DISCUSSION
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The results of present studies on determination of suitable soil, effect of hormone and effect of different fertilizer combination on growth of plant, primary metabolites, chlorophyll content and amount of alkaloids are being discussed below:-

DETERMINATION OF SUITABILITY OF SOIL FOR BOERHAAVIA DIFFUSA AND SOLANUM XANTHOCARPUM

The cuttings of Boerhaavia diffusa grown in kanhar soil gave best result for almost all the parameter as compared to result obtained with Bhata and Matasi soil.

In case of Solanum xanthocarpum it was found that the Kanhar soil is more suitable for almost all the parameters as compared value with Bhata and Matasi soil with literature survey, however, none any similar study could be found.

HORMONE TREATMENT:

Cuttings of Boerhaavia diffusa treated with 50ppm IBA gave best response for plant height /length, number of leaves, size (length / width) of leaves, number of nodes & inter nodes, number of root and length of root. In case of Solanum xanthocarpum 100 ppm IBA gave better response than any other concentrations of IBA and IAA. Gupta et al (1989) found that 50ppm IBA gave best response in Melia azadarach for inducing root. Badola et al (1991) found that the IBA treatment was best in Solanum hispidum for maximum number of roots, root length, rooting percentage and shoot length also. Promotions of adventitious root formation on stem cutting of many plant species, treated with IBA and another auxin is well known (Nanda, 1970, 1971, Hartmann & Kestar 1983, Nanda & Kochhar 1988, Pal1988). However IBA treatment not only increased the number of roots produced per cuttings, it also
promoted root growth, increased sprouting of axillary buds and stimulated shoot growth on branch cutting of *Solanum hispidum* but NAA and IAA 300ppm has been found more effective concentration for early rooting, root length and survival percentage in Rosemarrry (Chauhan et al., 1992) in *Ficus glomerata* Bhat & Badoni, 1993) in *Robinia pseudocacia* Linn (Swamy et al., 1994). *Grewia optiva* (Husen et al., 2003).

Kurasihi et al (1980) have also obtained similar result in *Onganum vulgare*, *Mentha piperia* and *Melissa officinalis*. 10mg/IBA promotes rooting as well as shoot growth and leaf formation on the cuttings which in contrary to the general belief that the concentration of an auxin which promotes rooting inhibits shoot growth of *Solanum torum* Sw. (Nanda, 1978), similar result found that in S. torvum (Badola et al., 1993).

Maximum number of leaves, branches, number of nodes, root, length, number of roots and rooting percentage was found in IBA at 50ppm in *B. diffusa* and IBA at 100ppm in *S. xanthocarpum*. Maximum number of leaves, branches, number of nodes, root, length, number of roots and rooting percentage was found in IBA at 0.5 and 1.0 mg ml\(^{-1}\) and NAA 0.1 & 0.2 mg ml\(^{-1}\) NAA in *Ficus glomerata* (Bhat & Badoni, 1993). However, Negi and Tiwari (1984) suggested that higher concentration of IBA are beneficial for the promotion of rate of rooting and obtained heavier root system in stem cutting of *Pongamia pinnata*. Pari and Shamet (1988) also found maximum rooting potential in stem cutting of *Celtis australis Grevia optiva*, *Leucaena leucocephala* and *Robina pseudocacia* treated with lower concentrations of IBA and NAA. Hu and Tse–Arshen (1986) suggested that higher concentration of NAA accelerates root initiation in *Acacia quiriculiformis* leafy cuttings.

100ppm IBA was found properly to be more effective in rooting percent, root number, root length, root number and percent survival was also in observed *Tylophora indica* (Pal et al., 1993). However, since the optimal concentration of an auxin required for promotion of rooting of branch cuttings,
the auxin, on the session of taking, cuttings depends, beside the chemical nature of the auxin, on the season of taking cuttings, the environmental conditions under which the cuttings are planted, the morphophysiological status of the cuttings and the genotype of the plant (Singh 1983; Nanda & Kochhar 1985; Pal 1988). Suitable trials should be conducted locally before deciding optimal auxin doses for a given clonal material of Anamtamul but our findings show that 50ppm IBA was more effective for vegetative growth as well as for rooting response.

Maximum number and length of root found in IBA at 50ppm concentration in *B. diffusa* and IBA at 100ppm gave maximum number and length of root in case of *S. xanthocarpum*. Pal *et al* (1994) reported 100 mg/1IAA stimulating rooting and percent survival of rooted cuttings of *Withania somnifera* but its 1000 mg/1 concentration and all the other auxin treatment which were tried either failed to elicit any response or inhibited rooting. It has been reported that branch cutting of many plant species do not root even on their treatment with auxins (Nanda, 1970; Bansal & Nanda 1981; Hartman & Kastar 1983). The species related variation in rooting response of many other plant species is also well known (Nanda 1970). Thus the nodal segment of *S. khasianum*, *S. torvum* and *S. nigrum* rooted more easily, as is evident from the higher percent rooting in the control cuttings of these species, than the nodal segment of *Solanum hispidum*, *Solanum xanthocarpum* and *Solanum indicum*. IBA treatment increased the percentage rooting, root growth, number of roots, and leaves produced per cutting, and the shoot length. However, the effectiveness of IBA varied with the species and the growth parameter i.e.; rooting or shoot growth. Similar variations in the effectiveness of auxin in other species have been reported by Nanda (1970) and Hartman and Kestar (1983) also. Thus while 10 mg/1 concentration of IBA was the more effective treatment in *S. hispidum* and *S. xanthocarpum* 100 mg/1 concentration of IBA was the most effective concentration for promoting rooting and shoot growth in the other species (Pal & Bhandi, 1994).
High rooting and shoot length was recorded for cuttings of *Ulmus willchiiana* treated with 5000ppm IAA during March. (Sharma & Shamet, 1995). Palanisamy and Kumar (1996) reported 1000ppm IBA to be the best treatment which induces 80% rooting in *Azadirachta indica*. Pal *et al* (1995) reported the treatment with indole 3-butyric acid and 1-nepthyl acetic acid suppressed rooting in *Rauwolfia serpentina*. But Kanwer *et al* (1995) reported that IBA 250 mg l, NAA 500 mg/l and carbendazim 750 mg l were best chemical for rooting. 750 mg/l NAA increased rooting while 250 mg/l IAA increased number of leaves and leaf area both.

Maximum number of cutting rooted were observed with 200ppm IBA while highest number of sprouts and number of roots per cutting were found with 200ppm IBA found in *Alnus nitida* reported by Thakur (1999).

1000ppm IBA has been found to be the best concentration for rooting percentage, number of roots root length and root dry weight in *Azadirchta indica* (Gera *et al*., 1998). Genetic factors are known to affect the rooting behaviour of cuttings of many woody plant species. (Hartmann & Kestar, 1983; Pal 1989).

Bharadwaj & Mishra (1998) reported that 5000ppm IBA was effective in maximum rooting percent, root number, root length and root dry weight in *Acer oblongum*. Smith and Wareing (1972) hypothesized that poor rooting of cutting from the apical portion may be related to bud development and hormone level. The percent of rooting increased by increasing concentration of all growth regulators from 1000 – 4000 ppm but these after decreased reported by (Bhat & Todaria., 1993., Chandrasekher *et al*., 1996., and Reddy *et al*., 2001) in *Givotia rotleriiformis*.

Husen *et al* (2003) reported in *Grewia optiva*, the highest percent rooting and sprouting was obtained from without application of phytohormones. In most of the cases the higher concentration of auxins are most suitable for root growth but are not favorable for shoot growth (Hartmann
et al., 1977). Increased root numbers and their length per cutting due to IBA and NAA application was also observed in *Vitex negundo* leafy stem cutting (Husen & Mishra, 2001). Khali & Sharma (2003) reported in *Taxus baccata* that the IBA at 10,000 ppm is optimum for induction of better rooting percentage, higher number and greater length of primary roots in juvenile stem cutting of *Taxus baccata*.

Sharma *et al* (2004) reported in *Colutea nepalensis* the IBA treatment significantly promoted adventitious rooting in shoot cuttings but in combination with thiamine failed to produce any synergetic effects on induction and growth of adventitious roots. Stick (NAA with sodium as active ingredient) treated cutting showed maximum average node, sprouting, number of leaves, maximum rooting percentage in *Vitex negundo* (Tiwary *et al*., 2004). Higher concentration of auxin inhibit root initiation. (Ramulu *et al*., 2005). Research on vegetative propagation method is highly needed. It is simple and less expensive. Several species from different families have been successfully propagated by stem cutting including *Tamarindus indica* (Srivasuki *et al*., 1990), *Ficus glomerata* (Bhatt & Badoni, 1993), *Terminalia bellerica* (Bhardwaj *et al*., 1993), *Carallia brachiata* (Vijaykumar *et al*., 1993) and *Eucalyptus hybrid* (Bakshi, 1998).

**FERTILIZER TREATMENT:**

In the cuttings of *Boerhaavia diffusa* increasing doses of fertilizer as cow dung 0 ton/ha + N:P:K 0 kg/ha to cow dung 10 ton/ha + N:P:K 45:35:15 kg/ha increased plant height, number and size of leaves, number of nodes and internodes, number and length of root, but decreased with cow dung 10 ton/ha + N:P:K 60:40:20 kg/ha. In case of *Solanum xanthocarpum* plant height, number and size of leaves, number of nodes and internodes, number of flower and number of fruit were increased from cow dung 0 ton/ha + N:P:K 0 kg/ha to cow dung 10 ton/ha + N:P:K 60:40:20 kg/ha.
Masoodi et al (1996) found that the combination of 80 kg N/ha and 20×20 cm spacing is more appropriate for raising better nursery stock of Acer oblongum. Increasing doses of nitrogen increased stem height and girth (Sehgal et al., 1992). Similar findings have been recorded by (Hindson, 1975) in Glycine max. Lund. (1979) in birch seedlings. Agarwal (1981) in Pinus caribaea. Differences in the growth parameters due to nitrogen concentrations were also observed in Leucaena leucocephala (Pokhriyal et al., 1988).

Mohan (1992) found maximum growth (height and girth) and biomass (above and below ground) in Gmelina arborea at 150 kg/ha nitrogen, 75 kg/ha phosphorus and 25 kg/ha murate of potash as NPK fertilizer doses. Sood et al (2000) found that nitrogen application had significant effect on the growth character where shoot length increased with the increasing level of nitrogen up to 2000 kg Nitrogen/ha. Similar findings have been recorded by Shashi kumar & Bhutani, (1996), Chauhan & Sharma (1995), Purshotam Lal (1993) & Singh (1999) in different species.

Vijay and Kumar (2005) found that in Asparagus racemosus N₂ in the form of urea improved the growth of the plants up to 80mg/kg in the form of maximum biomass production and root development. The lower concentration of N₂ caused poor growth while higher concentration promoted fasciculate root system. Singh and Ramesh (2002) found that application of nitrogen at the rate of 150 kg/ha or 2.5 t/ha vermicompost + 75 kg N₂ + 2 kg P₂O₅ + 25 kg K₂O/ha gave maximum plant height and herbag in Ocimum basilicum were significantly higher than control (no fertilizer) and application of 5 ton/ha vermicompost. Channbasavanna et al (2002) found that the fertilizer doses of 60:40:20 kg/ha was optimum for Coriandrum sativum in deep black soil under irrigation. Apte and Jadhav (2002) found that maximum vegetative growth and yield in Patchouli was obtained with the application of fertilizer doses 150 kg N: 60 kg P₂O₅; 60 kg K/ha along with 30 percent light intensity.
Kanjilal et al. (2002) found that crop spacing at 30 x 30 cm in *Andrographis paniculata* and 45 cm spacing row to row in *Boerhavia diffusa* had significant effect on biomass yield and other attributes. NPK treatment increased the yield significantly over control in both the crops. Application of NPK at the rate of 50:30:30 kg/ha was found to be optimum to get increased yield in *Andrographis paniculata* and *Boerhavia diffusa* respectively while according to present findings are crop spacing at 20x20 cm row to row in *B. diffusa* had significant effect on vegetative growth. Rai et al. (2002) found that in *Foeniculum vulgare* the plant height, number of leaves/plant, length of internodes, number of tillers/plant and plant spread increased with increasing doses of N and P and maximum was found with 90 kg N and 50 kg N/ha. 60 cm inter row spacing resulted in significantly higher plant spread, number and length of primary and secondary branches, number of fruits and fruit weight per plant and fresh fruit yield in *Solanum luteum* Khandelwal et al. (2003). 150 kg N/ha with var.RH-10 was best for *Curcuma longa* reported by Yadev and Prasad (2005). The sheep manure 10t/ha and vermicompost 7.5 t/ha significantly increase the plant height, and seed yield in *Cuminum cuminum L.* Malhotra et al. (2005).

**ESTIMATION OF PRIMARY METABOLITES:**

The data obtained during present investigations revealed that the cuttings grown in Kanhar soil was best soil for the estimation of primary metabolites and chlorophyll content. Kanhar soil gave better response than the Matasi soil and Bhata soil. Similar results were found also with *Solanum xanthocarpum*.

Cuttings of *B. diffusa* treated with different concentrations of indole-3-acetic acid and indole-3 butyric acid. 50ppm treated cuttings of *B. diffusa* gave best response for primary metabolites and in root, leaf and stem growth but 100ppm IBA showed best response of primary metabolite in leaf, stem and root cuttings of *S. xanthocarpum*. 
The increasing level of fertilizers as cow dung 0 ton/ha + N:P:K 0 kg/ha to cow dung 10 ton/ha + N:P:K 45:30:15 kg/ha increased primary metabolites in root, leaf and stem of cuttings of *Boerhaavia diffusa* but decreased at higher level as cow dung 10 ton/ha + N:P:K 60:40:20 kg/ha primary metabolites increased from cow dung 0 ton/ha + N:P:K 0 kg/ha to cow dung 10 ton/ha + N:P:K 60:40:20 kg/ha. Agrawal (1988) found in *Pinus caribaea* the maximum concentration of reducing sugar was found at optimum phosphorus level. Hass (1936) reported in *Cirus* cuttings that increasing level of phosphorus caused increasing sugars concentration contrary to Hass many workers have observed that phosphorus deficiency increases reducing sugar concentration in Sunflower, Soyabean and Mustard (Eaton, 1949-50) and in Cotton (Frgle & Eaton, 1975). Joy *et al* (2004) found that the 10 × 10 cm spacing resulted in a higher chlorophyll a and chlorophyll a + b content and primary metabolites.

**ESTIMATION OF SECONDARY METABOLITES:**

Maximum amount of alkaloid was found in roots of cuttings of *B. diffusa* grown in Kanhar soil. Similarly the seedlings of *S. xanthocarpum* grown in Kanhar soil gave maximum amount of alkaloid.

The amount of alkaloid in roots of *B. diffusa* also maximum with 50 ppm treated cuttings but in case of *S. xanthocarpum* 100 ppm IBA gave maximum amount of alkaloid in the berries of *S. xanthocarpum*.

Amount of alkaloid in roots of *B. diffusa* increased from cow dung 0 t/ha + N:P:K 0 kg/ha to cow dung 10 t/ha + N:P:K 45:30:15 kg/ha but decreased at higher levels of cow dung 10 ton/ha + N:P:K 60:40:20 kg/ha however, in the berries of *S. xanthocarpum* amount of alkaloids are increased from cow dung 0 t/ha + N:P:K 0 kg/ha to cow dung 10 ton/ha + N:P:K 60:40:20.
Pundarikashada et al (2003) obtained solasodine content in fresh mature yellow berries of *S. xantocarpum*. Chauhan and Tiwary (2003) obtained the nitrogen application at the rate of 40 kg N/ha resulted in maximum andrographolide accumulation in roots of above ground parts. Al-fayyad et al (2002) found that increasing fertilizer level significantly improve colchicines content in different plant parts and stages. Sharma and Kasera (2001) found in Shankhpushpi (*Evolvulus alsinoides*) N:P:K full dose + FYM + hexameal treated plants showed a significant increase in total pigments, sugar and protein content. Joy et al (2004) reported that 10 × 10 cm spacing resulted in the higher amount of curculigoside in rhizome.