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Field efficacy of Plant Growth Regulators on the growth, physiological and yield parameters of Fenugreek, *Trigonella foenum graecum* L.

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Abstract

A field experiment was conducted to elucidate the effect of plant growth regulators on Growth, physiological parameters and Yield in Fenugreek (*Trigonella foenum graecum* (L.) CV. RMT-305. The study was done at Puthur farm of Bharath Institute of Higher Education and Research, Chennai during January to May 2022. Ten different treatments (T1-GA3 50 ppm, T2-GA3 100 ppm, T3-GA3 150 ppm, T4- NAA 10 ppm, T5-NAA 20 ppm, T6-NAA 30 ppm, T7-Ethrel 75 ppm, T8 Ethrel 100 ppm, T9-Ethrel 150 ppm and T10-water spray) were tested at three concentrations and replicated thrice. Treatments were sprayed uniformly to all the plots at 30 and 60 DAS and at harvest with hand sprayer. Plant height, Number of primary branches, Days to fifty per cent flowering, Chlorophyll content in Leaves and Number of pods per plant were documented. Foliar application of 100 ppm of GA3 significantly increased the plant height observed at 30 DAS and harvest whereas it was least in the control plot. NAA 30 ppm treated plants flowered earlier compared to control. The chlorophyll content of leaves at flowering and pod filling stage was highest in plots treated with NAA 20 ppm. Application of 20 ppm NAA recorded higher number of pods per plant.

Key words : Fenugreek, flowering, chlorophyll, ethrel.

Fenugreek (*Trigonella foenum-graecum* L.) is an annual plant and belongs to the family Fabaceae of sub family Papillionaceae and order Fabales. Fenugreek is a valuable source of several highly desirable biologically active compounds such a galactomannan,

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Diosgenin (4hydroxy- isoleucine) and Trigonelline that have specific health benefits. The seeds and green leaves of fenugreek are used in food and medical industry. It has been used to increase the flavour and colour and also modifies the texture of food materials. Seeds of fenugreek spice have medicinal properties such as hypocholesterolemic, lactation aid, antibacterial and anti-diabetic agent. These compounds are glycosides of diosgenin. Leaves contain about 86.1% moisture, 4.4% protein, 0.9% fat, 1.5% minerals, 1.1% fibre, and 6% carbohydrates. The mineral and vitamins present in leaves include calcium, zinc iron, phosphorous, riboflavin, carotene, thiamine, niacin and vitamin C. Fresh leaves of fenugreek contain Ascorbic acid of about 220.97 mg per 100 g of leaves and β-carotene about 19 mg/100 g.

Fenugreek occupies an area of 156.0 million hectares, 241 metric tonnes and with a productivity of 1.7 metric tonnes per hectare. In India, the major fenugreek producing states are Rajasthan Gujarat, Uttarakhand, Uttar Pradesh, Madhya Pradesh, Maharashtra, Haryana and Punjab. Among these states, Rajasthan is the major producer of fenugreek, which ranks third position among the major seed spices.

Plant growth regulators present a new possibility to break yield barrier, particularly imposed by the environment. The plant growth regulators act as chemical catalysts in plants and improve physiological and reproductive efficiency in the plants. The plant growth regulators possibly improve the gene expression for efficient sucrose transport and increase dry matter partitioning for seed production. Effectiveness of plant growth regulators depends on several factors such as concentration, method and time of application etc. It is established fact that plant growth regulators in small quantity can regulate various physiological processes but information regarding the suitability of various plant growth regulators and their time of application for fenugreek is very limited. Hence with this background the study was undertaken to study the field efficacy of Plant Growth Regulators on the growth, physiological and yield parameters of Fenugreek.

The present investigation was carried out at School of Agricultural Sciences (Bharath Institute of Higher Education and Research, Selaiyur, Chennai). The filed was thoroughly prepared to a fine tilth. The soil type of experimental plots was sandy Loam soil. Sowing of seeds of Fenugreek variety RMT 305, with adopting a spacing of 15x20 cm. Recommended package of practices were followed uniformly to all the plots. Seeds of (*Trigonella foenum-graecum* L.) variety RMT 305, were purchased from Vinod seeds, Madhuranthagam. NAA (1-Napthalene acetic acid), GA3 (Gibberellic Acid), Ethrel (2-chloroethyl phosphonic acid) were utilized in foliar application. Ninety per cent ethanol was used to dissolve the chemicals such as NAA which were insoluble in water.

Three growth substances each at three concentration forms the treatment. The total number of treatments were 10 including water sprays as control.

The experiment consisted of the following treatments :

T_1 -GA3 50 ppm; T_2 -GA3 100 ppm;

T_3 -GA3 150 ppm; T_4 -NAA 10 ppm; T_5 -NAA 20 ppm; T_6 -NAA 30 ppm; T_7 -Ethrel 75 ppm; T_8 -Ethrel 100 ppm; T_9 -Ethrel 150 ppm; T_{10} -Control (water spray)

Number of replications: Three
Design : RBD

Foliar spray of GA3 100 ppm was found superior, registering increased plant height of 37.68 cm (Table-1) over other treatments. A decrease in plant height was noticed in control (27.98cm) The results of analysis indicated that foliar application of GA3 100 ppm outperformed other treatments recording significantly more plant height (55.64

Table 1. Effect of plant growth substances on plant height (cm) at 30 DAS and atHarvest stage

Treatment Number	Treatments concentrations	Plant height 30 DAS	Plant height at Harvest
T_1	GA_3 50 ppm	33.51	51.34
T_2	GA_3 100 ppm	37.68	55.64
T_3	GA_3 150 ppm	34.28	54. 64
T_4	NAA 10 ppm	31.68	51.20
T_5	NAA 20 ppm	32.97	50.84
T_6	NAA 30 ppm	31.86	51.86
T_7	Ethrel 75 ppm	32.07	50.86
T_8	Ethrel 100 ppm	30.95	50.19
T_9	Ethrel 150 ppm	31.39	50.45
T_{10}	Control	27.98	50.22
SED		**0.2185**	**0.05**
CD(0.05)		**0.4566**	**1.6560**

Table-2. Effect of plant growth substances on number of primary branches at 30 DAS and at Harvest stage

Treat-ment Number	Treat-ment concentra-tions	No. of Primary Branches 30 DAS	No. of Primary Branches at Harvest
T_1	GA_3 50 ppm	3.31	5.28
T_2	GA_3 100 ppm	3.89	6.29
T_3	GA_3 150 ppm	3.54	5.35
T_4	NAA 10 ppm	3.22	4.73
T_5	NAA 20 ppm	2.74	4.46
T_6	NAA 30 ppm	2.83	4.34
T_7	Ethrel 75 ppm	3.19	4.47
T_8	Ethrel 100 ppm	2.63	4.28
T_9	Ethrel 150 ppm	2.67	4.33
T_{10}	Control	2.37	3.80
SED		**0.3056**	**0.1514**
CD(0.05)		**0.8341**	**0.3162**

Table-3. Effect of plant growth substances on 50% flowering

Treatment Number	Treatments concentra-tions	Days 50% flowering
T_1	GA_3 50 ppm	42.65
T_2	GA_3 100 ppm	43.64
T_3	GA_3 150 ppm	43.95
T_4	NAA 10 ppm	42.34
T_5	NAA 20 ppm	41.51
T_6	NAA 30 ppm	40.05
T_7	Ethrel 75 ppm	44.10
T_8	Ethrel 100 ppm	44.66
T_9	Ethrel 150 ppm	41.76
T_{10}	Control	45.08
SED		**0.0371**
CD(0.05)		**0.0775**

Table-4. Effects of plant growth substances on chlorophyll content of leaves (mg/g) atflowering and pod filling stage

Treat-ment Number	Treat-ments concentra-tions	Chloroph-yll content at Flower-ing stage	Chloroph-yll content at Pod filling stage
T_1	GA_3 50 ppm	1.42	1.40
T_2	GA_3 100 ppm	1.46	1.44
T_3	GA_3 150 ppm	1.38	1.36
T_4	NAA 10 ppm	1.47	1.46
T_5	NAA 20 ppm	1.78	1.76
T_6	NAA 30 ppm	1.70	1.67
T_7	Ethrel 75 ppm	1.55	1.53
T_8	Ethrel 100 ppm	1.30	1.28
T_9	Ethrel 150 ppm	1.32	1.30
T_{10}	Control	1.18	1.09
SED		**0.0247**	**0.026**
CD(0.05)		**0.0516**	**0.0547**

Table-5. Effect of plant growth regulators on Number of pods/plant

Treatment Number	Treatments concentra-tions	No. of pod/ plant
T_1	GA_3 50 ppm	25.51
T_2	GA_3 100 ppm	25.47
T_3	GA_3 150 ppm	25.56
T_4	NAA 10 ppm	28.50
T_5	NAA 20 ppm	33.52
T_6	NAA 30 ppm	27.66
T_7	Ethrel 75 ppm	26.94
T_8	Ethrel 100 ppm	23.16
T_9	Ethrel 150 ppm	24.52
T_{10}	Control	22.65
SED		**0.0432**
CD(0.05)		**0.0901**

cm). This was closely followed by GA3 150 ppm (55.64cm). The plant height was less in control (50.22 cm).

Primary branches at 30 DAS more number of primary branches (Table-2) was recorded in the plants which received foliar application of GA3 100 ppm (3.89) this was closely followed by foliar application of GA3 150 ppm (3.54). The no. of primary branches per plant was lower in the plants which received water spray. The results revealed that an increasing no. of primary branches was observed by foliar application of GA3 100 ppm (6.29) However, lowest number of primary branches was in control plot (3.80) The result of the present study reported that foliar application of growth regulators significantly improved the growth characters. Among different plant growth regulators applied, 100 ppm GA3 resulted in maximum plant height, at different growth stages. Gibberellin has been known to play an important role in the germination of seeds. By far the most dramatic effect of gibberellins on plant is their effect on stem elongation intermodal length. Therefore plants treated with GA3 grow taller. Increase in plant height takes place by two processes-cell elongation and cell division.

The chlorophyll content (Table-4) at flowering stage was significantly higher by foliar application of NAA 20 ppm (1.78 mg/gm) than other treatments. The second best treatment was NAA 30 ppm (1.70 mg/gm). The lower values seen in control plot (1.18 mg/g)Foliar application of NAA 20 ppm showed higher chlorophyll content (1.76 mg/g) closely followed by NAA 30 ppm (1.67 mg/g). The chlorophyll content at pod filling stage was less in control plot (1.09 mg/g). The overall improvement in plant growth by cell division, cell enlargement and production of sufficient photosynthesis through increased chlorophyll content of leaves on one hand and efficient utilization/immobilization photosynthesis towards development of flowers and fruits on the other hand, might have been responsible for increased yield attributes.

Data showed that the plants which received NAA 30 ppm spray flowered earlier (Table-3) @ 40 days than water spray. Maximum number of pods per plant (Table-5) was recorded by foliar application of NAA 20ppm (33.32) which was significantly superior to other treatments. While less number. of pods per plant was noticed with water spray (22.65). Foliar application of NAA 10 ppm (28.50) ranked the second in the order. There are a few plants in which auxin caused flower formation. In flowering the action of auxin is not direct but is mediated through the formation of ethylene. Growth stimulators enter the plant system causing improved net photosynthetic rate by increasing CO_2 fixation and by reducing the photorespiration. This hormonal interference at the molecular level is ultimately expressed in the form of the alteration in growth behaviour of various morphological components of the plant, which in turn is expressed as yield[1]. The role of NAA in enhancing the growth, fruit set and yield attributes in fenugreek has been reported by Alagukannan and Vijayakumar[1]. The present study confirms the earlier reports of Gour *et al.,*[4]. Similar beneficial effect of growth regulators also obtained by Shivran *et al.,*[7], Krishnaveni *et al.,*[5], Gour *et al.,*[4], Bhunia *et al.,*[3] and Lakshmi *et al.,*[6] in fenugreek. The

possible reason for increased yield was due to higher photosynthetic activity of treated plants as compared to control[2]. Foliar application of 20 ppm NAA recorded the maximum number of pods/ plant, pod length.

Foliar application of 100 ppm GA3 significantly increased the plant height observed at 30 DAS and At harvest, whereas the control plot decreased the plant height Increased number of primary branches was observed due to the applications of 100 ppm GA3. NAA 30 ppm treated plants flowered earlier compared to control The chlorophyll content of leaves at flowering and pod filling stage was highest in plots treated with NAA 20 PPM compared to control. The number of pods per plant was varied significantly with different treatments. Application of 20 ppm NAA recorded higher number of pods per plant than control.

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