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Euphorbia antisyphilitica: Effect of growth regulators in improving growth and productivity of hydrocarbon yielding plant

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ABSTRACT

Green plants use solar energy to generate reducing equivalents and incorporate atmospheric CO_2 into organic molecules. Although worldwide production of biodiesel increased but still there is need to search for alternatives sources of fossil fuel. Today, ethanol and biodiesel are predominantly produced from corn kernels, sugarcane or soybean oil. However another biofuel feedstock, the latex is being explored. The race is on to optimize the technology that can produce biofuels from hydrocarbons present in latex. These hydrocarbons can be converted into petrochemicals. There is campaign, which advocates that 25% of US energy come from arable land by 2025. India is aiming 20% renewable mix by 2020. Present study has been undertaken with an object to improve latex contents of *E. antisyphilitica* along with its growth. Different phytohormones – IAA, NAA, GA_3, CCC and 2, 4, 5-T were used to study their effect.

Key words: *Euphorbia antisyphilitica,* Ethanol, Bio-diesel, Biofuel, Hydrocarbons, Latex, Phytohormones.

INTRODUCTION

Solar energy, accumulated under earth in the form of fossil fuels since the inception of life, accounts for more than 97 per cent of the world consumption of energy of which the share of oil is about 39 per cent. The biomass accounts for 43 per cent of the total energy supply in the developing countries as compared to only 1 per cent in the developed countries (Hall, 1982). In the third world, biomass is used mainly as fuel wood by over 90 per cent of the population. The world's total yearly supply of fuel wood, which more than doubled in the 40 years up to 1950, is estimated to have levelled off at about 1070 million m^3 per cent thereafter (Lewis, 1981). Tropical forests in the world are estimated to be vanishing at an annual rate of about 7 million hectares while the corresponding rate for woodlands in the semi-arid zones is 4 million hectares (Tebicke, 1985). Use of biomass for energy and industry allows a significant quantity of hydrocarbons to be consumed without increasing the CO_2 content of the atmosphere and thus makes a positive contribution to the Greenhouse effect and to the problems of "global change" as occurs in both industrialized and developing countries (Kumar, 2008, Kumar 2011) Growth regulators are commonly applied for rotting in the plants raised through cuttings (Bahuguna *et al*, 1988). Exogenous application of growth regulators has been reported for several horticultural and ornamental plants, along with nutrients (Wareing and Philliips, 1985). Application of growth regulators like cycocel (CCC), α-naphthalene acetic acid, gibberellic acid (GA_3), indole acetic acid (IAA) and others have been reported for several crops such as *Glycine max* (L.) Merril. (Holm and Abeles, 1968), *Digitalis lantana* Ehrh. (Puri *et al*, 1982) and *Solanum khasianum* Clake (Hazarika, 1985). Favourable influence of auxins such as NAA has been reported on invertase content of sugarcane (Sacher and Glasziou, 1962; Sacher *et al*, 1963). Similar studies

on latex yielding crops is fairly limited. Reports on prolonged latex flow by the application of various mixtures and hormonal compound to the bark of the rubber tree are made in last century. 2,4-D is best for such yield (Chapman, 1951). 2,4-D and NAA are also reported to increase sucrose utilization in *Hevea brasiliensis* Muell. (Tupy, 1969) More heptane extractables and sugar fraction were obtained by the application of benzyladenine in *Euphorbia lathyris* L. (Minago-Castel *et al*, 1984). Increase biomass and hexane extractables were noted in *E. lathyris* with the application of IAA and NAA respectively (Garg and Kumar, 1987 a). Present study has been undertaken with an object to study the influence growth regulators on *E. antisyphilitica*.

MATERIALS AND METHODS

Growth regulators taken for present study are – IAA, NAA, CCC, GA_3 and 2, 4, 5-T. A 60 µm aqueous solution of all these growth regulators was prepared separately. A drop of 'Triton' was added to the solution of each growth regulator before spraying it on the plant to improve its retention on plant surface.

RESULTS

Maximum plant height of aboveground parts was observed in GA_3 followed by CCC, NAA, 2, 4, 5-T and IAA. The root length was promoted generally to the same extent in 2, 4, 5-T, CCC and GA_3 (Table-1). IAA and NAA exhibited poor growth (length) of underground parts. Spray of different growth regulators resulted in enhanced fresh and dry weight production in both aboveground and underground plant parts. GA_3 favoured maximum production of aboveground biomass and underground percent dry weight (Fig.-1). Percent dry weight of aboveground and underground plant parts was maximum in the plants sprayed with GA_3 (Table-1). NAA, 2, 4, 5-T, CCC and IAA favoured the increase in fresh weight over the control in decreasing order. GA_3 promoted maximum growth and did not induce maximum biocrude which was at the highest level in the plants treated with NAA and IAA (Fig.-2). CCC and 2, 4, 5 - T favoured less amount of biocrude as compared to other growth regulators. The sugars were maximum in NAA followed by IAA, however, maximum chlorophyll contents were observed in IAA followed by NAA, GA_3, CCC and 2, 4, 5- T(Table-1).

Table 1

Effect of different growth regulators on plant growth, hexane extractables, sugars and chlorophyll contents of E. antisyphilitica

Growth regulator	Length		Fresh Wt.(g)		Dry Wt.(g)		Dry Wt.(%)		HE	Sugar	Chlorophylls (Mg/g)		
	AG	UG	AG	UG	AG	UG	AG	UG	(%)	(mg/g)	a	b	Total
Con.	37.21	45.07	41.26	13.91	4.16	2.23	10.08	16.03	7.20	53.0	0.373	0.135	0.508
2,4,5-T	45.45	58.24	65.77	21.85	7.90	4.14	12.01	18.95	9.12	45.5	0.263	0.232	0.495
CCC	47.31	58.6	60.03	21.92	5.78	3.80	9.63	17.34	9.45	60.0	0.495	0.242	0.737
NAA	46.85	41.24	68.14	22.30	6.84	4.01	10.04	17.98	10.50	201.0	0.557	0.209	0.766
IAA	44.0	49.10	55.95	21.90	5.86	4.46	10.47	20.37	10.55	161.0	0.519	0.365	0.884
GA_3	63.6	58.20	75.22	21.70	9.28	5.15	12.34	23.73	9.87	61.0	0.498	0.252	0.750
SEm	±3.79	±6.80	±5.11	±2.15	±1.41	NS							
CD at 5%	7.91	14.19	10.66	4.49	2.95								
CD at 1%	10.79	19.36	-	6.12	4.02								

NS = Non Significant

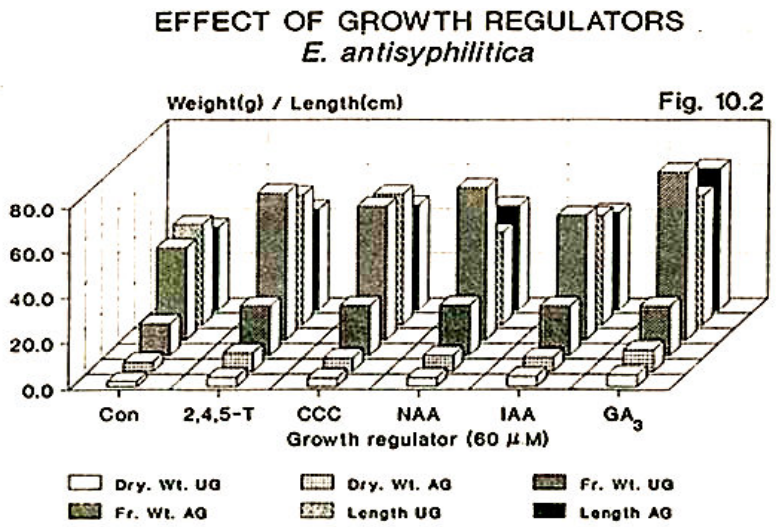

Figure 1

Effect of different growth regulators (60 micro m each) on aboveground and underground length, fresh weight and dry weight of E. antisyphilitica.

Con = Control (not sprayed with growth regulator)

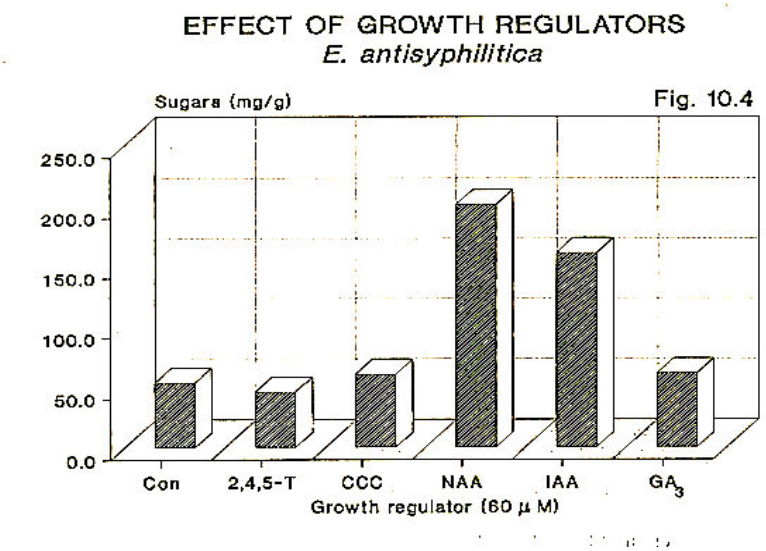

Figure 2

Effect of different growth regulators (60 micro m each) on sugar contents (mg/g dry weight) of above ground parts of E. antisyphilitica. Con = Control (not sprayed with growth regulator)

DISCUSSION

Latex is generally collected by tapping method. This latex flow could be prolonged by the application of various hormones to the bark of the rubber tree. In present study percent hexane extractables increased in plants treated with IAA and NAA. Auxins were also found to influence carbohydrate content in *Hevea* latex (Wort, 1964; Tupy, 1969). Increased invertase activity in the treated plants might be responsible for enhanced sucrose utilization in latex serum. And carbohydrates are presumed to be the main source of carbon for hydrocarbon and rubber formation.

Thus the influence of auxin of hydrocarbon formation may be indirect, through increasing invertase, to increase carbohydrate contents of latex, which in turn affect hydrocarbon and rubber formation. Auxins, i.e., IAA and NAA also enhanced the level of chlorophyll and sugars respectively. However, during present study, total sugar contents per gram of dry weight was estimated and not in latex. Gibberellin treatment is reported to increase the fresh and dry weight of *Physalis peruviana* L. and *P. angulata* L. (Raghava and Murty, 1988). The effect of gibberellins on enhancement might be due to its direct action on cell permeability, extension and cell division, or mediated through ethylene production, which in turn influences isodiametric growth. Hence, the effect may be direct or mediated through enhancement of auxin level and regulation of ethylene action. It is also suggested that higher concentrations of gibberellins counteract the effect of abscisic acid which causes growth inhibition. During the development of many tissues and organs of the plants, the physiologically active form of hormones changes. An interaction between endogenous and exogenous level of hormones might also play an important role in growth and productivity of plant.

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