



Comparative Studies on Effectiveness of Physical, Micronutrients, PGR and Botanical Seed Treatments on Growth and Yield of Fenugreek (*Trigonella foenum-graecum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was carried out at a field experimentation centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, SHUATS, Prayagraj (U.P). During Rabi season 2020-2021, to find out the suitable electric, magnetic, micronutrients, plant growth regulators and botanical seed treatments on growth and yield of Fenugreek (LFC-84). Different concentrations with different duration of seed treatments with control (untreated) were evaluated by screening 8 hours viz., Electric treatment (0.5A for 60 seconds and 1.0A for 60 seconds), Magnetic treatment

(10mT for 15 min and 20 mT for 30 min), ZnSO₄ (1% and 3% for 8 hrs), MnSO₄ (1% and 3% for 8 hrs) Ascorbic acid (100 ppm and 300 ppm for 8 hrs), Moringa leaf extract (1% and 3% for 8 hrs). It has been reported that among all the treatments T₆ - ZnSO₄-3% for 8 hrs has performed the best results in field parameters like field emergence, Plant height, number of branches per plant, days required to 50% flowering, days required to 50% pod formation, days to maturity, number of pods per plant, number of seeds per pod, seed yield per plant (g), test weight (g), biological yield (g), harvest Index (%) followed by Ascorbic acid 300 ppm for 8 hours and found to be lowest in control seeds. Hence seed treatment of Fenugreek seeds with ZnSO₄ (3%) for 8 hours is the best treatment compared to other seed treatments.

Keywords: Fenugreek seeds; electric seed treatment; magnetic seed treatment; zinc sulfate (ZnSO₄); manganese sulfate (MnSO₄); ascorbic acid.

1. INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) locally known as 'Methi' belonging to the family Leguminosae and subfamily Papilionaceae. This crop is native to an area extending from Iran to northern India and is widely cultivated in China, India, Egypt, Ethiopia, Morocco, Ukraine, Greece, turkey, etc., with 80 species [1]. Most species, including *Trigonella foenum-graecum* L., are diploid with 2n=16 chromosomes.

India – The land of Spices is the world largest producer, consumer, and exporter of spices. The area under spices is 3,895 thousand ha with the production of 9,216 M.T during 2018-19 [2]. In India, it is mainly grown in Rajasthan, Madhya Pradesh, Uttar Pradesh and Gujarat. Rajasthan claims the monopoly in production accounting for about 80-90% of fenugreek produce in the country Prakash et al. [3].

Fenugreek leaves and seeds are consumed in different countries around the world for different purposes such as medicinal uses, making food, roasted grain and coffee-substitute, controlling insects in grain storages, and perfume industries [4]. It is also a commercially important annual spice crop grown almost in every part of the country. It is also used as a condiment, leafy vegetable, green fodder and green manure crop. It is rich in proteins, iron, calcium, vitamin A, B2 and C.

Fenugreek is a rabi crop; it requires low temperature during the early stage for better vegetative growth, while a dry and relatively high temperature favours better ripening and high seed production. It is tolerant of frost. Fenugreek has got wider adaptability concerning soil and climatic conditions. Seeds of fenugreek are small (5 mm long), hard and brownish yellow, the colour may vary. They are and have a very

characteristic rhomboidal outline. The plant growth rate is slow at the beginning of the growing season and leaf development is temperature-dependent [5].

Physical methods of seed treatment such as electric and magnetic fields of different frequencies significantly improve seed germination. To improve the quality of seed in respect of crop stand, many workers studied the effect of the electrical stimulus on seed viability, vigour, seed germination and seedling growth and found positive results.

Plant growth regulators may be defined as any organic compounds, which are active at low concentrations in promoting, inhibiting or modifying growth and development. The plant growth substance has been used for various beneficial effects such as promoting shoot and root growth, number of branches per plant, number of pods per plant, number of grains per pod, yield and grain quality [6].

One such method of improving the seed quality is seed priming i.e., controlled hydration followed by redrying of seeds which helps to reduce germination time, harmonize germination, improves seed germination rate, field emergence and quality of seedlings. Hence, the plants resulted in the establishment of a good crop stand in the field of many crops [7]. Further, improved and uniform emergence, better allometric (changes in the growth of plant parts over time) attributes and requisite crop stand in many Agri-horticultural crops.

The present investigation was carried out to study Comparative studies on the effectiveness of Physical, Micronutrients, PGR and Botanical seed treatments on the growth and yield of fenugreek and to find out suitable electric, magnetic, micronutrients, plant growth

regulators, botanical seed treatments on growth and yield of fenugreek.

2. MATERIALS AND METHODS

The research work was carried out in the experimental field during rabi season 2020-2021. Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Uttar Pradesh). The experiment was conducted in Randomized Block Design (RBD) with three replications. Seed material consists of fenugreek variety LFC-84. The experimental material for the present investigation comprised of thirteen treatments. Fenugreek seeds were subjected to various seed treatments like T₀-control, T₁-Electric treatment (0.5A) for 60 seconds, T₂-Electric treatment (1.0A) for 60 seconds, T₃-Magnetic treatment (10mT) for 15 minutes, T₄-Magnetic treatment (20mT) for 30 minutes, T₅-ZnSO₄ (1%) for 8 hours, T₆-ZnSO₄ (3%) for 8 hours, T₇-MnSO₄ (1%) for 8 hours, T₈-MnSO₄ (3%) for 8 hours, T₉-Ascorbic acid (100ppm) for 8 hours, T₁₀-Ascorbic acid (300ppm) for 8 hours, T₁₁-Moringa leaf extract (3%) for 8 hours, T₁₂-Moringa leaf extract (5%) for 8 hours. After completion of seed treatments, seeds were air-dried under the shade to bring back to their original moisture content and used for sowing. Field emergence, plant height (cm), number of branches per plant, days to 50% flowering, days to 50% pod formation, days to maturity, number of pods per plant, number of seeds per pod, seed yield per plant, test weight (g), biological yield (g), harvest index (%) data were collected from the field. The data were subjected to statistical analysis.

3. RESULTS AND DISCUSSION

According to the results, all treatments were significantly different from each other. Here we will see about the performance of various treatments depends on the data which is recorded (Table 1).

3.1 Field Emergence

The maximum field emergence (88.25) was recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (86.80) and minimum field emergence (73.21) was recorded with T₀-control. This experiment provided information about field emergence will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek

seed than other treatments. Similar results were observed by Nagar et al., [8].

3.2 Plant Height

The maximum plant height (43.66) was recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (42.59) and the minimum plant height (28.93) was recorded with T₀-control. This experiment provided information about plant height will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar results were observed by Kavitha et al. [9]; Kashif et al. [10].

3.3 Number of Branches per Plant

The maximum number of branches per plant (6.61) was recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300 ppm) for 8 hours (6.43) and the minimum number of branches per plant (5.13) was recorded with T₀-control. This experiment provided information about the number of branches per plant that will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar results were observed by Abbas et al. [11].

3.4 Days to 50% Flowering

The maximum number of days to 50% flowering (49.98) was recorded with T₀ - Control and minimum days to 50% flowering (38.63) recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (40.84). This experiment provided information about days to 50% flowering will be reduced when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Kaya et al. [12].

3.5 Days to 50% Pod Formation

The maximum number of days to 50% pod formation (62.04) was recorded with T₀ -Control and minimum days to 50% pod formation (52.77) recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (53.04). This experiment provided information about days to 50% pod formation will be reduced when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Reddy et al. [13]; Prom-u-thai et al. [14].

Table 1. Mean performance of Growth and yield Characters of fenugreek (*Trigonella foenum-graecum* L.)

Symbols	Treatments	Field emergence (%)	Plant Height (cm)	Number of branches	Days to 50% flowering	Days to 50% pod formation	Days to maturity	Number of pods per plant	Number of seeds per pod	Seed yield per plant (g)	Test weight (g)	Biological yield (g)	Harvest index (%)
T ₀	Control	73.21	28.93	5.13	49.98	62.04	89.48	16.45	13.41	2.31	7.09	14.16	15.73
T ₁	Electric Treatment 0.5A	78.33	32.21	5.26	48.40	59.38	88.89	20.18	16.39	3.28	8.01	17.53	18.78
T ₂	Electric Treatment 1.0A	80.85	35.16	5.7	46.03	58.40	86.84	21.59	19.40	2.63	7.87	16.18	16.39
T ₃	Magnetic Treatment 10mT	76.86	33.92	5.53	47.78	59.12	88.32	17.80	17.77	3.60	9.36	18.26	19.67
T ₄	Magnetic Treatment 20mT	82.08	35.49	5.91	45.67	57.88	86.12	22.14	19.68	3.07	8.84	18.10	19.50
T ₅	ZnSO ₄ – 1%	85.66	40.06	6.37	41.43	53.98	82.09	24.90	21.14	2.82	7.46	16.77	16.95
T ₆	ZnSO ₄ – 3%	88.25	43.66	6.61	38.63	52.77	80.68	26.80	22.00	4.90	11.17	20.81	23.53
T ₇	MnSO ₄ - 1%	83.81	38.29	6.13	43.73	55.92	84.03	19.36	20.49	3.22	9.03	17.65	18.34
T ₈	MnSO ₄ - 3%	83.98	38.52	6.21	42.86	55.67	84.74	21.10	20.66	3.19	7.13	18.29	17.46
T ₉	Ascorbic acid – 100 PPM	84.23	39.40	6.3	42.41	54.59	83.21	22.88	21.02	3.87	8.98	18.82	20.47
T ₁₀	Ascorbic acid – 300 PPM	86.80	42.59	6.43	40.84	53.04	81.42	25.89	21.28	4.25	9.68	19.78	21.33
T ₁₁	Moringa leaf extract – 3%	81.95	34.82	5.6	46.67	58.71	87.14	23.21	18.97	3.41	7.71	17.95	18.96
T ₁₂	Moringa leaf extract – 5%	82.54	36.47	6.01	44.38	56.83	85.33	20.60	19.88	3.73	9.18	18.00	20.71
	MEAN	82.20	36.88	5.94	44.52	56.79	85.25	21.76	19.39	3.41	8.58	17.87	19.06
	Max	73.21	43.66	6.61	49.98	62.04	89.48	26.80	22.00	4.90	11.17	20.81	23.53
	Min	88.25	28.93	5.13	38.63	52.77	80.68	16.45	13.41	2.31	7.09	14.16	15.73
	C.D @ (5%)	3.73	2.41	0.73	1.59	1.57	2.26	2.35	1.94	0.68	0.70	2.26	3.10
	SE (d)	1.81	1.17	0.36	0.77	0.76	1.10	1.14	0.94	0.33	0.34	1.10	1.50
	C.V.	2.69	3.87	7.5	2.12	1.64	1.57	6.42	5.95	11.77	4.86	7.52	9.66
	F test	S	S	S	S	S	S	S	S	S	S	S	S

3.6 Days to Maturity

The maximum number of days to maturity (89.48) was recorded with T₀-Control and the minimum days to maturity (80.68) were recorded with T₆- ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (81.42). This experiment provided information about days required to maturity will be reduced when it will be treated with ZnSO₄-3% of fenugreek seed than other treatments. Similar findings were observed by Rajpar et al. [15].

3.7 Number of Pods per Plant

The maximum number of pods per plant (26.80) was recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (25.89) and the minimum number of pods per plant (16.45) was recorded with T₀-control. This experiment provided information about the number of pods per plant that will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Patra and Bhattacharya [16].

3.8 Number of Seeds per Pod

The maximum number of seeds per pod (22.00) was recorded with T₆ -ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (21.28) and the minimum number of seeds per pod (13.41) recorded with T₀-control. This experiment provided information about the number of seeds per pod that will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Gendy et al. [17].

3.9 Seed Yield per Plant

The maximum seed yield per plant (4.90) was recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (4.25) and the minimum seed yield per plant (2.31) was recorded with T₀-control. This experiment provided information about seed yield per plant will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Shabanzadesh and Galavi [18].

3.10 Test Weight (g)

The maximum test weight (g) (11.17) was recorded with T₆-ZnSO₄ (3%) for 8 hours

followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (9.68) and the minimum test weight (g) (7.09) was recorded with T₀-control. This experiment provided information about test weight (g) will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Ali et al. [19].

3.11 Biological Yield

The maximum biological yield (20.81) was recorded with T₆ -ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300ppm) for 8 hours (19.78) and minimum biological yield (14.16) recorded with T₀- control. This experiment provided information about the biological yield that will be increased when it will be treated with ZnSO₄ (3%) for 8 hours of fenugreek seed than other treatments. Similar findings were observed by Rizvi et al. [20].

3.12 Harvest Index

The maximum harvest index (23.53) was recorded with T₆-ZnSO₄ (3%) for 8 hours followed by T₁₀-Ascorbic acid (300 ppm) for 8 hours (21.33) and the minimum harvest index (15.73) was recorded with T₀-control. This experiment provided information about the harvest index that will be increased when it will be treated with ZnSO₄ (3%) of fenugreek seed than other treatments. Similar findings were observed by Kumawat [21].

4. CONCLUSION

It is concluded from the present investigation that seed treatment with T₆-ZnSO₄ (3%) for 8 hours significantly increased the characters studied in the field experiment. In the different seed treatments T₆-ZnSO₄ (3%) for 8 hours performed the best results in growth and yield characters like field emergence, plant height (cm), number of branches per plant, days to 50% flowering, days to 50% pod formation, days to maturity, number of pods per plant, number of seeds per pod, seed yield per plant, test weight(g), biological yield, harvest index. it is followed by Ascorbic acid (300 ppm) for 8hours and found to be lowest in control. Thus, seed treatment with ZnSO₄ (3%) for 8 hours may be useful for improving the growth and yield characters of fenugreek. And these recommendations are based on six months of experimentation and therefore further investigation is needed to arrive at a valid recommendation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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