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Study on Vegetative Propagation by Shoot Cuttings of *Rhododendron arboreum* Sm. and *Rhododendron burmanicum* Hutch.


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Abstract

The two species of Rhododendron (*R. arboreum* and *R. burmanicum*) is one of the most stately and impressive species of Chin State in Myanmar. It possesses various aesthetic, sacred, economic and medicinal values faces wide scale human interferences due to its overexploitation and unsustainable extraction making these species as nearly threatened. In addition to its difficulty in multiplication, scanty information is available regarding vegetative propagation methods of this species. Therefore the present study was an attempt to investigate the simple propagation techniques and optimal conditions for the vegetative propagation of the two species of Rhododendron. The effects of the rooting ability was evaluated on two species of Rhododendron for shoot cutting techniques with root promoting hormones such as (Indole 3 Butric Acid) IBA, (Indole 3 Acetic Acid) IAA and ferti-start at that two media mixture(sand + peat soil) and peat soil. Despite the only one statistically significant effect of genotype, better rooting results were observed after cuttings were treated by indole 3 butyric acid (IBA) and cultivated in substrate composed from sand and peat soil (1:2), compared to other auxin formulas (indolyl-acetic acid (IAA) and Ferti-start at 1000 ppm. This study showed that *R. burmanicum* with hormonal treatment in peat soil, (81.25%, 82.25%, 73.75%) and sand + peat soil (78.75%, 77%, 69.5%) and *R. arboreum* with hormonal treatment in peat soil (72%, 69.5%,58.5%),and in sand+ peat soil (64.5%, 57.75%, 58.5%) gave rooting percentage of both species. In peat soil with three kind of hormone (IBA, IAA and Ferti-start) was the better one. This method is cost effective many plants can be produced It will help a lot in establishing forest plantations. This is the first study for shoot cuttings of Rhododendron species where plants have been successfully produced and it would be transferred to the field. The intensive study is also needed to understand it's rooting behavior and conservation.

Keywords: Cuttings, Rooting hormone, Rhododendron, Vegetative propagation

ခန္ဓာပိုင်းမျိုးပွါးနည်းဖြစ်သော အညွှန့်ပိုင်းကိုင်းထိုးနည်းစနစ်ဖြင့် တောင်ဇလပ်နီ (*Rhododendron arboreum* Sm.) နှင့် တောင်ဇလပ်ဝါ (*Rhododendron burmanicum* Hutch.) တို့၏ အမြစ်ထွက်နှုန်းအားလေ့လာခြင်း

ဒေါ်တင်တင်မူ၊ လက်ထောက်သုတေသနအရာရှိ
ဒေါ်အိအိဇင်၊ သုတေသနလက်ထောက်-၂
ဒေါက်တာမူမူအောင်၊ သုတေသနအရာရှိ
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်း

တောင်ဇလပ်နီ (*Rhododendron arboreum*) နှင့် တောင်ဇလပ်ဝါ (*Rhdoodendron burmanicum*) သစ်မျိုးစိတ်တို့သည် ချင်းပြည်နယ်၏ အထင်ကရ သစ်မျိုးများဖြစ်ပြီး ဘာသာရေး၊ လူမှုရေး၊ စီးပွါးရေးနှင့် ဆေးဖက်ဝင်အဖြစ် အသုံးပြုလျက်ရှိကြပါသည်။ ဤမျိုးစိတ်များအား ထုတ်ယူသုံးစွဲမှု ပိုမိုများပြားလာသည်နှင့်အမျှ ဒေသတွင်းမျိုးသုဉ်းပျောက်ကွယ်လုနီးပါးဖြစ်နေသော အပင်များဖြစ်ပါသည်။ ၎င်းမျိုးစိတ်များသည် သဘာဝ အလျောက်မျိုးဆက်ပြန့်ပွားမှုရှိသော်လည်း ကြီးထွားမှုနှုန်း အလွန်နှေးကွေးသောကြောင့် ခန္ဓာပိုင်းမျိုးပွါးနည်း စနစ်တစ်ခုဖြစ်သော အညွှန်းပိုင်းကိုင်းထိုးနည်းစနစ်ဖြင့် အမြစ်ထွက်နှုန်းကို လေ့လာစမ်းသပ်ရန် ဤသုတေသနကို ဆောင်ရွက်ရခြင်းဖြစ်ပါသည်။ ဤစာတမ်းတွင် ဒေသမျိုးရင်း(၂)မျိုးအား အမြစ်အားတိုးဆေးဟော်မုန်း (၃)မျိုး ဖြစ်သော IAA၊ IBA နှင့် Ferti-start များအား အသုံးပြုခဲ့ပါသည်။ ထို့နောက် သစ်ဆွေးမြေ (Peat Soil)၊ သဲနှင့် သစ်ဆွေးမြေ ပေါင်းစပ်ထားသော (Mixed soil) (၂) မျိုးအား အသုံးပြုစမ်းသပ်ရာတွင် အမြစ်ထွက်နှုန်းသည် ဟော်မုန်း(၃)မျိုး စလုံးနှင့် သစ်ဆွေးမြေသည် အသင့်တော်ဆုံးဖြစ်ပြီး သဲနှင့် သစ်ဆွေးမြေပေါင်းစပ်ထားသော (Mixed soil) သည်လည်း သစ်မျိုးနှစ်မျိုးလုံး အတွက် အသုံးပြုရန် သင့်တော်သည့် မြေအမျိုးအစားဖြစ်ပါကြောင်း လေ့လာတွေ့ရှိရပါသည်။ ဤသုတေသန၏ တွေ့ရှိချက်မှာ အညွှန့်ပိုင်းကိုင်းထိုးနည်းဖြင့် အပင်မျိုးစိတ်များ ပွါးများရာတွင် နွေဦးပိုင်းတွင် ဟော်မုန်း IBA ၊ IAA နှင့် Ferti-start ပြင်းအား (1000) ppm တွင် သိသိသာသာအောင်မြင်ကြောင်းတွေ့ရှိရပါသည်။ ဟော်မုန်း(၃)မျိုးနှင့် မီဒီယာ နှစ်မျိုး သစ်ဆွေးမြေ (Peat Soil)၊ သဲနှင့် သစ်ဆွေးမြေပေါင်းစပ်ထားသော (Mixed soil) (၂) မျိုးအားတို့ကို နှိုင်းယှဉ်ရာတွင်သစ်ဆွေးမြေတွင် တောင်ဇလပ်ဝါမျိုးစိတ်သည် ဟော်မုန်း(၃)မျိုးစလုံးတွင် မိနစ်ပိုင်းစိမ်၍ စမ်းသပ်ပေးခြင်းဖြင့်အမြစ်ထွက်နိုင်စွမ်းရာခိုင်နှုန်း(%) သည်

(IAA) ၈၁.၂၅%၊ (IBA)၈၂.၂၅%၊ (Ferti-start) ရ၃.၇၅% နှင့် သဲနှင့် သစ်ဆွေးမြေပေါင်း စပ်ထားသော (Mixed soil) မြေတွင် (IAA) ၇၈.၇၅ %၊ (IBA)၇၇% ၊(Ferti-start) ၆၉.၅ % စီ အသီးသီးအမြစ်ထွက် ရှိမှုကောင်းမွန်သည်ကိုတွေ့ရှိရပါသည်။ တောင်ဧလပ်နီသစ်မျိုးသည် သစ်ဆွေးမြေတွင် (IBA) ၇၂% ၊ (IAA) ၆၉.၅% ၊ (Ferti-start) ၅၈.၅ %) နှင့် သဲနှင့် သစ်ဆွေး မြေပေါင်းစပ်ထားသော (Mixed soil) တွင် (IBA) ၆၄.၅% ၊ (IAA) ၅၇.၇၅% ၊ (Ferti-start) ၅၈.၅%)အမြစ်ထွက်ရှိမှုနှုန်းသည် အနည်းငယ်အားနည်းနေသည်ကို သိရှိရ ပါသည်။ သစ်ဆွေးမြေနှင့် ဟော်မုန်း(၃)မျိုး အသုံးပြုပေးခြင်းဖြင့် အမြစ်ထွက်နိုင်သည် နှုန်းမှာ ၈၀ ရာခိုင်နှုန်း အထက် တွေ့ရှိရပါသည်။ သို့သော် သဲနှင့် သစ်ဆွေးမြေ ပေါင်းစပ်ထားသော (Mixed soil) မြေသည် ဟော်မုန်းများဖြင့် မျိုးစိတ်(၂)မျိုးလုံးအတွက် အသုံးပြုသင့်ကြောင်း တင်ပြရပါ သည်။ ဤနည်းစနစ်သည် ကုန်ကျစရိတ် သက်သာခြင်းနှင့် အပင်ပေါင်းများစွာ ထုတ်လုပ် ပွါးများနိုင်ပြီး သစ်တောစိုက်ခင်းများ ထူထောင်ရာတွင်များစွာ အထောက်အကူ ပေးနိုင်မည် ဖြစ်ပါသည်။ ဤသုတေသနစမ်းသပ်မှုသည် တောင်ဧလပ် မျိုးစိတ်များအတွက် ခန္ဓာပိုင်း မျိုးပွားနည်းစနစ်ဖြင့် ပထမဦးဆုံး လေ့လာစမ်းသပ် တင်ပြသည့် စာတမ်းဖြစ်ပြီး ယခုတွေ့ရှိ မှုများကို အခြေခံ၍ ဆက်လက်လေ့လာသင့်သော သုတေသနတစ်ခုဖြစ်ပါကြောင်း တင်ပြ အပ်ပါသည်။

Study on Vegetative Propagation by Shoot Cuttings of
***Rhododendron arboreum* Sm.** and ***Rhododendron burmanicum* Hutch.**

1. Introduction

The two species of Rhododendron (*R. arboreum* and *R. burmanicum*) is one of the most stately and impressive species of Chin State in Myanmar. It possesses various aesthetic, sacred, economic and medicinal values faces wide scale human interferences due to its overexploitation and unsustainable extraction making these species as nearly threatened.
It is being utilized as a traditional remedy for different diseases. Flowers of this plant are traditionally utilized by the people residing in the mountainous region to make pickle, juice, jam, syrup, honey, squash, etc. One of the most important problems that mountainous forests are experiencing is poor regeneration (Karauchi et al. 2000). It is necessary to find alternative methods of propagation to ensure regular a supply of planting stock. In addition to its difficulty in multiplication, scanty information is available regarding vegetative propagation methods of this species. Therefore the present study was an attempt to investigate the simple propagation techniques and optimal conditions for the vegetative propagation of the two species of Rhododendron.

1.2 Habitat and their distribution

Rhododendron is a very large genus of 1,024 species of woody plants belong to the heath family (Ericaceae), which is one of the most decorative shrub or small tree group with wide diversity of habitual characteristic, leaf size as well as flower richness and colour, represent one of the most important collections in numerous botanical gardens, arboretums and parks. Their natural distribution area comprises particularly Eastern Himalayas, Western China, North America and Malaysia, Sri Lanka, Myanmar, N Thailand, India, Japan, Vietnam. According to the Checklist of Myanmar by Kress *et al*., (2003), 205 species of *Rhododendron* have been recorded in Myanmar. In this study, it was focused on the two species of Rhododendrons which is naturally distributed in the Natma Taung National Park, western part of Myanmar. Rhododendrons have been considered key indicators of healthy mountain forest ecosystems, especially along temperate zones in Chin State.

1.1.1. Botanical Characteristic of Rhododendrons

Myanmar Name	-	Taung Zalat Ni
Scientific Name	-	*Rhododendron arboreum* Sm.
Family	-	Ericaceae
Diagnostic Character	-	Evergreen much branched tree up to 14 m in height & 2.4 m in girth. Leaves are oblong-lanceolate, crowded towards the ends of branches, petiole covered with white scales when young. It is glossy green, with deeply impressed veins from above white fawn, cinnamon or rusty brown felt is found at the under surface. The flowers of *R. arboreum* range in color from a deep scarlet, to red with white markings, pink to white. Fruit is a capsule.
Ecology	-	It is found in highland vegetation types, 2000-3000 m

		altitude and sometimes forms almost pure forest in restricted areas. It is common in the Chin hill in association with *Quercus semecarpifolius* and *Pinus kesiya* It thrives best on moist loam although it is also found on moist rocky ground. The tree can withstand shading although it develops better in the open.
Distribution	-	Myanmar, Bhutan, China, N India, Nepal, Sri Lanka, N Thailand, N. Vietnam
Phenology	-	Flowering season is from March-April/June-September
Conservation Status	-	Least Concern (LC) (Source: IUCN Ver. 3.1, 2018)

Fig. 1 Vegetation and plant form of *R. arboreum*

Myanmar Name	-	Taung Zalat Wah
Scientific Name	-	*Rhododendron burmanicum* Hutch.
Family	-	Ericaceae
Diagnostic Character	-	An evergreen shrub usually under 2 m high and often dwarfs in the wild; young stems scaly and slightly bristly. Leaves oblanceolate to obovate, abruptly narrowed to a mucronate tip, tapered at the base, densely scaly on both sides, the scales less than their own diameter apart or even overlapping, undersurface green between the scales; Flowers fragrant, yellow, greenish yellow, greenish white, borne in terminal trusses of five or six on scaly stalks. Fruit is a capsule.
Ecology	-	Native of Natma Taung National Park NMTNP (Mt Victoria), a mountain just over 2500-3000 m high in the Southern Chin Hills, South-west Myanmar
Distribution	-	Endemic to Myanmar, NMTNP (Mt. Victoria)
IUCN Status	-	Least Concern (LC) (Source: IUCN Ver. 3.1, 2018)


Fig. 2 Vegetation and plant form of *R. burmanicum*

1.2 Vegetative Propagation of Shoot Cuttings

Forest plantation is one of the ways to solve the deforestation's problem. But the successful implementation of any plantation program of Indigenous species would require efforts in research and development in a number of areas of establishment. Development of vegetative propagation should also be undertaken. Foresters realized that once an individual tree of desired characteristics is found, it can be multiplied rapidly through vegetative propagation. It is necessary to find alternative methods of propagation to ensure regular a supply of planting stock. One of the most important problems that mountainous forests are experiencing is poor regeneration (Karauchi et al. 2000).

Vegetative propagation by cutting can be one of the methods as it allows a large number of propagation from the genotype. It has also the advantage in providing superior individuals with more uniformity in genotype for growth and development especially after selection. Vegetative propagation using cutting is one of the most common methods in forestry. It is an easy and cheap technique which can undoubtedly solve many problems faced in seed production with regards to improve quality and quantity which justifies making clonal for forestry a profitable investment.

The application of root-promoting plant growth regulator substances is the most common treatment to enhance rooting in stem-cuttings (Hartman et al.1983, and Wiesman and Tchoundjeu 2002).Likewise, it may be the most effective treatment to achieve successful propagation. In addition to their effects on cell differentiation, auxins promote starch hydrolysis, and the mobilization of sugar and nutrient to the base of cuttings (Das et al.1997). According to Adjers and Otsamo (1996), the most widely used growth hormones are auxin such as IBA, IAA, and NAA. Hartman and kester (1983), they reported that IBA and NAA have been found to be the most reliable synthetic root promoting chemicals in stimulating adventitious most production in cuttings. Moreover, substrate pH has its role in rooting of cuttings (Brian, 2000). The base of cuttings were cut 0.5 cm below the lowest node (Sándor et al., 2008). Indole3-butyric acid is probably the best material for general use, because it is nontoxic to plants over a wide concentration range and is effective in promoting rooting of a large number of plant species (Hartmann and Kester, 1990).

Many literatures reported that juvenile cutting were proven good materials to root for many tree species. Hong (1969) as cited by kiang et al. (1974) said that the biological activity of growth substances which are active in root promotion may depend on their concentration.

2. Objectives

The objectives of the present study are:

a). To investigate the simple propagation techniques and optimal conditions for the vegetative propagation of the two species of Rhododendron and

b). To find out the effect of the treatment of growth regulating substances (GRS) on shoot cuttings and rooting ability

c). To transfer the techniques of vegetative propagation by shoot cuttings

3. Materials and Methods

3.1 Study site

The study site is situated at the Natma Taung National Park (NTNP) in the southern Chin Hill of western Myanmar (between 20º45'-22º00' N and 93º15' -94º15' E), close to the border of India and Bangladesh (Figure 3). The Park covers 72.300 ha including three townships such as Mindat, Kanpetlet and Matupi and contains Mt. Natma Taung (Mt. Victoria), which rises 2.200 m above the surrounding landscape to a height of 3.051 m. It is the highest mountain in central Myanmar (Piatt *et al*. 2012).

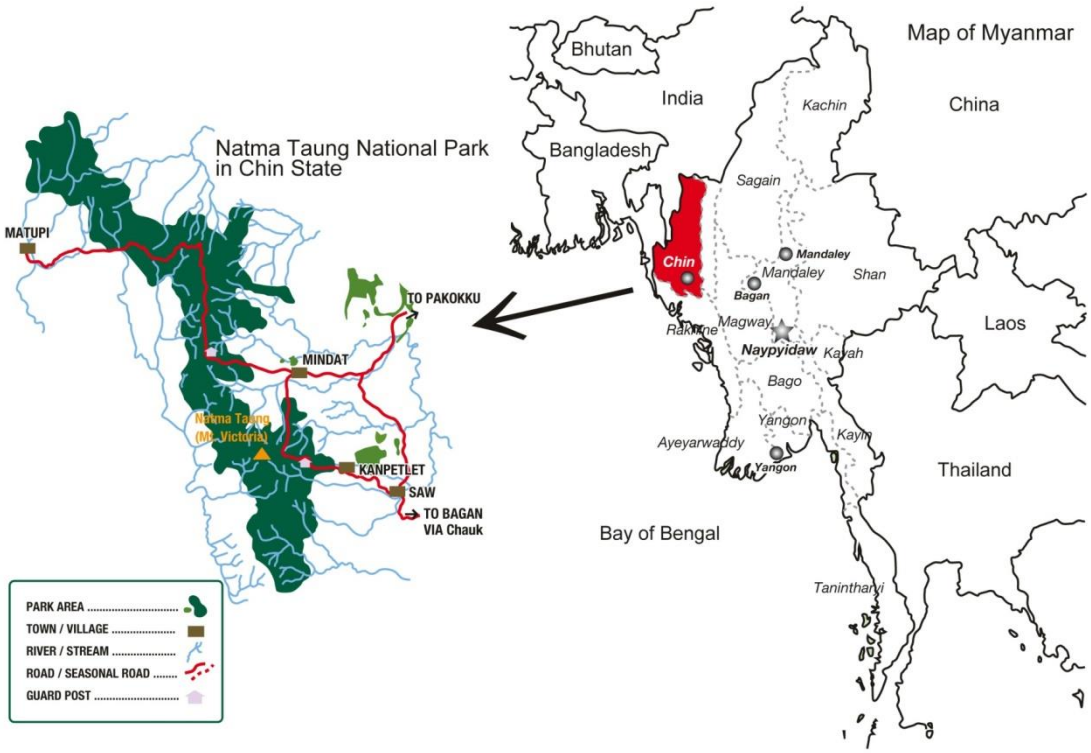

Fig. 3 Location of Natma Taung National Park in Chin State, Myanmar

3.1.1 Climate

The climatic of the Kanpetlet Township in the southern part of Chin State is characterized by its mild temperatures, high rainfall and humidity. From May to November are the rainy months, with this area getting more rain than other areas due to the monsoon

storms come in from the Bay of Bengal. An annual rainfall is >1,000 mm; a cold dry season, maximum temperature varies between 4ºC (December- January) and a hot dry season with temperatures up to 20ºC (Fujikawa, 2009).

3.1.2 Vegetation

Different flora is observed in each altitudinal range in NTNP, making Mt. Natma Taung a virtual island separated from its surrounding areas and consequently giving rise to species endemism. The first description of Mt. Natma Taung (Mt. Victoria) vegetation, to which six types were recognized, was publish more than half a century ago by Kingdon-Ward (1958). More recently, Fujikawa *et al*. (2008) described a more precise vegetation outline of the mountain (Figure 4). Rhododendron species is found in highland vegetation types, 2000-3000 m altitude and sometimes forms almost pure forest in restricted areas. It is common in the Chin hill in association with *Quercus semecarpifolius* and *Pinus kesiya*. It thrives best on moist loam although it is also found on moist rocky ground. The tree can withstand shading although it develops better in the open.

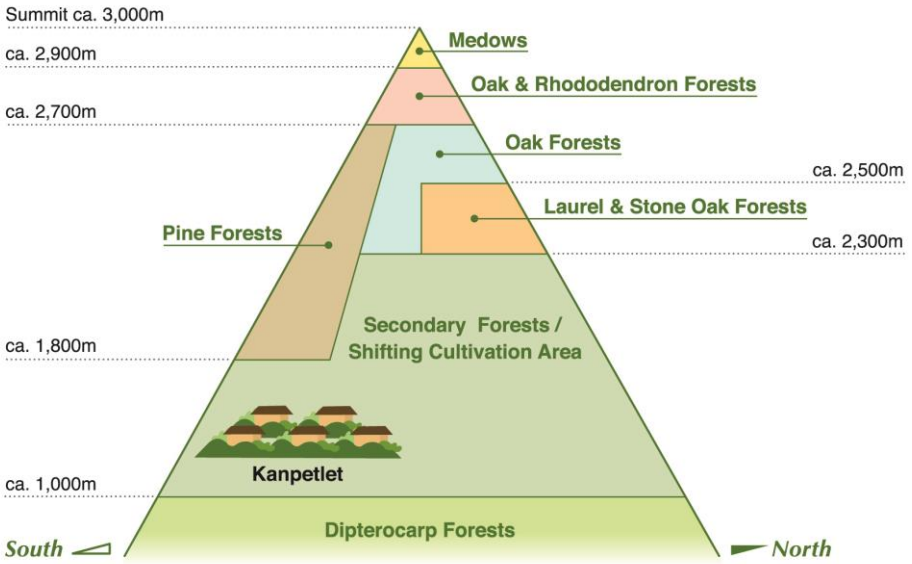

Diagram of vegetation types in the Natma Taung National Park

Fig. 4 Diagram of vegetation types in Natma Taung National Park (Source: Fujikawa *et al*. 2008)

In this study was carried out to evaluate the influence of different hormonal treatments and techniques on the survival rooting behavior of two species of Rhododendron. The experimental period was started from April, 2019 and September, 2019.

3.2 Methods

In this study, the two experiments were conducted on rooting response from shoot cutting of two species of Rhododendrons (*R. arboreum* and *R. burmanicum*)

Experiment (I): The effectiveness of different media for shoot cutting

Experiment (Π): The effectiveness of three growth regulating substances of two species for rooting ability

3.2.1 Experiment (1): The effectiveness of different media for shoot cutting

3.2.1.1. Construction of chambers for the experiment

The type of chamber was used as Portable Plastic Chamber (PPC). The PPC, size of (10' x 5' x 3') was made with bamboo frame. Some parts of the roof were covered with transparent plastic sheet to enable plants to receive sunlight inside the chamber. Seedlings were cut and the leafless cuttings were put in the PPC. The shoot cutting treatments were investigated in PPC.

3.2.1.2 Rooting media

In this experiment, two kinds of media peat soil and sand + peat soil (1:2). Sterilized sand was used as rooting medium for all experimental units. When the shoot cuttings were planted in the media and placed in the PPC. The experiment was conducted in four replications, four treatments, with two species and media. Temperature (20º-25º) C and relative humidity (60-90 %) were maintained at the PPC during the growth period of the cuttings.

Two kinds of media were used. They are (1) peat soil (2) 1: ration 2 of sand + peat soil. These media was sterilized under the sunlight about six-seven hours. Shoot cuttings were kept in the bamboo portable plastic Moisture chamber (10' x 5' x 3') which was placed in there. When the shoot cuttings were planted in the media and placed (saw dust) in the PPC. Sterilized sand was used as rooting medium for all experimental units .The shoot cuttings were watered regularly or as the need arises using a water hose with a mist sprayer. After 60 to 75 days, cuttings produced adventitious roots and were ready for transfer to individual 10″ x 8″ black polyethylene bags.

3.2.1.3 Preparation of plant growth hormones

This experiment were used the different three rooting hormones such as IBA (Indole 3-butyric acid), IAA (Indole Acetic acid) and Ferti-start solution (containing Thiamine hydrochloride and chelated iron). They were commercial rooting hormones: The stock solution of hormones were prepared by dissolving the weighted quantity (100 mg in 1 Liter for 1000 ppm) making it to 1000 ml with distilled water to get 100 ppm. Amount of 5% of these solutions was mixed with distilled water to get 1000 ml concentration. Dipping methods were used in this experiment. The stock solution should always be fresh. Hormones used to determine the most suitable one for rooting of stem cuttings of Rhododendrons.

All of the cuttings were treated with 1000 ppm IBA, IAA and Ferti-start solution as rooting hormone soaked 10, 20, 30 minutes.it may promote cell division in the growing stage of plant. Hence, it is mainly applied to facilitate mature, step-up output, break quiescence, and encourage rooting. Growth hormones treatment is to improve the rooting percentage,

hasten root initiation and increase the number and uniformity of roots produces (Hartmann, 1997). In Hormone treatment IBA, IAA and Ferti-start were used throughout the experiments. The concentrations used were 1000 ppm (10, 20, 30 minutes) and control. The dip method was used throughout the experiment; the basal ends of the prepared cuttings were dipped in the prepared hormone solutions, which were put in a plastic bag. Then the cuttings were planted as described above and watered daily and kept moist by watering whenever necessary. The experiment was conducted in four replications with four treatments and two species.

3.2.1.4 Preparation of cutting materials

In experiment I: shoots of *R. arboreum* and R. *burmanicum* were collected from young plants within 3-5 years old of naturally growing in the NMTNP is early in the morning (between 08:30 Am to 09:30 Am). The length of shoot cuttings are within 76 mm to150 mm and diameter 0.3-0.5 mm were collected on tip or terminal part of mother plants which were free from disease and insect attack. And then, one half of the top leaves were clipped off, leaving only one half of the top leaves to reduce transportation rate of shooting and placed in 5% Benlate solution (Benomyl at 500 g/kg active ingredients) for 30-45 minutes. The bases of the cuttings were dipped in the different rooting hormone. Each treatment consisted of 50 cuttings. The cuttings were tested at a temperature of 25-30 degrees Celsius and 60-90% Relative humidity in a portable Plastic chamber or moist chamber.

3.3.1 Experiment (Π): The effectiveness of three growth regulating substances of two species for rooting ability

The experiment conducted was the same as previous procedure. The only difference was that, only one hormone was used with different concentration levels. The Growth Regulating Substances (GRS) used were of different forms of commercial IBA, IAA which were as follows; (A = 100ppm IBA solution), (P =30000ppm IBA powder), (R = 5% Root fro with vitamins), and control (untreated). The experiments conducted were of 4 treatments with 2 species.

3.3. Statistical Analysis

The experiment was carried out to investigate the vegetative propagation by shoot cutting methods for establish the Rhododendron plantations. A Randomized Complete Block Design (RCBD) was used with four replications to compare the effectiveness among the two species and four Plant growth regulators. All data were performed by using Statistical Package for the Social Science for Windows (SPSS 20) (Illinois, USA) software program.

4. Results

As the results of the research, rooting response varied with species, growth regulating substances (Growth Hormone), their concentration, different forms of commercial hormone compound and also the season of treatment. The following results were obtained.

4.1 Experiment I: the effectiveness of two kinds of media for shoot cuttings

The results showed that the shoot cuttings of the two Rhododendron species were treated under different media as peat soil and sand + peat soil and Hormones. In sand + peat soil, the highest rooting percentage of the IBA hormone (64.5%) was obtained. In Hormone IAA was found to have an optimal root rate of (57.75%), the hormone Ferti-start has a root rate of (58.5%) was found (Figure 3).

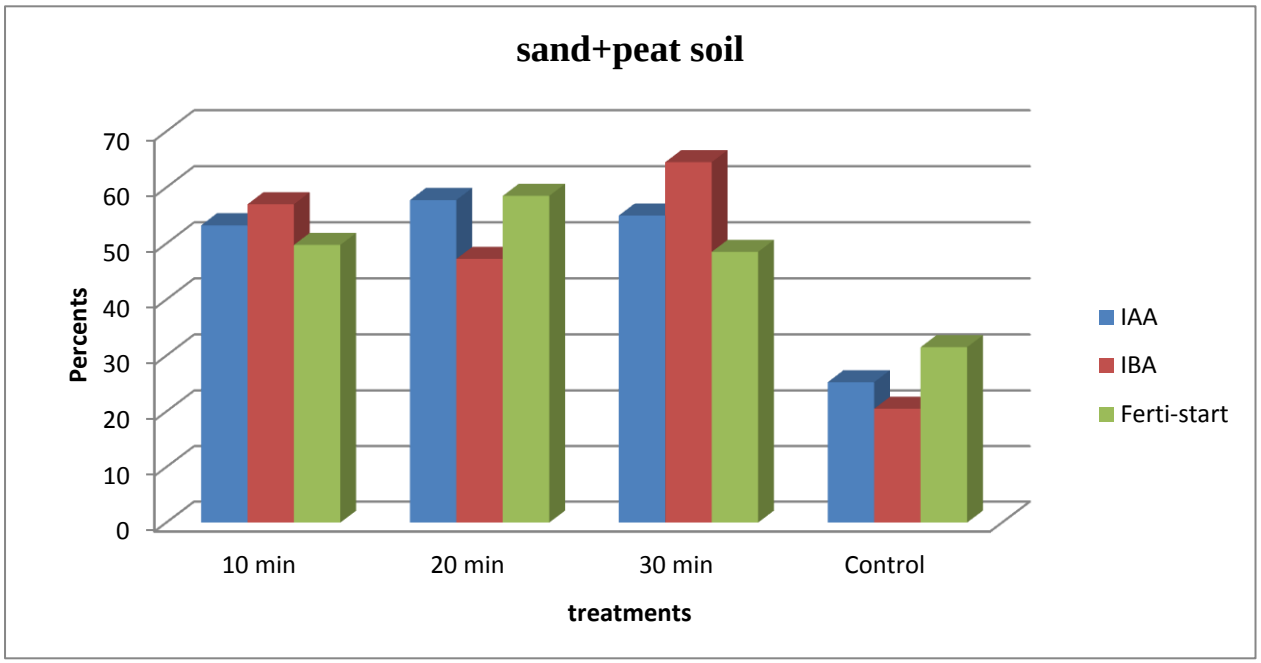

Fig. 5 *Rhododendron arboreum* Sm, effect of treatment in sand + peat soil

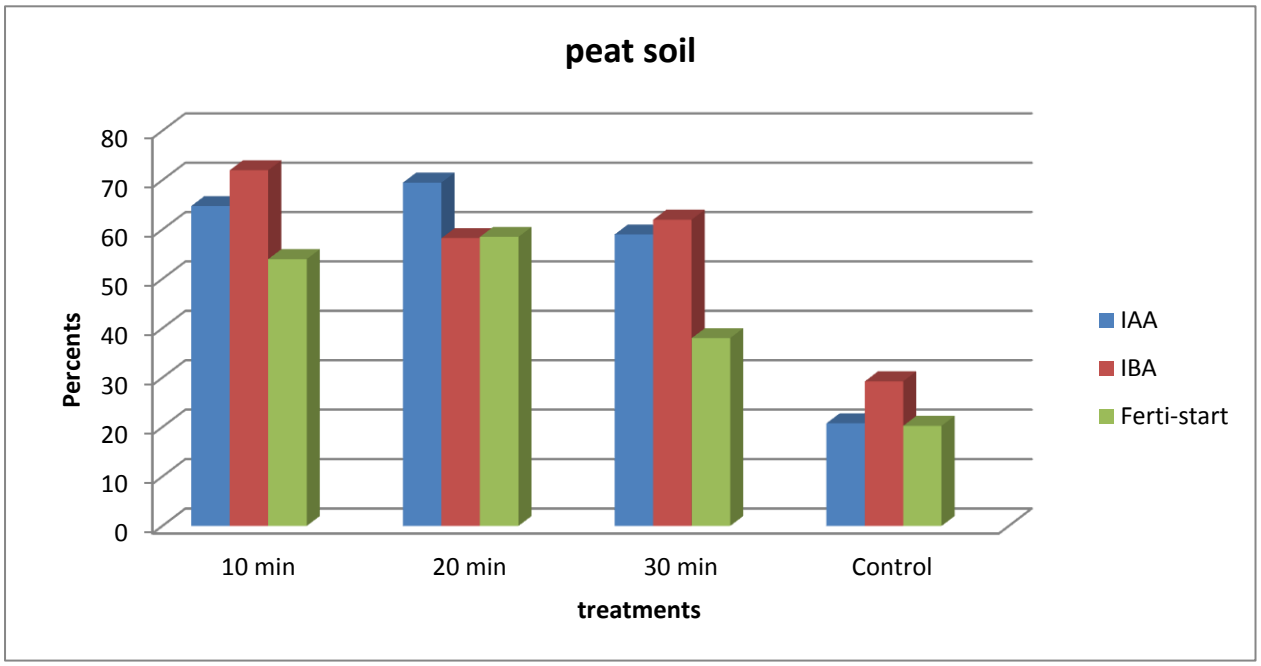

Fig. 6 *R. arboreum* Sm, effect of treatment in peat soil

In peat soils, the effect of IBA hormone showed that the root rate is (72%), the rooting percentage of the IAA (69.5%) was the highest and then, Ferti-start hormone showed the root rate was decreased to (58.5%) (Figure 4). According to Comparison of two kinds of media, the rooting percentages of the species were gradually decreased in sand +peat soil (Figure 3 and 4).

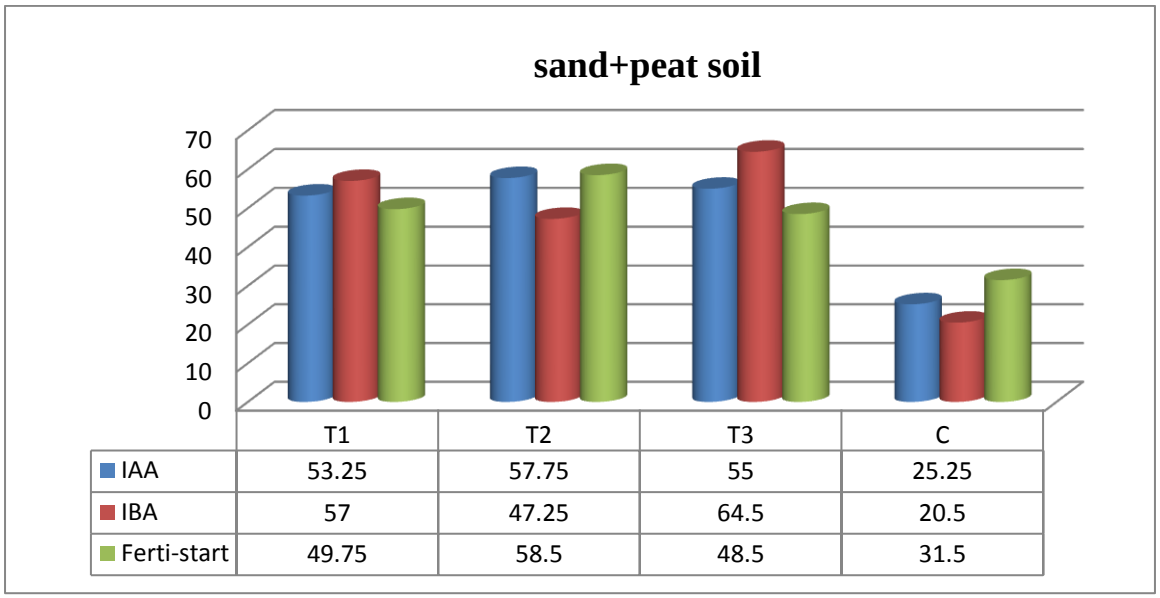

Fig.7 *R. burmanicum* effect of treatment in sand + peat soil

In sand +peat soil with hormonal treatments (T1=10 minute,T2= 20 minute, T3=30 minute) Hormone IBA was found root percent 64.5% (T3),57% (T1), 47.25% (T2) follow by hormone IAA was found roots percent 57.75%(T2), 55% (T3), 53.25% (T1)and Ferti-start, 58.5%, (T2),49.75% (T1), 48.5% (T3)

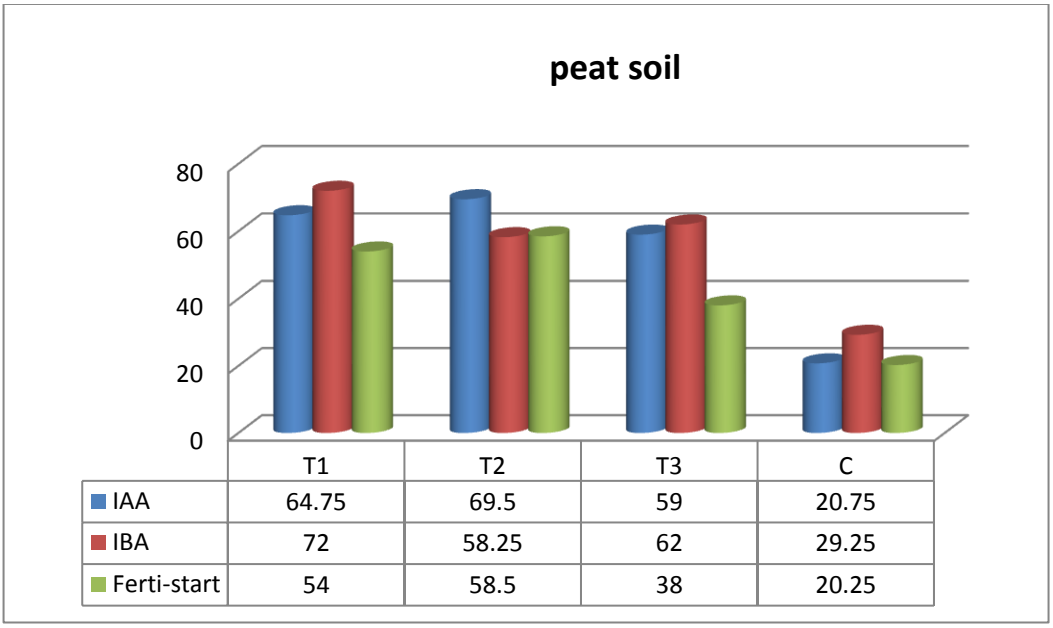

Fig.8 *Rhododendron burmanicum*, effect of treatment in peat soil

As the results, peat soil treatment was significant in media. Treatments were significant than control. There was no effect in between them. Not significant among them, there was not interaction between treatment and media. Treatment is significant but not significant between treatments.In peat soil with hormonal treatments (T1= 10 minute, T2 =20 minute, T3 =30 minute) hormone IBA was found roots percent 72% (T1), 62% (T3),58.5% (T2) follow by hormone IAA was found 69.5% (T2), 64.75% (T1), 59% (T3) and hormone Ferti-start was found 58.5% (T2), 54% (T1), 38% (T3) (Figure 6)

4.2 Experiment (II) the effectiveness of different kind of hormone for rooting ability

In the genus *R arboreum*, the rooting ability is significant between the hormones (IAA, IBA, and Ferti-start) and Treatments (10, 20, 30 minutes). Ferti-start, a hormone is similar to other hormones, such as hormone IBA. Significant with the hormone IAA. No Significant Between Hormone IAA and IBA. (Table 2,3)

In Sand + peat soil with hormone ferti-start was found to have an optimal root rate of 58.5% in 20 minutes of repair (Figure 5).

R. arboreum is significant between media and hormonal treatments. The treatment of the hormone and the media has an interaction. (Table-2,3)((Figure 5)

Although hormonal treatment with control (without Treatment) is significant, there is no significant difference between the two treatments. (Table-2,3) (Figure 5)

In Sand + peat, the treatments are significant but not significant in media. Treatment is significant than control there was no effect in between them (Table-2,3)

It is significant compared to treatment and control (without treatment)

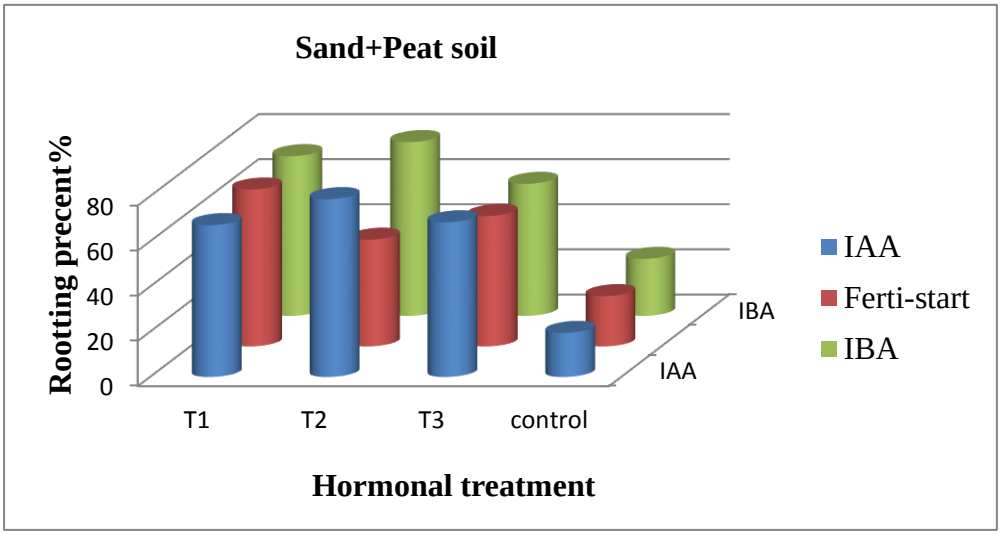

Figure.**9** *R. burmanicum*, Effect of different kind of hormone for rooting ability

R. burmanicum Hutch In sand + peat soils, the hormone IAA was 78.75% in 20 minutes, followed by hormone IBA at 77% in 20 minutes. Hormone Ferti-start found 69.5% of roots in 10 minutes of repair (Figure 7),(Table 4,5).

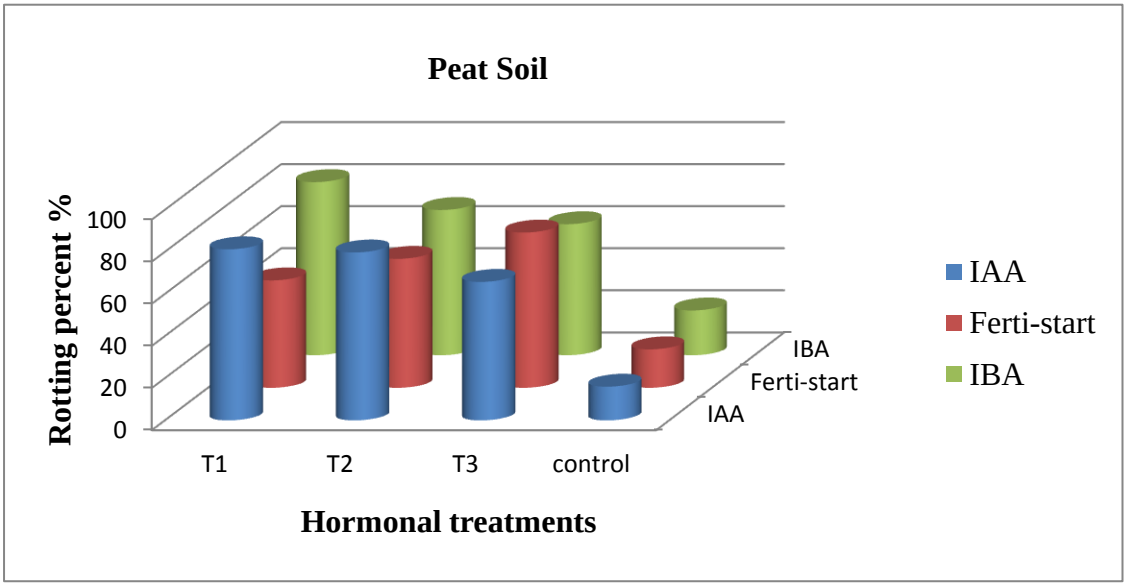

Figure.10 *R. burmanicum*, effect of different kind of hormone for rooting ability

R. burmanicum Hutch In peat soils, the hormone IBA has a root rate of 82.25% in 10 minutes of repair; In 10 minutes of repair, the hormone IA was 81.25%; Hormone Ferti-start found 73.75% of the roots in 30 minutes of repair, respectively.(Figure 10), (Table 4,5).

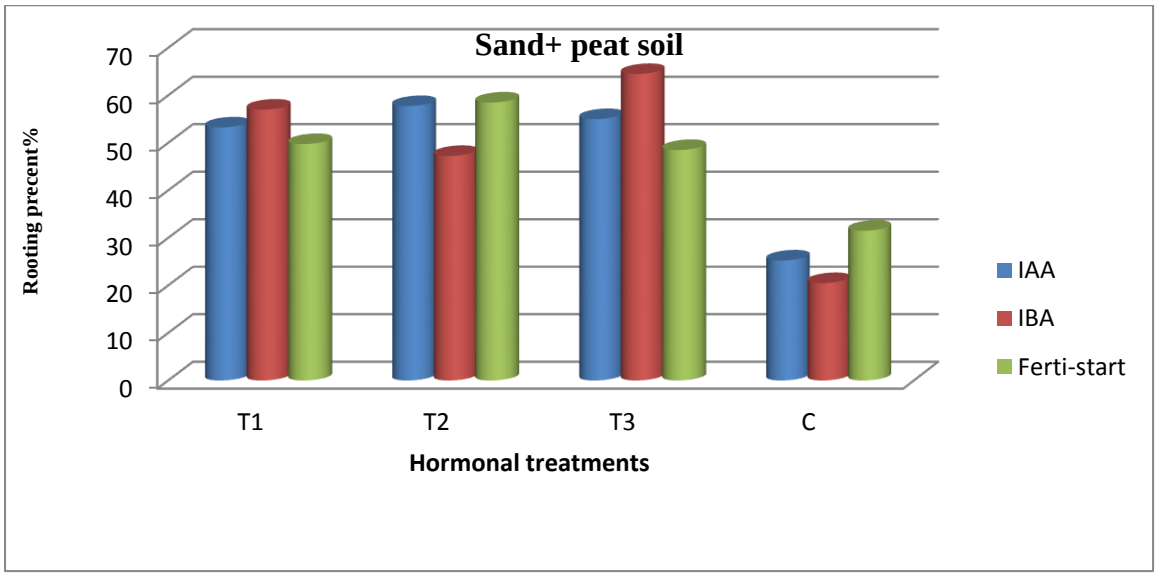

Figure.11 *R arboreum*, Effect of different kind of rooting ability

R. arboreum in Sand + peat soil Hormone IAA, IBA and Ferti-start was found to have an optimal root rate of 57.75%,,64.5%and 58.5%,in 20 minutes of repair.

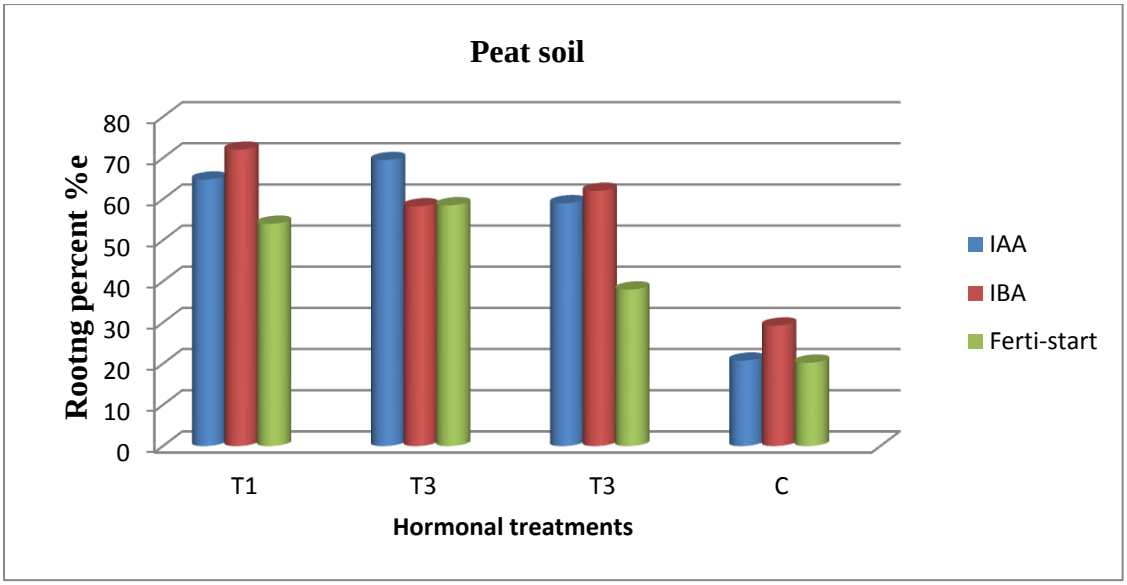

Figure.12 *R. arboreum,* Effect of different kind of rooting ability

R. arboreum, in the media peat soil with Hormone IBA found an optimal 72% root rate in 10 minutes of repair. Hormone IAA and Ferti-start was found to have an optimal root rate of 69.5%.72%, and 58.5%, in 20 minutes of repair. (Figure 12) (Table 2,3).

5. Discussion

In all study showed the different plant growth regulating substances of shoot cutting, different season such as early summer and late summer is also a sprouting season and winter is the dormant time for many plant species. This study highlighted that, the effectiveness of different plant media with hormonal treatments for survival rooting of shoot cutting.

And then shoot cutting of young plants originating from the top part (terminal) of two species of Rhododendron showed that higher rooting percentage in peat soil by hormonal treatment (IBA, IAA and Ferti-start) but in peat soil, *R. burmanicum* survival rooting percentage more than *R. arboreum.* Therefore, two species of *R. arboreum* and *R. burmanicum* with plant growth regulating substances (IBA, IAA and Ferti-start) would have rooting response more better than control (without treatment). This two species were successfully propagated using tip (Terminal) shoot cuttings effect of hormone treatments on initiation and promote of roots and shoots were found inconsistent in the cuttings methods.

6. Conclusions and Recommendations

Two species of Rhododendron of native region were liked to peat soil. They are slow growth type of natural regeneration. It is showed that the roots emerge within 60 to 75 days after planting. In the Portable plastic chamber with Temperature (20° - 25C) and Relative humidity is (60-90%) the best suitable gradient for the cutting Methods of vegetative propagation of tree species. From current study considerable practical significance and the process has to be successfully exploited for large scale production of hilly region species. In this study shoot cutting method on two kinds of media, peat soil was more effective in treatment and media. *Rhododendron burmanicum* is a peat soil favorite. Vegetative

propagation by cutting for Rhododendron species has a considerable practical significance and the process has to be successfully exploited for mass production of plantation for sustainable and management of native plant.

Further studied for extended period to detect the effects of the different hormone concentrations on the different shoot cuttings (eg. top, middle, basal etc.) related with grafting, Air layering, branch cutting, and micro-propagation or tissue culture.

This is the first study for shoot cuttings of Rhododendron species where plants have been successfully produced and it would be transferred to the field. The intensive study is also needed to understand it’s rooting behavior and conservation.

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References

Ashraf, Mohammad, Rehman, Sham-ur. (2001). A short note on the vegetative propagation of Ailanthus and Prosopis. The Pakistan Journal of Forestry. 51(1): 85. [46216]

Billings, W. D.; Cain, S. A.; Drew, W. B. (1937).Winter key to the trees of eastern Tennessee. The Journal of the Southern Appalachian Botanical Club. 2(3): 29-44. [79793]

El Houri, A. and K. Badi; Elsk E. A.(2001) Species for Agroforestry. Agroforestry Education outlook in the Sudan. U K and ANAFE African Network for Agroforestry Education May 2001.

Gibbs, D Chaimberlain, D. & Argent, G.(2011). The red list of Rhododendrons:1-128.Botanic Gardens Conservation International, Richmond, U.K.

Hartmann, H.T., D.E. Kester, and F.T. Davies Jr. (1997) *Plant Propagation: Principles and Practices, 6th Edition.* Prentice-Hall, Inc., Englewood Cliffs, NJ.784 pp.

Jeffrey L. Bushu(1993) A Preliminary Study Using the Willow Cutting Method to Reduce Lake Shoreline Erosion.

Kumar, V., Suri, S., Prasad, R. *et al.* Bioactive compounds, health benefits and utilization of *Rhododendron*: a comprehensive review. *Agric & Food Secur* 8, 6 (2019). https://doi.org/10.1186/s40066-019-0251-3

Kress, W.J., DeFilipps, R.A., Farr, E. and Kyi, Y.Y. (2003) A checklist of the trees, shrubs, herbs, and climbers of Myanmar. Contributions to the United States National Herbarium 45: 1–590.

Peerzada Ishtiyak Ahmad a,c , Lokho Puni b, Rajiv Pandey c , Nazir A. Pala a, M. Maqbool Rather a , Megna Rashid a , A.R. Malik (2020) Influence of different treatments and techniques on rooting behaviour of *Rhododendron arboreum* Sm. In Indian Himalayas.

Sir George Watt (Jan 8, 2015).the first Economic Botanist of British India who surveyed Manipur and Nagaland from 1882-1885 (Watt, 1889).

Snow,A.G,Jr.(1939) Clonal variation in rooting response of red male Cutting , Naaaaorthcastern Forest Experiment station 5th technical Note. Forest service, US Dept of Agriculture.

Somphou Choummaravong(1995).Vegetative propagation of *Azadirachta excels* by rooting of cutting.

The International Plant Names Index and World Checklist of Selected Plant Families. (2021).

Tilahun1, Begashaw Manahlie, Getachew Abebe and Genet Negash (2018). Effect of cutting position and indole butyric acid (auxin) concentration on rooting response of Araucaria heterophylla Abera.

Vikas Kumar (2019) Bioactive compounds, health benefits and utilization of Rhododendron: a comprehensive review.

Appendix 1

Table. 1 Tests of Between-Subjects Effects ANOVA					
Dependent Variable: length					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8722.729[a]	11	792.975	7.402	.000
Intercept	107825.521	1	107825.521	1006.474	.000
treatment	7539.563	3	2513.188	23.459	.000
media	4.667	2	2.333	.022	.978
treatment * media	1178.500	6	196.417	1.833	.120
Error	3856.750	36	107.132		
Total	120405.000	48			
Corrected Total	12579.479	47			
a. R Squared = .693 (Adjusted R Squared = .600)					

(*R. arboreum* for peat soil)

Table. 2 Tests of Between-Subjects Effects ANOVA					
Dependent Variable: length					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15100.229[a]	11	1372.748	11.186	.000
Intercept	122513.021	1	122513.021	998.352	.000
treatment	12541.229	3	4180.410	34.066	.000
media	1500.792	2	750.396	6.115	.005
treatment * media	1058.208	6	176.368	1.437	.228
Error	4417.750	36	122.715		
Total	142031.000	48			
Corrected Total	19517.979	47			
a. R Squared = .774 (Adjusted R Squared = .704)					

(*R. arboreum* for sand+peat soil)

Appendix 2

Table.3 Tests of Between-Subjects Effects ANOVA					
Dependent Variable: length					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20544.063[a]	11	1867.642	20.718	.000
Intercept	146191.687	1	146191.687	1621.724	.000
treatment	17657.396	3	5885.799	65.292	.000
media	867.125	2	433.562	4.810	.014
treatment * media	2019.542	6	336.590	3.734	.005
Error	3245.250	36	90.146		
Total	169981.000	48			
Corrected Total	23789.313	47			
a. R Squared = .864 (Adjusted R Squared = .822)					

(*R. burmanicum* for sand+peat soil)

Table. 4 Tests of Between-Subjects Effects ANOVA					
Dependent Variable: length					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	27144.563[a]	11	2467.688	14.571	.000
Intercept	154927.687	1	154927.687	914.815	.000
treatment	23597.063	3	7865.688	46.445	.000
media	825.500	2	412.750	2.437	.102
treatment * media	2722.000	6	453.667	2.679	.030
Error	6096.750	36	169.354		
Total	188169.000	48			
Corrected Total	33241.313	47			
a. R Squared = .817 (Adjusted R Squared = .761)					

(*R. burmanicum* for peat soil)

Appendix 3

Figure.13 Preparation of potting media and Portable Plastic chamber(PPC) for shoot cutting

Figure. 14 Preparation of potting bags on potting media in Portable plastic chamber

Figure. 15 Preparation of hormone treatment of *R .arboreum and R. burmanicum*

Appendix 4

Figure. 16 Rooting ability of *R .arboreum and R. burmanicum*

Figure. 17 Rooting ability of *R .arboreum and R. burmanicum*