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Effect of foliar application of plant growth regulators on vegetative growth of medicinal plant *Simarouba glauca* DC

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ABSTRACT

Field experiment was carried out to investigate effect of foliar application of Plant Growth Regulators (PGRs) like 6-benzylaminopurine (6-BA), gibberellic acid (GA), chlormequat(CCC), salicylic acid (SA), cysteine and methionine with 5 and 20 ppm concentration on vegetative growth of *Simarouba glauca* DC. Foliar application of both concentrations of all the PGRs promoted root length, shoot length, height of plant, number of leaves per plant, leaf area, fresh and dry weight of leaf, stem, root and fresh and dry weight per plant. The significant increase in plant height, leaf area and dry weight were obtained in plants treated with GA, SA and methionine while 5ppm GA gave highest number of leaves per plant. This will improve the availability of plant biomass for extraction of various bio active molecules in pharmaceutical industries.

Keywords: *Simarouba glauca*, 6-benzyl aminopurine 6-BA, CCC chlormequat, salicylic acid SA, cysteine and methionine

I. INTRODUCTION

Simarouba glauca has a long history in herbal medicine in many countries. It is rainfed, wasteland, and evergreen edible oil tree. It is commonly known as Laxmitaru or Paradise tree which belongs to family Simaroubaceae. It is indigenous to Southern Florida, the West Indies and Brazil (Cronquist, 1981). Plant growth regulators are organic compounds, which are synthesized in very small quantity in plants and play an important role during seed germination growth and development of horticultural and forest plants, hence, are becoming most popular in forest and horticultural nurseries. The significant effect of GA on different plant growth was reported by several workers. Shedeed *et al.* (1991) on croton plant, EI-Gendy *et al.* (1995) on *Hedera helix* and *Cissus rhombifolia*, Soad (2005) on Jojoba and Darwish and Sakr (2008) on *Hedera canariensis.* Cytokinin mainly 6-BA is wide spectrum PGR accelerate growth of cell. Effect of 6-BA on growth of different plants have reported by Eraki *et al.* (1993) on Salvia plant, Mazrou (1992) on datura, Mazrou *et al.* (1994) on sweet basil and Vijakumari (2003) on *Andrographis paniculata.* According to Raskin (1992) SA plays an important role in flower induction, growth and development, ethylene biosynthesis, stomatal behavior and respiration. The effect of SA on physiological process is variable, promoting some processes and inhibiting others depending on its concentration, plant species, developmental stages and environmental conditions (EI-Mergawi and Abdel Wahid, 2004). Lower concentration of SA enhanced growth of wheat and maize (Shakirova *et al.,* 2003). SA is considered to be hormonal substance that plays a key role in regulating, plant growth and development (Huang *et al.,* 2008).

CCC is 2-chloroethyl trimenthyl ammonium chloride. It is also known as cycocel or chlormequat. CCC is well known for its antigiberellin action. Methionine plays an important role as intermediate in the biosynthesis of cysteine, carnitine, taurine, lecithin, phosphatidylcholine and other phospholipds. Improper conversion of methionine can lead to atherosclerosis Refsum *et al.,* 1998. The hydrophobic amino acid cysteine contains side chain of a non polar thiol group. The thiol side chain mostly participates in enzymatic reactions and acting as a nucleophile. The thiol is susceptible to oxidization to give the disulfide derivative cystine, which serves an important structural role in many proteins. The vegetative growth components of plants are widely used in the extraction of crude drugs in bulk quantity. Hence an attempt has been made in the present investigation to study the effect of PGRs on vegetative growth of medicinally important *S. glauca* DC.

II. METHODS AND MATERIAL

The present study was carried out in the field at Shivaji University, Kolhapur. Seeds were sown in polybag containing FYM and soil with the ratio of 1:3. In each polybag seeds of *S. glauca* were sown and allowed to grow for one year. The one year grown fully developed seedlings were planted in the rows in specially prepared field plots of 2m X 2m size in the month of July. The seedlings were allowed to establish in field for three months. The plots were equally irrigated with tap water. After establishment of seedlings each plots were sprayed with respective 5 and 20ppm concentrations of 6-BA, GA, SA, CCC, cysteine and methionine and distilled water serve as control during the month of October 2010. Foliar sprays were given in duplicate after every 7 days and every care was taken to raise healthy plants. The weed control of plots was done by hand weeding. After the completion of four foliar sprays the randomly selected five plants were harvested in between 9-11 a.m. from each treatments and brought to the laboratory. The roots were briefly rinsed in cold distilled water to remove the surface salts blotted to dry. Each plant was analyzed for the growth studies. The parameters include height, root-shoot length and total numbers of leaves, leaf area per plant, number of branches were recorded. Plant parts were separated into root stem and leaves. The fresh weight of individual plant parts were masured immidiatelly and they were dried in oven at 60^0C for eight days and reweighed until the constant weight. These dry weights were used for the determination of dry matter partitioning. The leaf area of leaflet was determined by using the Leaf area meter (Systronics,211).

III. RESULTS AND DISCUSSION

Data presented in Table 1 and 2 indicate that foliar application of both concentrations i. e. 5 and 20 ppm of 6-BA, GA, CCC, SA, cysteine and methionine had significantly affected all the growth parameters in *S. glauca* in terms of root length, shoot length, height of plant, number of leaves per plant, leaf area, fresh and dry weight of leaf, stem, root and fresh and dry weight per plant. The maximum plant height, leaf area and dry weight were obtained in plants treated with GA, SA and methionine, whereas, 5ppm GA gave highest number of leaves per plant. These results are conformity with those of EI- Fouly *et al.* (1988) and Abdel- Fattah *et al.* (1995). They found application of GA increases plant height in beans. GA application enhanced shoot elongation in *Parkia biglobossa, Senna siamea*, *Albeizia lebbe*ck and *Prosopis africana* (Ingram *et al.*, 1986 and Davies 1995). GA stimulated shoot length significantly in *Lagenaria siceraria* Molina standley (Vwioko and Longe, 2009). GA sprayed mustard plants showed enhanced leaf area (Khan *et al.*, 2002). Similar results are also reported by Hussein (2009) in *Cryptostegia granndiflora* R. Br. and Shahin *et al.* (2010) in Anna apple trees. According to Sujatha (2001), foliar application of SA on green gram leads to increased plant height. Hayat *et al.* (2009) observed

application of salicylic acid 10^{-5}M was highly significant and increased root length and shoot length in Indian mustard. Mady (2009) reported SA at 50 ppm increases leaf area of tomato plant. Similar results are also obtained by Sivakumar *et al.* (2006) in pearl millet. Application of BA to *Plantago major* L. sp. *pleiosperma* significantly increased shoot growth and shoot to root ratio (Kuiper, 1988). According to Soad *et al.* (2010) 6-BA increased general growth in croton plants as compared to control. Increase in dry matter accumulation was recorded in small grain cereals by Ma and Smith (1992) and Emam and Moaied, (2000) due to CCC treatment. Application of CCC significantly increased number of leaves per plant of *Catharanthus roseus* L. (Choudhary and Gupta, 1998). Ngatia *et al.* (2004) noticed increased root, shoot and the total dry mass due to application of GA in common beans. Application of GA led to enhancement in fresh and dry weight of leaves, stem and root per plant of *Cryptostegia grandiflora* (Hussein, 2009). 100 mg/l BA significantly increased leaf dry weight of *Alstroemeria* (Mutui *et al.*, 2001). Increased dry matter production was recorded by application of SA in corn and soybean by Khan *et al.* (2003). Increased dry weight of artichoke plant was obtained by SA treatment (EI-Abagy *et al.*, 2010).

The vegetative growth in terms of root length, shoot length and height was significantly stimulated in response to GA, methionine and cysteine as a foliar application. The foliar characteristics i.e. leaf area, and number of leaves were increased in response to foliar sprays of growth regulators. The increased leaf area indicates the enhancement of productive investment of plant followed by building of photosynthetic capacity to support the productivity in terms of dry weight of the plant leading to the improvement of overall field performance in response to growth regulators. The accumulation of biomass in terms of dry weight was induced significantly in leaf, stem and root tissues. Further, this stimulation of dry matter partitioning was more significant in leaf tissue and stem tissue. In control plant the dry matter portioning was in the order of root > stem >leaf but in response to the applications of growth regulators the pattern of dry matter partitioning was changed from leaf > stem > root. The change in dry matter partitioning in leaf and stem might be due to growth hormone promoted cell division and elongation as indicated by Harringtonn *et al.* (1996) or it might be due to changes in the specific activities of root and shoot with respect to the assimilation of element in response to growth regulators.

Application of different growth regulators favorably induces growth parameters which will be prove beneficial for yield and productivity of this medicinally important oil yielding plant. Further foliar applications of PGRs during nursery development of *S. glauca* will helps to growers and nursery developers in production of nursery seedlings which will be useful for improvement of plantation value of this medicinal plant. Further the growers and pharmaceutical industries will access biomass on large scale for extraction and synthesis of various bioactive molecules in pharmaceutical industries.

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Table 1. Effect of foliar application of plant growth regulators on some growth parameters of *S. glauca*

Treatments	Root Length (cm)	Shoot Length (cm)	Height Of plant (cm)	No. Leaves per plant (cm)	Leaf area (LA) (sq. cm)
Control	19.00±1.02	53.25±2.17	72.25±6.50	23	2790.82
6BA 5ppm	29.75±2.18	58.25±3.27	88.00±3.43	22	3340.48
6BA 20ppm	38.25±2.69	59.25±2.54	97.50±2.76	23	3486.80
GA 5ppm	62.75±3.76	62.75±5.30	130.50±9.65	34	6202.96
GA 20ppm	64.00±3.22	66.00±4.15	133.50±10.16	32	6597.76
CCC 5ppm	39.25±1.09	64.75±2.96	104.00±4.72	29	5175.92
CCC 20ppm	34.25±1.55	60.00±2.66	94.25±6.43	23	4350.68
SA 5ppm	58.00±2.22	69.00±2.32	128.75±9.51	36	8356.32
SA 20ppm	59.25±4.12	70.25±6.99	129.5±4.32	28	7853.44
CYSTEINE 5ppm	69.75±3.99	62.00±2.95	131.00±3.13	29	6214.70
CYSTEINE 20ppm	48.75±2.12	71.00±4.32	119.75±2.65	29	7220.52
METHION INE 5ppm	56.75±6.01	94.00±7.32	150.75±10.01	28	9332.00
METHIONINE 20ppm	55.25±3.52	89.00±6.17	144.25±4.78	26	8584.00

(The readings are the mean of 5 independent determinant)

Table 2. Effect of foliar application of plant growth regulators on fresh and dry weights of leaves, stem and root of *S. glauca*

Treatments	Conc. (Ppm)	Fresh weight Leaves (g)	fresh weight Stem (g)	Fresh weight Root (g)	Fresh weight Per Plant (g)	Dry weight Leaves (g)	Dry weight Stem (g)	Dry weight Root (g)	Dry weight Per Plant (g)
Control		51.50±4.82	57.5±2.65	63.50±2.76	169.50±2,96	14.17±1.02	16.98±1.21	19.13±2.13	50.28±5.06
6 BA	5ppm	67.50±3.37	61.00±3.76	50.50±5.78	179.00±2.14	20.85±1.09	18.05±1.18	15.50±1.13	54.4±6.76
6BA	20ppm	98.00±3.15	107.50±4.65	84.50±9.21	290.00±3.25	38.50±2.09	24.95±2.81	35.04±3.61	98.49±4.75
GA	5ppm	137.50±9.54	118.00±6.43	123.53±4.24	379.00±7.54	52.50±3.95	35.53±3.54	59.50±5.74	147.53±7.98
GA	20ppm	112.00±7.62	99.00±6.90	116.50±8.82	327.50±4.96	46.00±4.75	44.42±3.12	36.00±3.23	126.42±7.74
CCC	5ppm	108.50±6.25	107.00±7.02	104.00±6.73	319.52±5.67	45.00±5.43	34.99±4.43	27.53±4.28	107.52±5.58
CCC	20ppm	102.50±4.95	98.50±4.76	100.50±7.14	301.50±9.93	40.00±2.98	32.87±2.09	27.15±2.54	100.02±9.79
SA	5ppm	145.50±9.11	155.5±9.94	131±11.07	432.00±7,87	58.50±3.41	42.25±5.43	46.50±3.26	147.25±7.98
SA	20ppm	149.00±.13	151.5±7.63	128±4.65	428.50±8.97	59.00±4.23	41.59±2.98	46.24±4.17	*146.80*±8.92
Cysteine	5ppm	109.50±6.39	112.00±9.78	136±9.65	357.50±5,79	83.00±3.65	42.92±3.76	49.25±3.91	175.17±9.28
Cysteine	20ppm	138.00±10.34	141.50±5.76	132±7.65	554.00±3.54	32.00±2.19	41.50±5.65	47.50±2.50	121.00±10.07
Methionine	5ppm	210.50±13.22	200.00±13.76	175.5±14.53	586.00±2.98	71.50±7.18	59.28±6.54	54.03±1.59	184.81±12.21
Methionine	20 ppm	195.50±9.25	187.00±8.52	160.0±4.65	542.50±11.54	69.00±6.55	48.00±4.74	49.00±2.79	160.00±14.73