Sig
SE(m) ±	0.071
C.D. at 5%	0.208

As regarding to seed treatment, the seedling fresh weight was found maximum in treatment T_6 (5.50 g) i.e. impregnate with cow dung for 7 days followed by T_5 (5.00 g) i.e. impregnate with Cow dung for 5 days and T_{10} (2.73 g) i.e. Soaking in Cow urine for 12 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (0.66 g) i.e control.

The data presented in Table 7 showed that, *Melia dubia* seeds with treatment T_6 i.e impregnated in cow dung (7 days) gave the maximum seedling fresh weight. In present investigation, Cow dung contain growth promoting substance auxin. Auxin is a key regulator of plant growth and development, orchestrating cell division, elongation and differentiation, embryonic development, root and stem tropism, apical dominance and transition to flowering. So many nutrients present in cow such nitrogen, potassium, phosphorus which helps in increasing the rate of photosynthesis. The increased rate of photosynthesis within cell and the plant and resulted in higher fresh weight and dry of root, shoot and plant (Patel *et.al* 2018).

4.11 Effect of seed treatment on fresh and dry weight of shoot 120 DAS

The data presented in Table 8 and depicted in Fig.11 indicated that, seed treatment significantly influenced on fresh and dry weight of shoot of *Melia dubia*.

As regarding to seed treatment, the shoot fresh weight was found maximum in treatment T_6 (2.85 g) i.e. impregnate with cow dung for 7 days followed by T_5 (2.63 g) i.e. impregnate with Cow dung for 5 days and T_{10} (2.03 g) i.e. GA_3-500 ppm for 24 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (0.07 g) i.e control.

Table 8. Effect of seed treatments on fresh and dry weight of shoot at 120 DAS

Shoot fresh and dry weight (g)		
Seed treatments	**Shoot fresh wt. in (g)**	**Shoot Dry wt. in (g)**
T_0 – Control	0.07	0.014
T_1- Tap water (12 hrs.)	0.28	0.047
T_2- Tap water (24 hrs.)	0.35	0.063
T_3- Hot water (12 hrs.)	0.60	0.11
T_4- Hot water (24 hrs.)	0.79	0.16
T_5- Cow dung (5 days)	2.63	0.44
T_6- Cow dung (7 days)	2.85	0.45
T_7- GA_3 300 ppm (12 hrs.)	0.90	0.18
T_8- GA_3 300 ppm (24 hrs.)	1.30	0.22
T_9- GA_3 500 ppm (12 hrs.)	1.93	0.34
T_{10}-GA_3 500 ppm (24 hrs.)	2.03	0.35
T_{11}- Cow urine (12 hrs.)	1.70	0.28
T_{12}- Cow urine (24 hrs.)	1.88	0.30
F – Test	Sig	Sig
SE(m) ±	0.059	0.010
C.D. at 5%	0.172	0.031

4.12 Effect of seed treatments on shoot dry weight at 120 DAS

The data presented in Table 8 and depicted in Fig.11 indicated that, significantly influenced by seed treatment on dry weight of *Melia dubia*.

As regarding to seed treatment, the shoot dry weight was found maximum in treatment T_6 (1.05 g) i.e. impregnate with cow dung for 7 days followed by T_5 (0.97 g) i.e. impregnate with Cow dung for 5 days and T_{10} (0.83 g) i.e. GA_3-500 ppm for 24 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (0.04 g) i.e control.

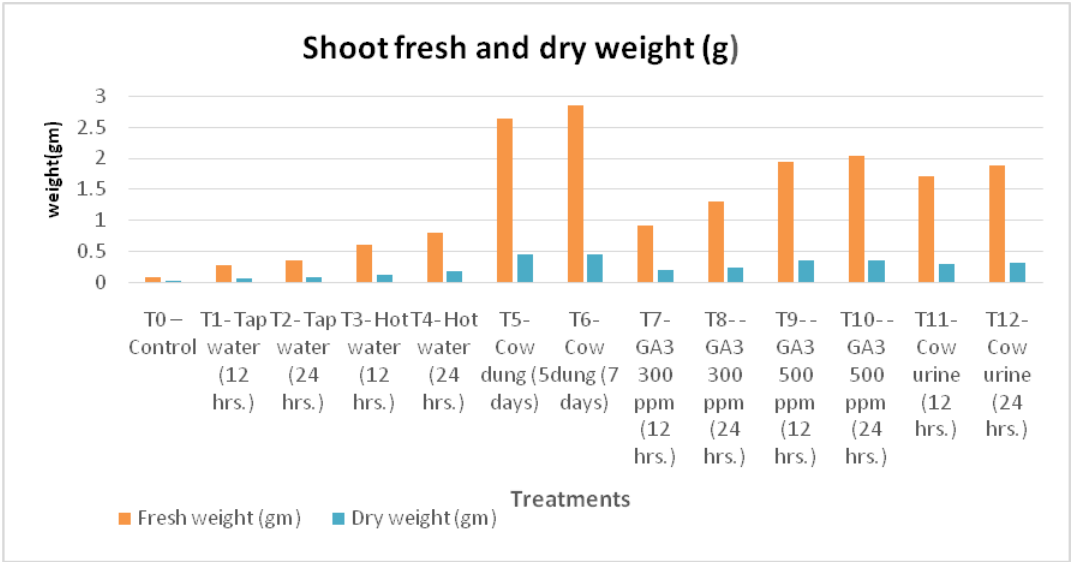


Fig 11. Effect of seed treatment on shoot fresh and dry weight (g) at 120 DAS

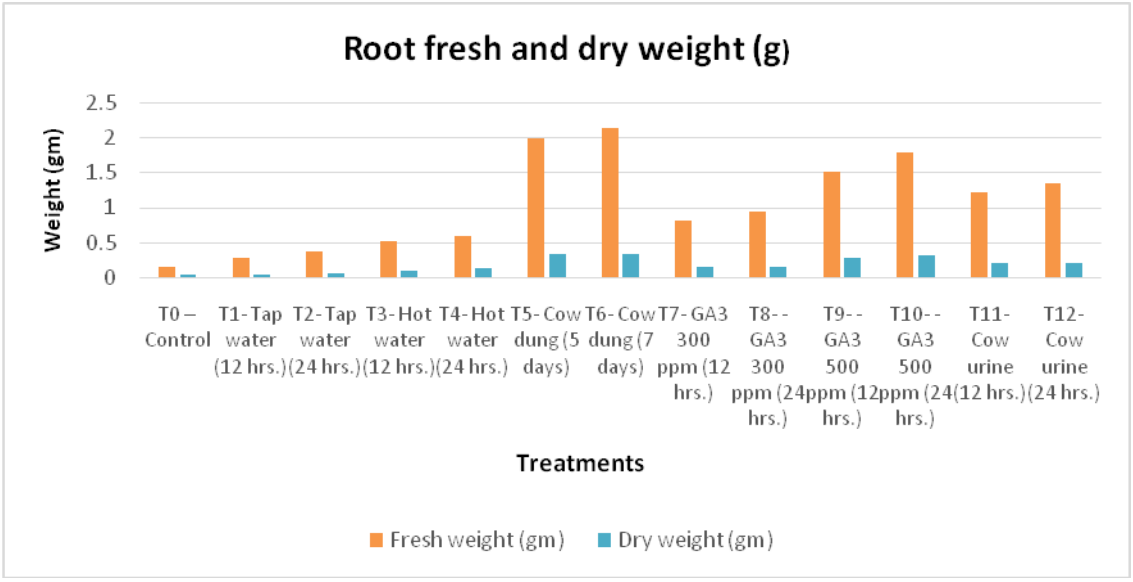


Fig 12. Effect of seed treatment on root fresh and dry weight (g) at 120 DAS

The data presented in Table 8 clearly indicates that, maximum fresh weight of shoot, root and seedling was treatment T_6 i.e. Impregnated with cow dung (7 days). This might due to fact that, scrapping plays an important role in enhancing early germination of seed which can be attributed to earlier in this earlier in this treatment have lead to overall assimilation and redistribution of photosynthates within the plants and these results are conformity with Priya (2016) in walnut.

4.13 Effect of seed treatments of fresh and dry weight of root at 120 DAS

The data presented in Table 9 and depicted in Fig.12 indicated that, seed treatment significantly influenced on fresh and dry weight of root of *Melia dubia*.

Table 9. Effect of seed treatments on Fresh and dry weight at 120 DAS

Root fresh and dry weight (g)		
Seed treatments	**Root fresh wt. in (g)**	**Root Dry wt. in (g)**
T_0 – Control	0.15	0.03
T_1- Tap water (12 hrs.)	0.27	0.04
T_2- Tap water (24 hrs.)	0.36	0.06
T_3- Hot water (12 hrs.)	0.52	0.09
T_4- Hot water (24 hrs.)	0.59	0.12
T_5- Cow dung (5 days)	1.99	0.33
T_6- Cow dung (7 days)	2.13	0.34
T_7- GA_3 300 ppm (12 hrs.)	0.80	0.14
T_8- GA_3 300 ppm (24 hrs.)	0.93	0.15
T_9- GA_3 500 ppm (12 hrs.)	1.50	0.27
T_{10}-GA_3 500 ppm (24 hrs.)	1.78	0.32
T_{11}- Cow urine (12 hrs.)	1.21	0.20
T_{12}- Cow urine (24 hrs.)	1.35	0.21
F – Test	Sig	Sig
SE(m) ±	0.028	0.005
C.D. at 5%	0.082	0.015

The data presented in Table 9 and depicted in Fig. 12 indicated that, significantly influenced by seed treatment on root fresh and dry weight of

Melia dubia. As regarding to seed treatment, the root fresh weight was found maximum in treatment T_6 (2.13 g) i.e. impregnate with cow dung for 7 days followed by T_5 (1.99 g) i.e. impregnate with Cow dung for 5 days and T_{10} (1.78 g) i.e. GA_3-500 ppm for 24 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (0.15 g) i.e control.

4.14 Effect of seed treatments of root dry weight at 120 DAS

The data presented in Table 9 and depicted in Fig 12 indicated that, significantly influenced by seed treatment on root dry weight of *Melia dubia*.

As regarding to seed treatment, the root dry weight was found maximum in treatment T_6 (0.34 g) i.e. impregnate with cow dung for 7 days followed by T_5 (0.33 g) i.e. impregnate with Cow dung for 5 days and T_{10} (0.32 g) i.e. GA_3-500 ppm for 24 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (0.03 g) i.e control.

The data presented in table 9 clearly indicates that, maximum fresh weight of shoot, root and seedling was treatment T_6 i.e. Impregnated with cow dung (7 days). This might due to fact that, scrapping plays an important role in enhancing early germination of seed which can be attributed to earlier in this earlier in this treatment have lead to overall assimilation and redistribution of photosynthates within the plants and these results are conformity with Priya (2016) in walnut.

4.15 Effect of seed treatments on shoot length (cm) at 120 DAS

The data presented in Table 10 and depicted in Fig. 13 indicated that, significantly influenced by seed treatment on root dry weight of *Melia dubia*.

Table 10. Effect of seed treatment on shoot length at 120 DAS

Shoot length (cm)	
Seed treatments	**Shoot length (cm)**
T_0 – Control	12.93
T_1- Tap water (12 hrs.)	14.01
T_2- Tap water (24 hrs.)	16.53
T_3- Hot water (12 hrs.)	18.33
T_4- Hot water (24 hrs.)	19.51
T_5- Cow dung (5 days)	25.67
T_6- Cow dung (7 days)	26.00
T_7- GA_3 300 ppm (12 hrs.)	19.90
T_8- GA_3 300 ppm (24 hrs.)	22.32
T_9- GA_3 500 ppm (12 hrs.)	24.03
T_{10}-GA_3 500 ppm (24 hrs.)	24.78
T_{11}- Cow urine (12 hrs.)	22.56
T_{12}- Cow urine (24 hrs.)	23.29
'F' – Test	Sig
SE(m)±	0.573
C.D at 5%	1.683

As regarding to seed treatment, shoot length (cm) was found maximum in treatment T_6 (19.99 cm) i.e. impregnate with cow dung for 7 days followed by T_5 (18.48 cm) i.e. impregnate with Cow dung for 5 days and T_{10} (16.00 cm) i.e. GA_3-500 ppm for 24 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (7.89 cm) i.e control

4.16 Effect of seed treatments on root length (cm) at 120 DAS

The data presented in Table 11 and depicted in Fig 14 indicated that, significantly influenced by seed treatment on root dry weight of *Melia dubia*.

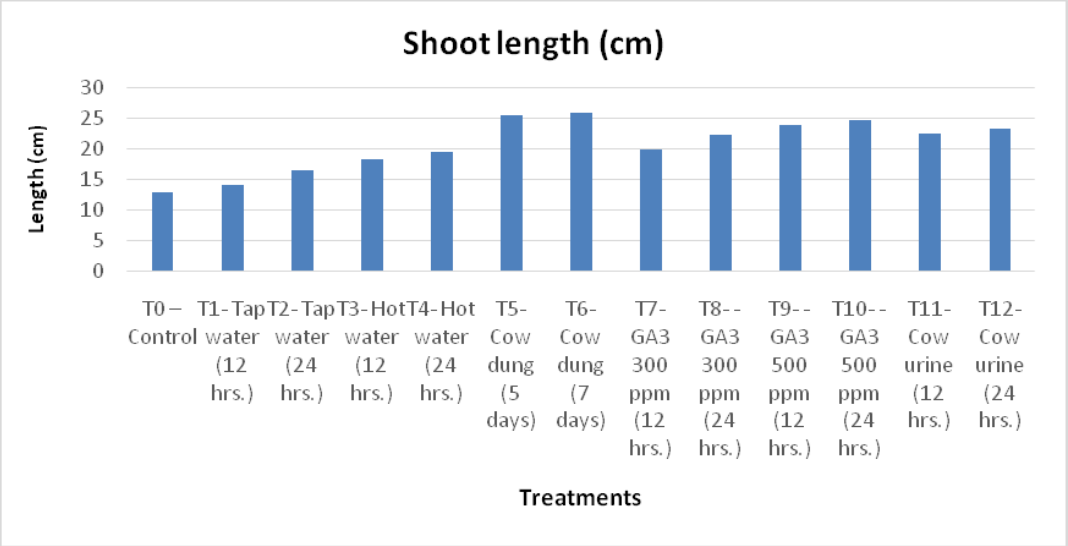


Fig 13. Effect of seed treatment on shoot length (cm) at 120 DAS

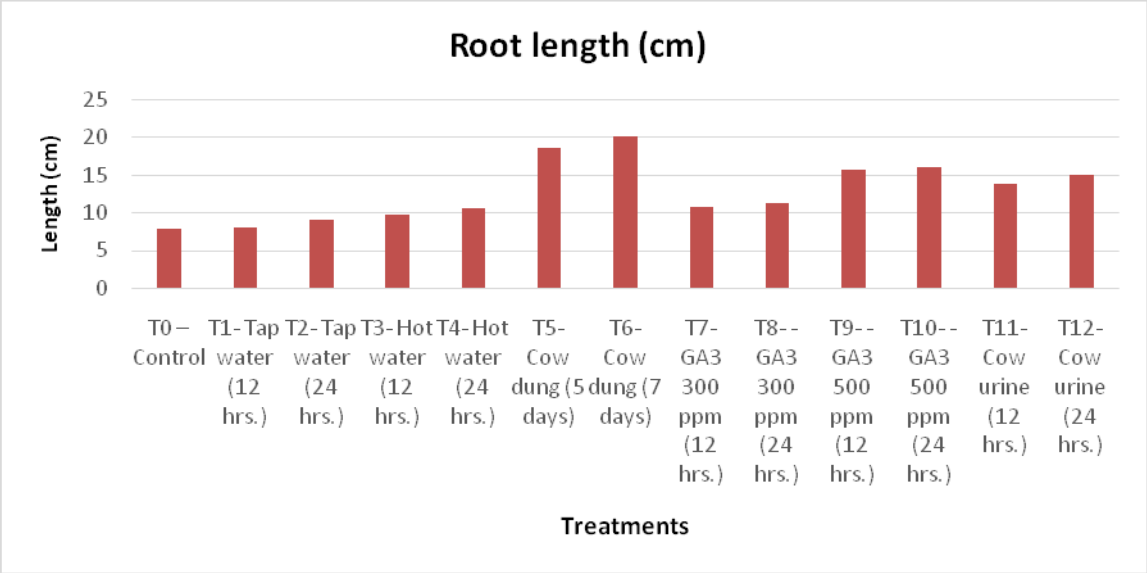


Fig 14. Effect of seed treatment on root length (cm) at 120 DAS

Table 11. Effect of seed treatment on root length at 120 DAS

Root length (cm)	
Seed treatments	**Root length (cm)**
T_0 – Control	7.89
T_1- Tap water (12 hrs.)	8.05
T_2- Tap water (24 hrs.)	8.98
T_3- Hot water (12 hrs.)	9.72
T_4- Hot water (24 hrs.)	10.50
T_5- Cow dung (5 days)	18.48
T_6- Cow dung (7 days)	19.99
T_7- GA_3 300 ppm (12 hrs.)	10.76
T_8- GA_3 300 ppm (24 hrs.)	11.30
T_9- GA_3 500 ppm (12 hrs.)	15.70
T_{10}-GA_3 500 ppm (24 hrs.)	16.00
T_{11}- Cow urine (12 hrs.)	13.82
T_{12}- Cow urine (24 hrs.)	14.90
'F' – Test	Sig
SE(m)±	0.423
C.D at 5%	1.243

As regarding to seed treatment, shoot length (cm) was found maximum in treatment T_6 (cm) i.e. impregnate with cow dung for 7 days followed by T_5 (25.67 cm) i.e. impregnate with Cow dung for 5 days and T_{10} (24.78 cm) i.e. GA_3-500ppm for 24 hours. However, minimum collar diameter of *Melia dubia* was recorded in T_0 (12.93 cm) i.e control

The data presented in table 11 and Fig. 14 clearly indicated that, maximum shoot and root length was obtained in treatment T_6 i.e. Impregnated in cow dung for 7 day. This might be due to the fact that, cow dung contain growth hormone known auxin, which promotes elongation in shoots and colepitels. It helps in cell differentiation and regeneration of vassular tissue. Auxin promotes secondary growth and induced cell division in vascular cambium. It also induces phototropism. Gavitropism and thigmotropism i.e. movement in response to light, gravity and touch respectively.

CHAPTER V

SUMMARY AND CONCLUSIONS

The present investigation entitled, “Assessment of pre-sowing germination treatment and seedling vigor in *Melia dubia* (Cav.)” was carried out during the year 2020-21 at Department of Forestry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola. An experiment was laid out Randomize block design with an objective to study the effect of seed treatment on germination of *Melia dubia* (Malabar Neem), to study the effect of seed treatment on seedling vigor of *Melia dubia*, to find out suitable seed treatments for better germination in *Melia dubia*. Thirteen treatments with 3 replications where executed in a nursery for study purpose. Several combinations of treatments such as soaking in tap water treatment (12 hrs), soaking in tap water treatment (24 hrs), soaking in hot water 80°C for 12hrs, soaking in hot water (80°C) for 24hrs, impregnate in cow dung (5 days), impregnate in cow dung (7 days), immersion in gibberellic acid- 300 ppm (12 hrs), immersion of gibberellic acid-300 ppm (24 hrs), immersion in gibberellic acid-500 ppm (12 hrs), immersion in gibberellic acid -500 ppm (24 hrs), soaking in cow urine (12 hrs), soaking in cow urine (24 hrs) and control were executed in nursery.

The observation based on the various morphological characters such as, days to initial germination, days to 50% germination, days final germination, germination percentage, seedling vigor index, seedling length (cm), collar diameter (mm), no of leaves, no of branches, fresh weight of shoot (g), shoot length (cm), dry weight of root (g), fresh weight of root (g), root length (cm) were observed based on means of 3 replications was also a part of study.

Amongst the different seed treatments Impregnated in Cow dung for 7 days i.e. T_6 gave maximum germination.

The plant growth in respect of seedling vigor index, collar diameter, no. of leaves, branches, seedling length and germination percentage of

seedling were found superior when the seeds treatment with Cow dung i.e. (soaking for 7 days).

Fast germination ensure the better shoot and root growth, which increases overall seeding vigor indication the high chances of establishment of the seedling.

Conclusions

From the results of present investigation entitle, “Assessment of pre-sowing treatment and seedling vigor of *Melia dubia* (Cav.)” the responses of seed treatment were found to be significant.

Amongst the different seed treatment, the seed treated with Cow dung i.e. (soaking it for 7 days) prior to sowing give the maximum germination percentage.

The seedling growth parameters viz. seedling vigor index, collar diameter, no. of leaves, seedling length and germination percentage of seedling registered and recorded maximum in seed treated with treatment T_6 i.e. impregnated in Cow dung for 7 days and it is followed T_5 i.e. Impregnated in Cow dung for 5 days and T_{10} i.e. GA_3-500 ppm for 24 hours respectively. Hence, it could be concluded that, seed treated with above treatment gave maximum germination with optimum vegetative growth and germination percentage of seedling.

The above conclusion was based on the finding of experimental perpetuation of study and location. However, an extensive trial may be conducted to confirm the above result.

CHAPTER VI

LITERATURE CITIED

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WASP – Web Agri Stat package developed by Ashok kumar Jangam and Pranjali Ninad Wadekar at ICAR Research Complex.

https://ccari.icar.gov.in/wasp/index.php

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Signature of student

APPENDIX I

The passport data regarding tree of *Melia dubia*

Character of Mother Tree of *Melia dubia*	**Observation recorded**
Tree height (m)	20m
Age (years)	15
Girth (D.B.H. in m)	1.2 to 1.5m
Month of flowering	January-March
Time of fruiting	November-February
Seed weight (kg)	160 seeds /kg
Number of branches	15 to 25