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Influence of different hormones and potting media on growth and quality of Chitrak [*Plumbago zeylanica* L.]

Krishna Gorfad, Bimal S Desai, Sumankumar S Jha, Dhiraji P Patel, Vijay M Prajapati and Yogesh A Garde

Abstract
The present investigation was conducted to assess the effect of different hormone treatments and media on growth and quality of Chitrak- *Plumbago zeylanica* L. to develop effective nursery production technology. The experiment was conducted in completely randomized design with factorial concept, including twenty treatment combinations comprising of four levels of treatments with IBA hormone (Control, 500, 1000, 1500 ppm) and five levels of different growing media. Among various concentrations of IBA hormone as pre-soaking treatment, H_1 control treatment showed significantly better results for germination, growth, biomass and H_4 (IBA 1500 ppm) for TPC content in *Plumbago zeylanica* L. Similarly, among growing media, black soil + FYM (M_3) recorded maximum root collar diameter, number of branches per plant, number of leaves per plant, root length per plant, root biomass per plant, shoot biomass per plant, plant height per plant and TPC in M_5. Overall, the result indicated that that pre-soaking *Plumbago zeylanica* L. cuttings with H_1 control treatment and subsequently treated cuttings in M_3 media comprising of black soil + FYM enhance growth and biomass and H_4 (IBA 1500 ppm) with M_5 (black soil + sand + FYM) enhance TPC.

Keywords: Total phenolic content, hormone, Chitrak, media

Introduction
Chitrak i.e., *Plumbago* is known as "Vanaushadhi plant" (a wild medicinal plant) since ancient times in India and it is interesting to note that its reference is found even in Vedas (Gogate, 2009) [11]. Chitrak literally means "agni" i.e., fire which has capacity to "burn" the disorders and it aggravates “jatharagni” digestion (Chopra *et al.*, 1958) [5]. Latin *Plumbum*, lead and ago, a suffix of latin plant names meaning resemblance. Some authors consider that it is named *Plumbago* because of lead colored flowers. The plant species *Plumbago zeylanica*, known vernacularly as Chitraka, Agni, Pathi, Analanama, Vyala, Ushana. English- Ceylon leadwort, white, red or blue flowered leadwort. Hindi- Chita, Chitrak, Bengali- Chitra, Chita, Chitrak. Gujarathi - Chitro, Chitra, Pitaro. (Sharma *et al.*, 2000) [23]. In India it is found in Madhya Pradesh, Maharashtra, Uttaranchal and Uttar Pradesh. *Plumbago* as a wild species found in Tripura, West Bengal, Southern India, Ceylon etc. Throughout in Gujarat on hedges.
In India, *Plumbago zeylanica* L. syn. *P. viscosa* Blanco, *Plumbago auriculata* Lam syn. *P. capensis* syn. *P. camosa* and *Plumbago indica* L. syn. *rosea* L. syn. *P. coccinea* are found in Wild. Chitrak can easily be propagated through stem cuttings or seeds. Chitrak can be grown in a variety of soils, ranging from red laterite soil, with very little topsoil, to deep black soil.
Plumbago indica is often substituted by *P. zeylanica* L. If both the spp. i. e. *indica* and *zeylanica* are not available in sufficient quantities, it is adulterated by *Baliospermum montanum* L. Other than *Baliospermum montanum*, North Gujarat and Mt. Abu in Rajasthan supports *Vogelia indica*, which is often used to replace original drug *Plumbago indica* (Kirtikar and Basu, 1988) [18].
Macropropagation of Chitrak- *Plumbago zeylanica* L., using 3 node cuttings was undertaken as in AES- Zone III i.e., South Gujarat Heavy Rainfall Zone very scanty information is available. Moreover, seed viability is major limitation for multiplication in Chitrak. The most referred work using cuttings to propagate Chitrak in nursery conditions was of Dhar (1999) [8]. Since, it’s one of the important ingredients in many herbal formulations and further stating about its low availability from wild or under cultivation, Chitrak is often adulterated or substituted by *Baliospermum montanum* and *Vogelia indica*. Also, the plant is included in Ayurvedic Pharmacopoeia- Vol 1, published by AYUSH and in Ayurvedic Formularies of India.

To know the growth pattern and also Total Phenolic Content in Chitrak under the South Gujarat conditions, as phenols are one of the best source as Antioxidants, the present experiment was designed with below mentioned objectives:

1. To study the effect of hormone concentrations on the growth of *Plumbago zeylanica* L.
2. To find out the effect of various potting media on the growth and quality of *Plumbago zeylanica* L.

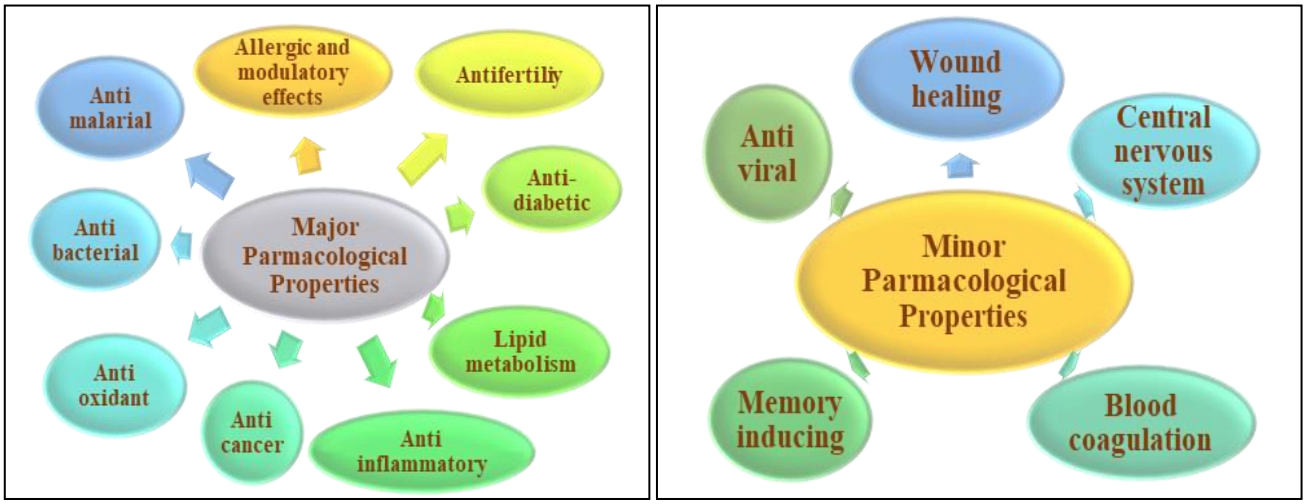


Fig 1: Clinically proven Major and Minor pharmacological properties (Khare, 2007 and 2004) [16, 17]

Table 1: Ethnomedicinal Usage of Chitrak- Western Indian Region

Sr. No.	Plant part	Diseases
1.	Roots	Medicine Abdominal pain, Diarrhoea, Dysentery, Fever, Indigestion, Leucoderma, Skin diseases, Wounds, Abscess, Abortifacient, Appetizer, Gout, Guinea worm, Hemorrhage, Piles, Poison, Stomach disease, Toothache and Warts
2.	Twigs	Toothache
3.	Seeds	Abortifacient and Leukoderma
4.	Leaves	Diarrhea, Dysentery, Eczema, Indigestion, Poison, Skin allergy and flatulence
5.	Fruits	Gout and Skin allergy
6.	Root bark	Hemorrhage, Indigestion and Leukoderma
(Jain, and Jain, 2017) [14] (Jain, 1992) [12]		

Table 2: Ethnoveterinary Uses

Sr. No.	Plant part	Disease
1.	Bark	Skin diseases
2.	Root	Stomatitis, skin diseases and Diarrhea
3.	Leaf	Bone fracture
4.	Whole plant	Uterine complaints
(Jain, 1999) [13]		
1	Root Bark	Stop bleeding in ruminants
2	Leaves	Relief flatulence
3	Root paste	Local inflammation
4	Root	Expel worms (horses in java)
(Chaudhary and Chaudhary, 2015) [3]		

Materials and Methods

The present investigation entitled "Influence of Different Hormones and Potting Media on Growth and Quality of Chitrak [*Plumbago zeylanica* L.] was carried out at Model Nursery of Medicinal & Aromatic Plants, ASPEE College of Horticulture and Forestry, NAU, Navsari (AES III-Heavy Rainfall Zone) during the month of November, 2021 to March, 2022.

The average rainfall received during the study period was 14.87 mm. The average relative humidity during the study period was 87% and 53% in morning and evening hours. The average maximum and minimum temperature during the study period was 32.51 °C and 18.95 °C respectively.

Equal sized 3 nodes stem cutting (approximate length of 10-12 cm) were treated with various concentrations of rooting hormone (IBA @ 500, 1000 and 1500 ppm) respectively. [Factor 1/level 1], where H_1 is control, H_2- IBA @ 500 ppm, H_3- IBA @ 1000 ppm and H_4- IBA @1500 ppm. In nursery condition 600 black polythene bags having size 6 × 8 inches (Mass capacity: 2.0 kg approx.) was used to fill the 5 types of potting mixtures. As a part of CRD with Factorial Concept, various potting media were used viz. M_1- Black Soil (Control), M_2- Red Soil, M_3- Black Soil + FYM (2:1), M_4- Red Soil + FYM (2:1) and M_5- Black Soil + Sand + FYM (2:1:1) respectively. (Factor 2/ Level 2)

For recording observations regarding the growth and quality, five plants were randomly selected and tagged in each replication. Whereas, for phenol extraction 20 plants were randomly selected. Plant height was recorded from the five randomly selected plants in each replication with the help of scale from the base to the tip of plant expressed in centimeters as mean plant height at regular intervals of 30, 60, 90 DAP

and at harvest. Number of leaves per plant and Number of branching were counted from the five randomly selected plants in each replication and expressed as mean number of leaves and branches per plant at regular intervals of 30, 60, 90 DAP and at harvest. Stem diameter per plant was measured with help of Digital Vernier Caliper at the collar region of plant expressed in millimeter (mm)as mean stem diameter per plant at regular intervals of 30, 60, 90 days after planting and at harvest. The total biomass per plant was worked out by adding the mean fresh leaf per plant, mean fresh stem yield per plant and mean fresh root yield per plant expressed in grams. The root and shoot biomass per plant was measured by weighing fresh and dry in grams. Length of main root was measured in centimeters with the help of scale at harvest. Root collar diameter of cuttings measured at collar region (or base, just above the soil) using digital caliper and it was expressed in millimeter (mm) at monthly intervals after sowing. *i.e.*, 30, 60, 90, and at harvest.

Five composite samples were drawn from the soil to record the textural and chemical characters of soil using standard procedures before the start of experiment. Soil was thoroughly mixed together, thus a composite representative sample was taken for chemical analysis using standard procedures to evaluate the fertility status of the soil at the end of experiment.

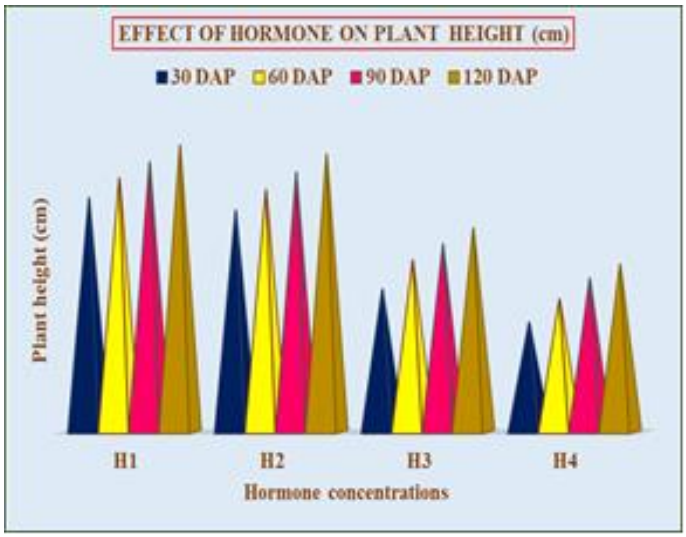
TPC was estimated by Folin-ciocalteau method with modifications as and when require. Agarval and Paridhavi, (2008) [1], Daniel, (1992) [6], Raman, (2006) [21], Sadasivam and Manickam, (2008) [22].

Results and Discussion

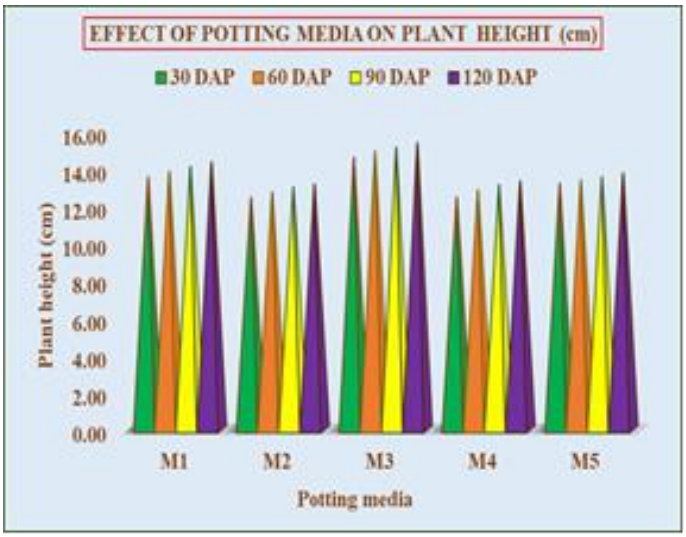
An appraisal of data indicated that maximum plant height (14.06 cm, 14.31 cm, 14.52 cm and 14.74 cm), maximum number of leaves (3.74, 6.37, 7.85 and 6.87), maximum number of branches (1.44, 1.71, 1.78 and 2.02), maximum stem diameter (5.46 mm, 5.60 mm, 5.76 mm and 5.97 mm) was recorded respectively at 30, 60, 90 DAP and at harvest in treatment (H_1). The maximum root fresh and root dry biomass were (0.88 g and 0.53 g), shoot fresh and shoot dry biomass were (3.15 g and 1.24 g), total fresh and total dry biomass were (3.28 g and 1.24), root length (18.34 cm) and (7.20 mm) root collar diameter at harvest in control, i.e., treatment (H_1). Amongst the different potting media used, the maximum plant height (14.66 cm, 14.99 cm, 15.20 cm and 15.44 cm), number of leaves (3.89, 6.27, 9.47 and 7.60), number of branches (1.49, 1.79, 1.82, 2.19), stem diameter (5.62 mm, 5.75 mm, 6.00 mm and 6.27 mm) were recorded at 30, 60, 90 DAP and at harvest, respectively and root length (19.27 cm), root collar diameter (7.88 mm), root fresh and dry biomass, (1.22 g and 0.67 g), shoot fresh and dry biomass, (3.15 g and 1.28 g) and total fresh and dry biomass, (3.45 g and 1.55 g) in treatment (M_3) i.e., Black soil + FYM (2:1).

Whereas, maximum TPC recorded was 36.15 (mg GAE /g dry weight basis) at harvest in treatment (H_4) i.e., @ IBA 1500 ppm and the recorded maximum root TPC 36.72 (mg GAE /g dry weight basis) was recorded at harvest in treatment (M_5) i.e., Black soil + Sand + FYM (2:1:1).

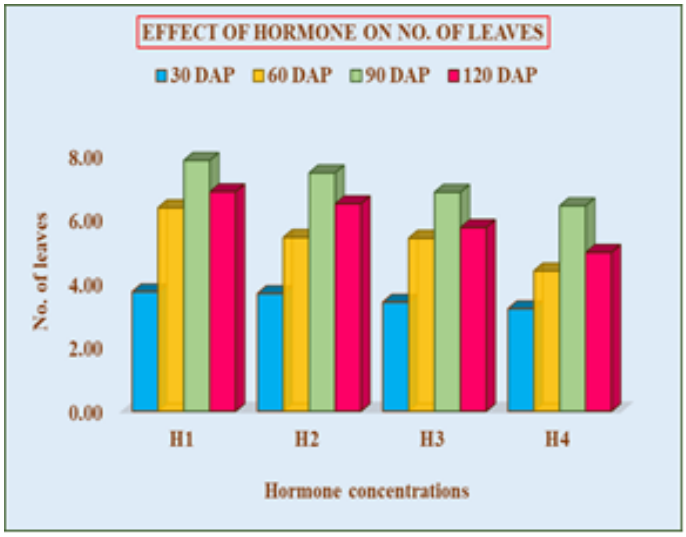
The results obtained during research/experiment with respect to growth and quality after application of hormones as well as different potting media are also supported by findings of other workers like Dhar (1999) [8], Deshpandey (2005) [5], Kalaiarasan and john (2011) [15], Walia *et al.* (2012) [24], Goel and Duhan (2014) [10], Chavda *et al.* (2015) [4], Ganvit (2016) [9], Malek (2017) [19], Pooja *et al.* (2017) [20] and Architha (2020) [2] respectively.



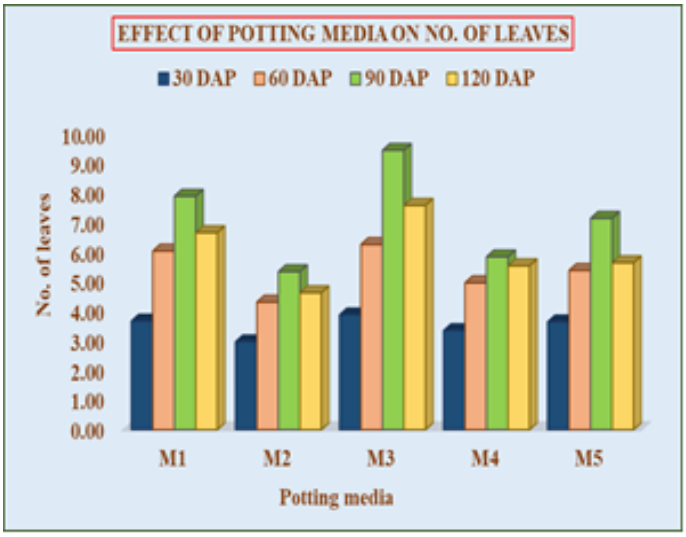
A



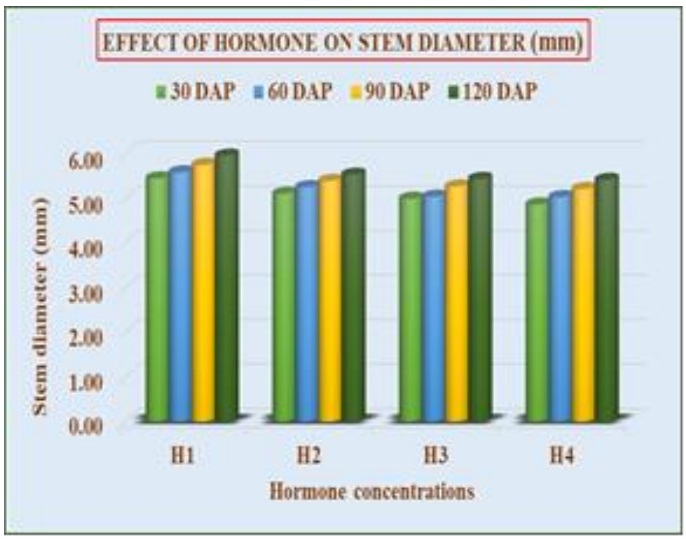
B


EFFECT OF HORMONE ON NO. OF LEAVES
30 DAP
60 DAP
90 DAP
120 DAP
No. of leaves
8.00
6.00
4.00
2.00
0.00
H1
H2
H3
H4
Hormone concentrations

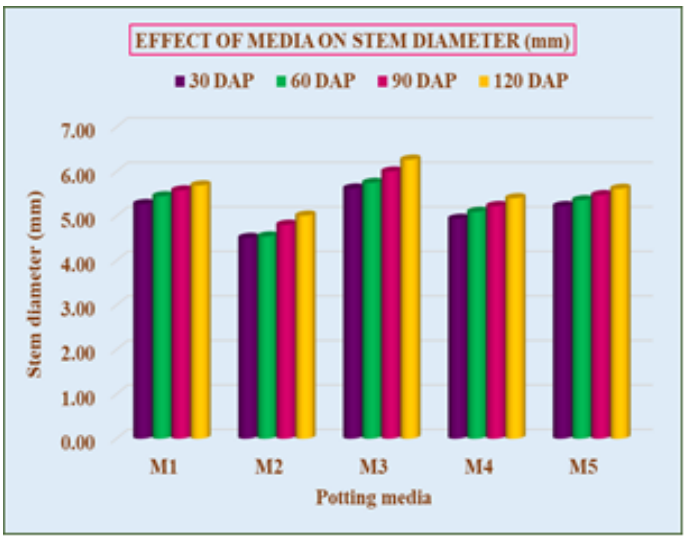
C


EFFECT OF POTTING MEDIA ON NO. OF LEAVES
30 DAP
60 DAP
90 DAP
120 DAP
No. of leaves
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
M1
M2
M3
M4
M5
Potting media

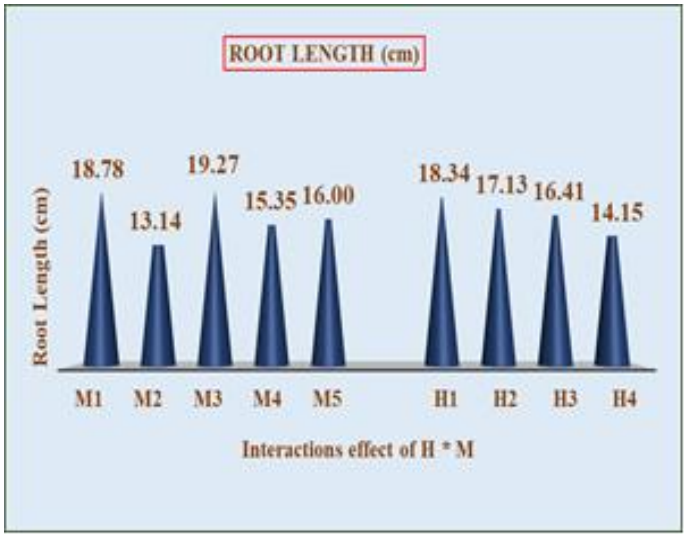
D


EFFECT OF HORMONE ON STEM DIAMETER (mm)
30 DAP
60 DAP
90 DAP
120 DAP
Stem diameter (mm)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
H1
H2
H3
H4
Hormone concentrations

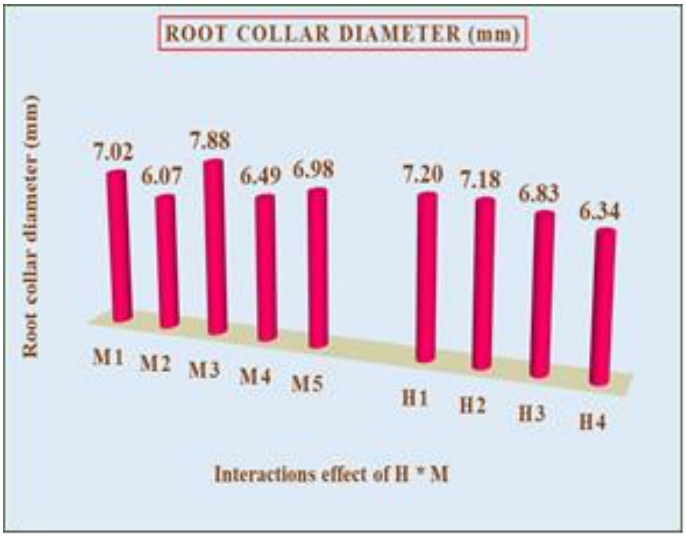
E


EFFECT OF MEDIA ON STEM DIAMETER (mm)
30 DAP
60 DAP
90 DAP
120 DAP
Stem diameter (mm)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
M1
M2
M3
M4
M5
Potting media

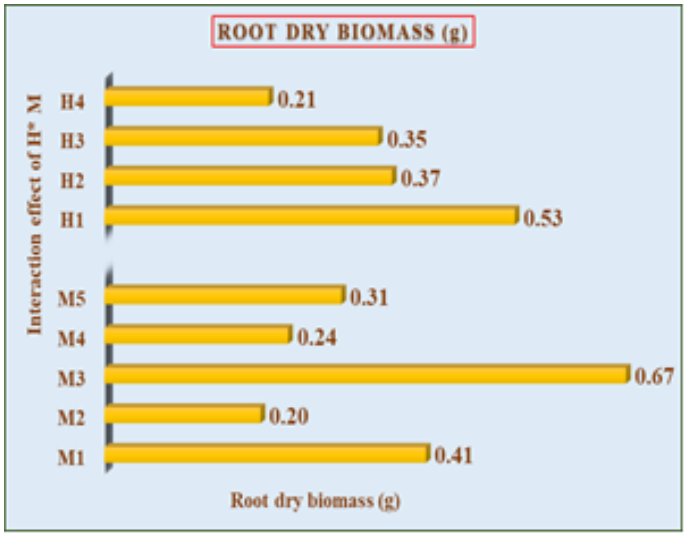
F


ROOT LENGTH (cm)
Root Length (cm)
18.78
13.14
19.27
15.35
16.00
18.34
17.13
16.41
14.15
M1
M2
M3
M4
M5
H1
H2
H3
H4
Interactions effect of H * M

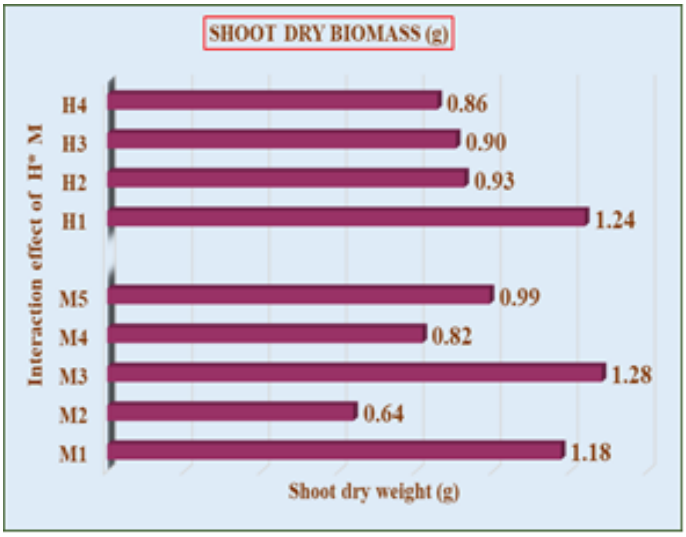
G


ROOT COLLAR DIAMETER (mm)
Root collar diameter (mm)
7.02
6.07
7.88
6.49
6.98
7.20
7.18
6.83
6.34
M1
M2
M3
M4
M5
H1
H2
H3
H4
Interactions effect of H * M

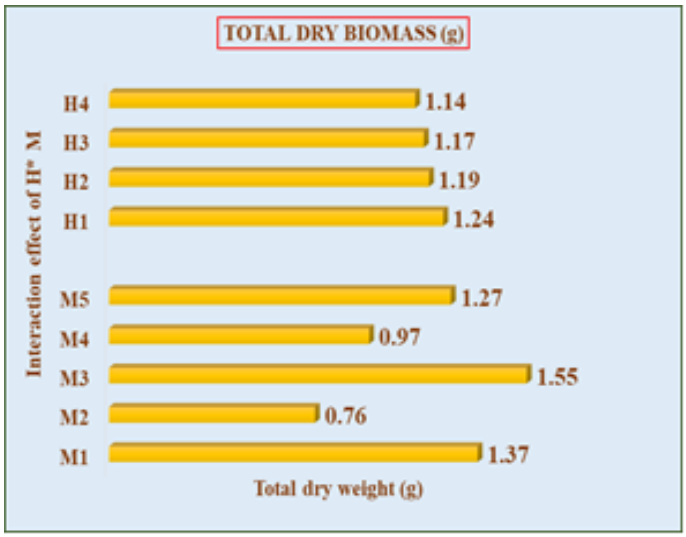
H



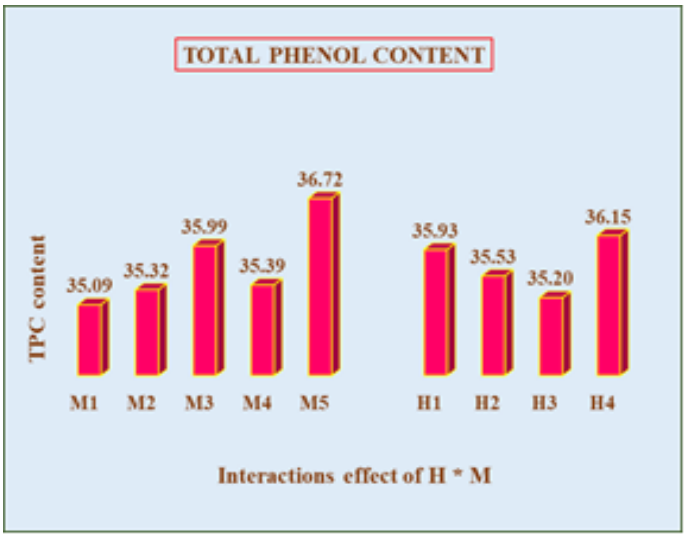
I



J



K



L

Fig: 2 Influence of different hormones and potting media on plant height (A-B), No. of Leaves (C-D), stem diameter (E-F), root length (G), root collar diameter (H), root dry biomass (I), shoot dry biomass (J), total dry biomass (K) and TPC (L).

Table 3: Influence of different hormones and potting media on biomass, root length, root collar diameter and total phenolic content (TPC) in Chitrak [*Plumbago zeylanica* L.]

Treatment	Shoot dry biomass	Root dry biomass	Total dry biomass	Root length	Root collar diameter	TPC
Growth Hormone – Factor 1						
H_1	1.24	0.53	1.24	18.34	7.20	35.93
H_2	0.93	0.37	1.19	17.13	7.18	35.53
H_3	0.90	0.35	1.17	16.41	6.83	35.20
H_4	0.86	0.21	1.14	14.15	6.34	36.15
SE(m)	0.03	0.01	0.05	0.44	0.18	0.06
CD at 5%	0.08	0.04		1.26	0.51	0.18
Potting Media – Factor 2						
M_1	1.18	0.41	1.37	18.78	7.02	35.09
M_2	0.64	0.20	0.76	13.14	6.07	35.32
M_3	1.28	0.67	1.55	19.27	7.88	35.99
M_4	0.82	0.24	0.97	15.35	6.49	35.39
M_5	0.99	0.31	1.27	16.00	6.98	36.72
SE(m)	0.03	0.01	0.05	0.49	0.20	0.07
CD at 5%	0.08	0.04	0.15	1.41	0.57	0.21
CV %	10.42	13.61	15.78	10.32	10.06	0.70

Conclusion

In conclusion, propagation and growth of Chitrak-*Plumbago zeylanica* L. can be improved in nursery condition applying Black Soil without IBA. Whereas, potting media viz., Black Soil + FYM (2:1) and without hormone treatment (H1) gave positive effect on growth and biomass yield parameter i.e., plant height per plant, number of branches per plant, number of leaves per plant, stem diameter per plant, total biomass per plant, root biomass per plant, root length per plant, root collar diameter per plant and shoot biomass per plant. The total phenolic content is reported higher in potting media i.e., Black Soil + Sand + FYM (2:1:1) with hormone treatment H4 i.e., @ IBA 1500 ppm.

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