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GROWTH, YIELD AND SEED QUALITY INFLUENCED BY *RHIZOBIUM* INOCULATION IN FENUGREEK (*TRIGONELLA FOENUM-GRAECUM* L.)

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SUMMARY

Ten genotypes of fenugreek with two sets of treatments (without *Rhizobium* and with *Rhizobium* inoculation) were subjected to assess the effect of *Rhizobium* inoculation on plant growth, yield and seed quality parameters. The field experimental site was located at Chaudhary Charan Singh Haryana Agricultural University, Hisar between 29.15°N latitude, 75.69°E longitude with a mean altitude of 215 m above msl. *Rhizobium* inoculation positively influenced the plant height, pods per plant, seeds per pod, leaf yield and seed yield. Maximum growth and yield parameters were recorded with *Rhizobium* inoculation by genotypes HM-348 and HM-355. With *Rhizobium* inoculation maximum test weight, standard germination, vigour index-I and II and lowest electrical conductivity was recorded by genotype HM-348. Genotypes HM-348 and HM-355 were found superior in all growth and seed quality parameters with or without *Rhizobium* inoculation. While seed inoculation with *Rhizobium* culture positively and significantly improved all growth, yield and seed quality parameters in comparison to no seed inoculation.

Key words : Fenugreek, growth, *Rhizobium*, seed quality

Bio-fertilizers have the ability to increase the health and productivity of plant life as well as reduce the use of chemical fertilizers. In recent years, more emphasis has been given to the bio- fertilizers use for sustainable farming. Pulse *Rhizobia* differ not only among themselves, but it is effective in legume crops. *Rhizobium* improves the ability of plants by biological nitrogen fixation that results in increase in legume nodulation. Biological nitrogen fixation, a microbiological process, which converts atmospheric nitrogen into plant useable form, offers economically attractive and ecologically sound means of reducing external inputs and improving internal sources. Currently, biological nitrogen fixation is gaining importance due to the unacceptable application of chemical/nitrogenous fertilizers that results in toxic effect to the soil and deteriorate its fertility. The seed inoculation with *Rhizobium* is effective and fenugreek being a legume crop responds to inoculation of *Rhizobium* and it also provides opportunity to improve yield, chemical composition and physical characteristics of seeds. Therefore, the present investigation comprising 10 genotypes was carried out with *Rhizobium* treatment to assess the efficacy of *Rhizobium* inoculation and its effect on growth, yield and seed quality of fenugreek genotypes.

MATERIALS AND METHODS

The field experimental site was located at Chaudhary Charan Singh Haryana Agricultural University, Hisar between 29.15°N latitude, 75.69°E longitude with a mean altitude of 215 m above msl. This region has semi-arid climate with severe cold winter and hot dry summer. The details of the meteorological data during the crop season are presented in Fig 1. Ten popularly cultivated genotypes of fenugreek viz., HM-257, HM-273, HM-291, HM-293, HM-346, HM-348, HM-355, HM-444, Hisar Suvarana and Hisar Sonali were collected from the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar and two sets of genotypes were undertaken; one set was without *Rhizobium* inoculation, while the second set inoculated with *Rhizobium* culture. Both sets were sown (November 12, 2012) in randomized block design (RBD) with three replications and sowing was done at spacing 50 × 10 cm and the plot size was 3.0 × 1.50 m. All recommended agronomic practices were followed timely for successful raising of the crop. Randomly 10 competitive plants were taken to record observations on five quantitative characters, namely, plant height (cm), number of pods per plant, pod length (cm), number of

Table 1. Effect of Rhizobium treatments on growth and yield parameters in fenugreek genotypes

Genotype	Without *Rhizobium*					With *Rhizobium* inoculation				
	Plant Height (cm)	Pods/ plant	Seeds/ pod	Leaf yield (q/ha)	Seed yield (q/ha)	Plant height (cm)	Pods/ plant	Seeds/ pods	Leaf yield (q/ha)	Seed yield (q/ha)
HM-257	82.28	71.22	15.31	50.65	20.37	83.71	71.66	16.94	52.79	21.99
HM-273	84.28	71.00	15.37	51.79	23.72	90.82	73.82	16.92	53.88	24.87
HM-291	83.04	81.31	16.02	55.97	21.71	85.88	95.95	16.81	57.74	24.94
HM-293	74.17	70.00	14.00	50.00	19.00	80.93	71.00	15.00	52.83	20.00
HM-346	89.22	87.00	15.02	59.15	24.40	99.68	90.55	16.88	61.00	24.98
HM-348	99.99	87.31	18.06	70.60	25.21	105.91	99.75	18.53	70.95	27.88
HM-355	99.00	86.18	18.02	61.24	24.55	102.66	98.00	18.41	62.00	26.00
HM-444	87.28	71.02	16.31	50.18	19.27	93.66	82.75	16.85	53.96	21.00
Hisar Suvarna	93.31	71.08	14.41	55.93	24.22	97.73	82.95	15.87	59.72	25.75
Hisar Sonali	86.31	75.08	16.48	52.84	21.26	90.75	97.64	15.77	59.70	23.90
Mean	87.89	77.12	15.90	55.83	22.37	93.17	86.40	16.80	58.46	24.13
C. D.	0.38	0.44	0.43	0.67	0.67	0.31	0.66	0.43	0.35	0.24

Rhizobium and without seed treatment maximum seed yield was observed by HM-348 (25.21 q/ha). Lowest seed yield was observed by HM-293 i. e. 19 q/ha without seed treatment. Anitha *et al.* (2015) suggested that maximum seed yield was due to bolder seeds, which was due to the nutrition of fenugreek plants and also nutrient combination (*Rhizobium* and PSB) reflected on seed quality. Naimuddin *et al.* (2014) also mentioned that application of *Rhizobium* inoculation enhanced the seed yield in fenugreek. Seed and leaf yield was increased significantly with seed treatment of all fenugreek genotypes and the trend of the increase is graphically shown in Fig 1. The weight of 1000 seeds denotes the extent of development of seed and is an important yield attribute besides contributing towards yield and quality of the seed. Seed inoculation with *Rhizobium* culture positively influenced the seed test weight as compared to no seed inoculation with

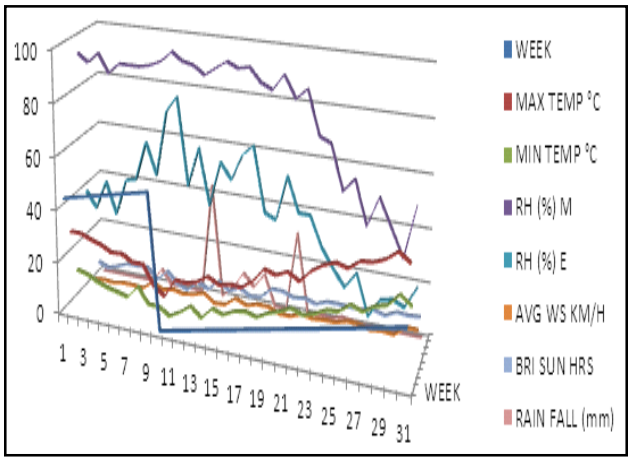

Fig. 2. Climate and Weather conditions during the sowing and harvesting time of fenugreek genotypes.

Rhizobium culture. Maximum test weight (Table 2) was recorded by HM-348 (13.94 g) with *Rhizobium* inoculation and lowest test weight observed by genotype HM- 293 (10.00 g). Wierzbowska *et al.* (2014) observed that fenugreek seed inoculation with *Rhizobium* had a great effect on seed quality and hence it had positive and significant effect on 1000-seed weight. With *Rhizobium* treatment, maximum standard germination (Table 2) was recorded by genotype HM-348 (98.00%) and without *Rhizobium* treatment maximum standard germination was recorded by genotype HM-3348 (97.50%). In both the treatments, lowest germination percentage was recorded by HM-293 (95.00) in without *Rhizobium* inoculation. Soundari *et al.* (2015) also found that *Rhizobium* inoculated plants showed increased seed germination percentage in fenugreek. Similar observationS were also recorded in Bengal gram, mothbean, greengram, peas by Pawar *et al.* (2014) and mentioned that seeds dressed with *Rhizobium* showed high seed germination and stimulatory growth over control. Maximum seedling vigour index-I and II were observed by genotype HM-348 (Table 2) in both sets of treatments and lowest value was observed by HM-293 in both sets of treatments. Anitha *et al.* (2015) observed that the organic bio-fertilizers inoculation and organic manures enhanced the accumulation of higher quantities of seed constituents like carbohydrates, proteins as enzymes which increased the seed vigour index of bolder seeds that containd greater metabolites for resumption of embryonic growth during germination. The measurement of electrical conductivity is very important for judging vigourness of seeds. The electrical conductivity test of solution reflects the amount of leachates extruded from the seeds. Highest EC value

TABLE 2
Effect of Rhizobium treatments on seed quality parameters of fenugreek genotypes

Genotype	Without *Rhizobium*					With *Rhizobium* inoculation				
	Test weight (g)	Standard germination (%)	Seedling vigour index-I	Seedling vigour Index-II	Electrical conductivity (µS/cm/seed)	Test weight (g)	Standard germination (%)	Seedling vigour index-I	Seedling vigour Index-II	Electrical conductivity (µS/cm/seed)
HM-257	10.22	95.99	1,929.71	7,200.33	0.125	10.70	96.69	1,972.67	7,302.33	0.132
HM-273	12.99	96.00	1,852.93	6,816.67	0.124	12.99	97.93	1,970.67	6,958.00	0.125
HM-291	10.07	96.28	1,905.90	6,524.67	0.142	11.99	96.99	1,931.67	6,633.67	0.145
HM-293	10.00	95.00	1,534.69	5,886.67	0.180	10.76	96.67	1,547.67	6,004.00	0.177
HM-346	10.52	95.99	1,781.96	6,252.67	0.119	10.78	96.80	1,632.67	6,341.00	0.119
HM-348	13.18	97.50	2,314.02	7,678.67	0.069	13.94	98.00	2,524.67	7,781.00	0.090
HM-355	11.97	96.96	2,166.93	7,592.00	0.088	13.76	97.99	2,366.67	7,699.00	0.098
HM-444	12.33	95.93	1,851.72	6,707.67	0.144	13.54	96.00	1,921.67	6,722.00	0.152
Hisar Suvarna	11.29	96.10	1,976.80	6,505.00	0.113	11.75	96.93	1,946.67	6,776.33	0.113
Hisar Sonali	10.32	96.00	2,043.84	7,465.67	0.133	11.06	96.86	2,121.67	7,628.33	0.144
Mean	11.29	96.17	1,935.85	6,863.00	0.123	12.13	97.08	1,996.00	6,984.57	0.129
C. D.	0.31	0.15	0.46	1.17	0.001	0.58	0.48	0.99	3.03	0.003

(Table 2) was observed by HM-293 (0.177) and lowest EC value was recorded by HM-348 (0.69). Saxena *et al*. (1987) reported a negative relationship between electrical conductivity and the levels of reducing sugars in leachate with per cent germination and other vigour and viability of vegetable seeds.

CONCLUSION

On the basis of the present investigation, it could be concluded that significant differences/variability were observed among the genotypes for almost all the yield components and seed quality parameters. Seed treatment with *Rhizobium* had significant impact upon the seed Genotypes HM-348 and HM-355 were observed the best genotypes in terms of seed and leaf yield with seed treatment with *Rhizobium* Therefore, seed treatment with *Rhizobium* should be followed for obtaining higher leaf and seed yield along with good quality seed.

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