

# **“Effect of plant growth regulators and bio-fertilizer on growth and quality of fenugreek (*Trigonella foenum-graecum* L.)**

## **Abstract**

The present investigation was carried out at the Experimental field, College of Agriculture, RVSKVV, Gwalior during 2020-21 under agro-climatic and soil conditions of Northern Madhya Pradesh. The experiment was laid out in Randomized Block Design (RBD) with three replications. Each replication consists of ten treatments of biofertilizers (viz., Rhizobium, PSB and KSB) and plant growth regulators (viz., GA3 and NAA). All the treatments were randomized separately in each replication. Result showed that the different biofertilizers (i.e. Rhizobium, PSB and KSB) and plant growth regulators (i.e. GA3 and NAA) treatments significantly influenced the growth and quality parameters of fenugreek. Treatment T4 (Rhizobium + NAA) gave the maximum growth, it was found best treatment combination as compared to all other treatment combinations of biofertilizers and PGRs, while the minimum growth, yield and economical parameters were recorded in treatment T1 (Control).

**Key words:** Fenugreek, Biofertilizers, growth regulators, Quality, Rhizobium.

## **INTRODUCTION**

Fenugreek (*Trigonella foenum-graecum* L.) generally known as methi, occupies an important position amongst leafy vegetables and condiment crop largely grown in northern India during Rabi season. Fenugreek is considered to have originated in South-Eastern Europe and West Asia. It is an annual herb belonging to sub family Papilionaceae family Leguminaceae. The genus *Trigonella* has two species viz., *Trigonella foenum-graecum* and *Trigonella corniculata*. Fenugreek seeds contains alkaloids including trigonelline, saponins, flavonoids, mucilage protein 4.4%, moisture 86%, carbohydrates 6%, mineral matter 1.5%, fiber 1.1%, fat 0.9%, calcium 360.0 mg, sulphur 167.0 mg, sodium 76.1 mg, magnesium 67.0 mg, phosphorous 541 mg, potassium 51 mg, iron 17.2mg, thiamine 0.05 mg, vitamin „A“ 6450 IU and vitamin „C“ 54 mg. Fenugreek is grown mainly in China, India, Turkey, Canada, Australia, Northern and Southern Africa, and Southern Europe (Ahmad et al.2016).In India, during 2020-21 fenugreek was cultivated in 133 thousand hectares land with an annual production of 203 thousand metric tons (NHB, 2020-21). The major fenugreek producing states are Rajasthan, Gujrat, Maharashtra, Madhya Pradesh, Haryana and Uttar Pradesh. Fenugreek is grown round the year for fresh vegetable purposes. According to the belief of the ancients, fenugreek stimulates digestive process as well as the metabolism in general. The seeds are used in colic flatulence, dysentery-2-diarrhea, dyspepsia with loss of appetite, chronic cough, dropsy, enlargement of liver and spleen, rickets, gout and diabetes.

In previous years, continued and imbalance use of chemical fertilizers with little or no use of organic manure is leading to poor nutrient use efficiency and low yield of crops. This condition leads to increases cost of production. 12 Hence it has become important to search for other resources of fertilizer of biological origin for integrated nutrient management in

fenugreek and manage plant geometry in field. The approach, microbial fertilizer application including Rhizobium, phosphate solubilizing bacteria (PSB) as well as KSB has been found promising to improve soil health and crop production. Gibberellic acid (GA3) and NAA are plant growth hormone and different plant geometry that regulates plant height, no. of branches, stem, diameter, root length, no. of pods/plant pod length pod weight no. of seed/pod and quality of fenugreek leaf.

## **Material and Methods**

### **a. Location and Place of working:**

The experiment was conducted at Experimental field, College of Agriculture, Gwalior during Rabi 2020-21 under agro-climatic and soil conditions of Northern Madhya Pradesh.

### **b. Experimental details**

The experiment was laid out in Randomized Block Design (RBD) with three replications. Each replication consists of ten treatments of biofertilizers (viz., Rhizobium, PSB and KSB) and plant growth regulators (viz., GA3 and NAA). All the treatments were randomized separately in each replication. The details of experiment are given below:-

Name of crop : Fenugreek (*Trigonella foenum-graecum* L.) , Variety : RMT-354 Design : RBD No. of Treatments : 10 Replications : 03 Total no. of treatments : 30 Gross plot size : 2.5 m x 2.5 m Net plot size : 2 m x 2 m Distance between replications : 1.5 m x 1.5 m Distance between rows : 30 cm x 10 cm.

### **Detail of treatments**

T1 – Control

T2 – Rhizobium

T3 – Rhizobium + GA3

T4 – Rhizobium + NAA

T5 – PSB

T6 – PSB + GA3

T7 – PSB + NAA

T8 – KSB

T9 – KSB + GA3

T10 – KSB + NAA

Note: 1. RDF/basal dose N,P,K (30:25:40 kg/ha) is common for all the treatment 2. Bio-fertilizers dose Rhizobium @ 5g/kg seed treatment, PSB @ 5g/kg seed treatment and KSB @ 5g/kg seed treatment 3. Plant growth regulators dose GA3 @ 100 ppm and NAA @ 100 ppm

**c. Chemical properties of experimental field:** The soil of the experimental field was sandy loam with 17.07% clay, 22.25% silt and 60.68% sand with pH ranging from 7.8 (normal). The soil was very low in available nitrogen, medium in available phosphorus and medium in available potassium. Soil constituents Value obtain Method of determination - Mechanical composition Sand (%) Silt (%) Clay (%) 60.68 ,22.25, 17.07 Bouyoucouc Hydrometer method (Piper, 1950) , Soil pH (1:2 soil- water ratio) 7.8 pH meter (Jackson, 1973) ,Electrical conductivity (ds/m) 0.14 Conductivity meter at 25°C (Jackson, 1967) , Organic carbon (g/kg) 4.83 Walkley and Black method (1934) , Available nitrogen (kg/ha) 218.0 Alkaline potassium permanganate method (Subbiah and Asija, 1956) , Available phosphorus P<sub>2</sub>O<sub>5</sub> (kg/ha) 15.12 Olsen's method (Olsen et al. 1954)

## Results and Discussion

### Growth parameters

#### Days required for seed germination

Result clearly shows that biofertilizers (like- Rhizobium, PSB and KSB) and plant growth regulators (like- GA<sub>3</sub> and NAA) were non- significantly influenced on days required for seed germination for fenugreek. The result showed that treatment T4 (Rhizobium + NAA) gave the minimum (4.00) days required for seed germination and it was found 46 significantly superior as compared to all other treatments, while the maximum days required for seed germination (6.67) was recorded in treatment T1 (Control). The results are in confirmation with the results achieved by Meena et al. (2015) and Sharanya et al. (2018).

**Table 1 Effect of plant growth regulators and biofertilizer on days required for seed germination of fenugreek**

Treatment	Days required for seed germination
T1 – Control	6.67
T2 – Rhizobium	5.67
T3 – Rhizobium + GA <sub>3</sub>	4.67
T4 – Rhizobium + NAA	4.00
T5 – PSB	6.00

T6 – PSB + GA3	5.33
T7 – PSB + NAA	4.33
T8 – KSB	6.33
T9 – KSB + GA3	5.33
T10 – KSB + NAA	5.00
<b>SEm ±</b>	<b>0.574</b>
<b>CD 5%</b>	<b>NS</b>

### Plant height and Number of branches

The results clearly indicate (Table -2) that the different treatment combination of biofertilizers and plant growth regulators were significantly influenced the plant height of fenugreek. The maximum plant height (14.04, 45.05 47 and 65.01 cm) at 30, 60 and 90 DAS was recorded in treatment T4 (Rhizobium + NAA), it was found significantly superior treatment as compared to other treatments and was at par to treatment T7 (PSB + NAA) at 30 DAS and treatment T3 (Rhizobium + GA3) and T7 (PSB + NAA) at 60 and 90 DAS. However, the treatment T1 (Control) gave the minimum plant height (11.02, 40.07 and 55.04 cm) at 30, 60 and 90 DAS.

The result revealed that (Table-2) the treatment combination of biofertilizers (like-Rhizobium, PSB and KSB) and PGRs (like- GA3 and NAA) significantly influenced the number of branches in fenugreek. The maximum number of branches at 30, 60, 90 DAS and at harvest were observed in treatment T4 (Rhizobium + NAA). While the treatment T1 (Control) gave the minimum number of branches at 30, 60, 90 DAS and at harvest. Findings are in agreement with those of Meena et al. (2015), Singh et al. (2016), Shivran et al. (2016), Kumawat et al. (2017), Raiyani et al. (2018), Saxena and Singh (2019) and Reddy et al. (2020).

**Table 2 Effect of plant growth regulators and bio fertilizer on plant height and number of branches at 30, 60 , 90 DAS and at harvest of fenugreek**

Treatment	Plant height			Number of branches			
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	At harvest
T1 – Control	11.02	40.07	55.04	3.03	4.01	5.02	6.01

T2 – Rhizobium	12.02	41.83	59.58	3.59	4.36	5.41	6.40
T3 – Rhizobium + GA3	13.35	44.08	64.06	3.86	4.65	5.86	6.83
T4 – Rhizobium + NAA	14.04	45.05	65.01	4.01	5.00	6.03	7.02
T5 – PSB	11.76	41.76	57.19	3.30	4.27	5.32	6.25
T6 – PSB + GA3	12.95	43.32	61.37	3.74	4.52	5.71	6.59
T7 – PSB + NAA	13.83	44.74	64.79	3.90	4.82	5.90	6.90
T8 – KSB	11.58	41.20	56.90	3.13	4.19	5.13	6.18
T9 – KSB + GA3	12.57	42.45	60.54	3.69	4.42	5.52	6.47
T10 – KSB + NAA	13.02	43.83	62.34	3.81	4.62	5.74	6.75
<b>SEm ±</b>	<b>0.169</b>	<b>0.375</b>	<b>0.388</b>	<b>0.105</b>	<b>0.085</b>	<b>0.057</b>	<b>0.047</b>
<b>CD 5%</b>	<b>0.503</b>	<b>1.114</b>	<b>1.153</b>	<b>0.313</b>	<b>0.253</b>	<b>0.170</b>	<b>0.140</b>

### Days taken to 50% flowering and Number of flower per plant

The data regarding days taken to 50% flowering and number of flower per plant is presented in table 3.

It is evident from the data that the treatment combination of biofertilizers (like- Rhizobium, PSB and KSB) and PGRs (like- GA3 and NAA) were found significantly influenced on the days taken to 50% flowering in fenugreek. The minimum days taken to 50% flowering (48.00) was noted in treatment T4 (Rhizobium + NAA), it was found significantly superior treatment as compared to other treatments and was at par to treatment T3 (Rhizobium + GA3), T6 (PSB + GA3), T7 (PSB + NAA) and T10 (KSB + NAA). However, the maximum days taken to 50% flowering (55.00) was observed in treatment T1 (Control). Similar results for most of the characters were also reported by Yugandhar et al. (2014), Meena et al. (2015), Maryhaokip et al. (2016), Yugandhar et al. (2017), Pavankumar et al. (2018), Raiyani et al. (2018) and Reddy et al. (2020).

The investigation revealed that the maximum number of flower per plant (45.00) was noted in treatment T4 (Rhizobium + NAA), it was found significantly superior treatment combination of plant growth regulators and bio fertilizer as compared to other treatments and it was at par to treatment T3 (Rhizobium + GA3), T7 (PSB + NAA) and T10 (KSB + NAA). However, the minimum number of flower per plant (38.00) was recorded in treatment T1 (Control). These results are supported by the findings of Meena et al. (2015) and Kumawat et al. (2017)

**Table 3 Effect of plant growth regulators and biofertilizer on days taken to 50% flowering of fenugreek**

Treatment	Days taken to 50% flowering	Number of flower per plant
T1 – Control	55.00	38.00
T2 – Rhizobium	53.00	40.67
T3 – Rhizobium + GA3	49.67	44.00

T4 – Rhizobium + NAA	48.00	45.00
T5 – PSB	54.33	39.67
T6 – PSB + GA3	51.00	42.00
T7 – PSB + NAA	49.67	44.33
T8 – KSB	54.67	39.67
T9 – KSB + GA3	52.00	41.00
T10 – KSB + NAA	50.67	43.00
<b>SEm ±</b>	<b>1.014</b>	<b>0.956</b>
<b>CD 5%</b>	<b>3.013</b>	<b>2.842</b>

### Quality parameters

#### Protein content (%),Ascorbic acid (mg/100g) and Chlorophyll content (mg/100g)

The results indicated (Table 4) that the different treatment combination of biofertilizers and plant growth regulators were significantly influenced the protein content, ascorbic acid and chlorophyll content in fenugreek. The maximum protein content, ascorbic acid and chlorophyll content were recorded in treatment T4 (Rhizobium + NAA), it was found significantly superior treatment as compared to other treatments. However, the treatment T1 (Control) gave the minimum protein content, ascorbic acid and chlorophyll content in fenugreek. Similar results for most of the characters were also reported by Singh et al. (2012),Yugandhar et al. (2014),Talab et al. (2014),Yugandhar et al. (2016),Govind et al. (2016) and Sharanya et al. (2018)

**Table 4 Effect of plant growth regulators and biofertilizer on protein content (%)ascorbic acid (mg/100g) and chlorophyll content (mg/100g)of fenugreek**

Treatment	Protein content (%)	Ascorbic acid(mg/100g)	Chlorophyll content (mg/100g)
T1 – Control	4.00	88.29	1.840
T2 – Rhizobium	4.22	90.72	1.860
T3 – Rhizobium + GA3	4.35	92.59	1.882
T4 – Rhizobium + NAA	4.52	93.03	1.903
T5 – PSB	4.10	89.78	1.856
T6 – PSB + GA3	4.24	92.35	1.878
T7 – PSB + NAA	4.45	92.86	1.894
T8 – KSB	4.05	89.03	1.844
T9 – KSB + GA3	4.23	91.78	1.866
T10 – KSB + NAA	4.34	92.39	1.880
<b>SEm ±</b>	<b>0.068</b>	<b>0.332</b>	<b>0.011</b>
<b>CD 5%</b>	<b>0.202</b>	<b>0.985</b>	<b>0.034</b>

### Conclusion

Result clearly shows that biofertilizers (like- Rhizobium, PSB and KSB) and plant growth regulators (like- GA3 and NAA) were non- significantly influenced on days required for seed germination for fenugreek. The result showed that treatment T4 (Rhizobium + NAA) gave the minimum days required for seed germination and it was found significantly superior as

compared to all other treatments, while the maximum days required for seed germination was recorded in treatment T1 (Control). A perusal of data indicates that the different treatment combination of biofertilizers and plant growth regulators were significantly influenced the plant height at 30, 60 and 90 DAS of fenugreek. The maximum plant height was recorded in treatment T4 (Rhizobium + NAA) and it was found significantly superior as compared to other treatments, while the treatment T1 (Control) gave the minimum plant height at 30, 60 and 90 DAS. The maximum number of branches at 30, 60, 90 DAS and at harvest were observed in treatment T4 (Rhizobium + NAA). While the treatment T1 (Control) gave the minimum number of branches at 30, 60, 90 DAS and at harvest. It is evident from the data that the treatment combination of biofertilizers (like- Rhizobium, PSB and KSB) and PGRs (like- GA3 and NAA) were found significantly influenced on the days taken to 50% flowering in fenugreek. The minimum days taken to 50% flowering was noted in treatment T4 (Rhizobium + NAA). However, the maximum days taken to 50% flowering was observed in treatment T1 (Control). The investigation revealed that the maximum number of flower per plant was noted in treatment T4 (Rhizobium + NAA), it was found significantly superior treatment combination of plant growth regulators and bio fertilizer as compared to other treatments. However, the minimum number of flower per plant was recorded in treatment T1 (Control).

The results indicated that the different treatment combination of biofertilizers and plant growth regulators were significantly influenced the protein content, ascorbic acid and chlorophyll content in fenugreek. The maximum protein content, ascorbic acid and chlorophyll content were recorded in treatment T4 (Rhizobium + NAA), it was found significantly superior treatment as compared to other treatments. However, the 91 treatment T1 (Control) gave the minimum protein content, ascorbic acid and chlorophyll content in fenugreek.

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