

SEED YIELD AND QUALITY OF FENUGREEK (*TRIGONELLA FOENUM-GRÆCUM* L.) CV. LAM METHI-2 AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

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ABSTRACT

A field experiment was conducted to evaluate the yield and quality aspects of fenugreek seed under different combinations of manures and fertilizers application in college farm, HC & RI, during *rabi* season. Seed yield in the presence of 50% inorganic fertilizers and 50% organic manures along with bio-fertilizer inoculation to seed reached maximum value (721.40 kg ha⁻¹). There is no significant difference in the treatment combinations for germination percentage and speed or rate of germination. Other quality parameters like seedling length, vigour index, seedling dry weight and protein content (9.36 mg/100g) reaching maximum in the combination of 50% inorganic fertilizers and 50% organic manures (*viz.*, poultry manure, vermi compost, neem cake, FYM) and bio-fertilizers inoculation.

INTRODUCTION

Seed spices include a group of annuals whose dried fruit or seeds are used as spice and condiment. These are characterised by pungency, strong odour and sweet or bitter taste. Coriander, cumin, fennel, and fenugreek occupy the largest area among the seed spices grown in India having high export value in global market as spice mixture (Aishwat *et al.*, 2011). Fenugreek (*Trigonella foenum-graecum* L.) is medicinally important seed spice belonging to the family leguminosae. Good seed is the basis for successful crop production programme. The quality seed are ensured with uniform germination, rapid root and seed development. In fact, there has been interdependence in use of quality seeds and higher yield. However realization of seed yield always depends on production of superior quality seeds as further dividends in cultivation of crop dependent on utility of quality seed (Kumar and Uppar, 2007). Fenugreek seed is good source of water soluble protein (10.7 g/ 100g seed) [Ali *et al.*, 2012] and high in mucilage. Among various factors contributing towards the attainment of potential yield with good quality, fertilizer management has considerable practical importance. Chemical fertilizers play an important role to meet nutrient requirement of the crop but continuous use of these on lands will have deleterious effects on physical chemical and biological properties of soil, which in turn reflects on yield (Sarkar *et al.*, 1997). Therefore, there is an urgent need to reduce the usage of chemical fertilizers and in turn increase

the usage of organic manures which are known to improve physico-chemical properties of soil and supply the nutrients in available form to the plants. Similarly, usage of biofertilizers is very essential because the insoluble phosphate which is not directly available to plants usually comprises 95-99 per cent of the total soil phosphorous. Integration of various organic manures with inorganic fertilizers and low cost bio-fertilizers inoculation not only reduces the fertilizer requirement but also an ecofriendly approach (Jeyabal *et al.*, 2000). Research indicates that a combined application of 50 to 75% of the recommended dose of fertilizers and 25 to 50% of organics leads to higher yield and better quality of seed spices as opposed to the application of organics alone (Aishwat *et al.*, 2011).

In view of this background, the present investigation to find out suitable nutrient management with the combined use of different organic, inorganic and bio-fertilizers in fenugreek was taken.

MATERIALS AND METHODS

The fenugreek cv. Lam methi-2 collected from HRS, Lam farm and seed sown in a spacing of 30 × 20 cm with the seed rate of 20kg ha⁻¹. *Rhizobium melilotii* and PSB (*Bacillus megatherium*) are collected from Nodule Research Centre, Amaravathi, Guntur, A. P. *Rhizobium* inoculated to seed @ 200g kg⁻¹ seed, PSB mixed with organic manures particular to treatment applied in the soil before sowing.

Experimental set up

The experiment was laid out in a Randomized block Design with twelve treatments and replicated three times. The statistical analysis was carried out as per the methods suggested by Panse and Sukhatme (1967). The plant protection measures were taken up as and when required along with intercultural operations. In each plot five plants were randomly selected and tagged to collect seed for measuring seed quality attributes. Seed germination percentage was calculated by number of seeds germinated/number of seeds sown \times 100. The seeds obtained from different treatments were tested for germination by adopting between paper towel method kept at optimum conditions of temperature ($25 \pm 5^\circ\text{C}$) and relative humidity ($95 \pm 1\%$ RH) in three replications of fifty seeds each as given by ISTA rules (Anon., 1999). The number of normal seedlings was counted at the end of 7 days and the germination percentage was calculated by using the above formula (Stephen, 2008). The total length of seedling was recorded at the end of 10th day for randomly selected seedlings and the averages were calculated and expressed in centimeters. The seedlings used for measuring seedling length were kept in a butter paper packet and dried in hot air oven maintained at 80°C temperature for 24 hours. Then the seedlings were cooled in dessicator for one hour and the weight of the dry seedlings was recorded using electronic balance and was expressed in miligrams. Seedling vigour index was calculated by multiplying germination percentage and seedling length in centimeter (Abdul-Baki and Anderson, 1973). Speed of germination was calculated by dividing germination percentage and days taken for germination (Bewley and Black, 1982). Soluble Protein content in seed estimated through Lowry *et al.* (1951) as Bovine Serum Albumin (BSA) as standard.

RESULTS AND DISCUSSION

Seed Yield

The data (Table 1) revealed that different organic manures,

inorganic fertilizers and bio-fertilizers in INM combinations significantly influenced the grain yield in fenugreek

The nutrient combination of 50% RDF+ poultry manure @ 1000 kg ha⁻¹ + *Rhizobium* + PSB (T₉) recorded significant maximum seed yield (721.4 kg ha⁻¹). Highest seed yield in this treatment was due to fact that combined application of 50% RDF through inorganic fertilizers and 50% RDF through organic manures, *i.e.*, poultry manure and bio-fertilizers (*Rhizobium* + PSB) led the availability of appreciable amount of essential plant nutrients and improved the physical properties of the soil as stated by Nambiar and Abrol (1989). The seed development might be attributed to the mobilization of reserved food material to developing seed, which acts as a sink for carbohydrates present in plant (Dalal and Nandakar, 2010). Further, the yield increase might be due to increased nutrient uptake by plant might have stimulated the rate of various physiological processes like growth and assimilation by the balanced application of organic and inorganic sources along with bio-fertilizers (*Rhizobium* + PSB) inoculation. Similar results were reported by Tolanur and Badnur (2003) in chick pea and Dalal and Nandakar (2010) in pigeon pea.

Germination percentage (%)

The data recorded for the character germination percentage presented in Table 1, revealed that there is no significant difference among the treatment combinations of integrated nutrient management. However, the maximum germination percentage (92) was recorded in the combination of 50% RDF + poultry manure @ 1000 kg ha⁻¹ + *Rhizobium* + PSB (T₉) and the lowest germination percentage (86) was recorded in control.

Release of certain enzymes responsible for degradation of macromolecules into micro molecules within the seed are not influenced by different combinations of integrated nutrient management as applied to the soil. The similar results were reported by Kumar and Uppar (2007) in moth bean and Chawale *et al.* (1995) in groundnut.

Table 1: Effect of INM treatments on seed yield (kg ha⁻¹) and quality parameters of fenugreek (*Trigonella foenum-graecum* L.)

Treatments	Seed yield (kg ha ⁻¹)	Germination percentage (%)	Speed of germination (% day ⁻¹)	Seedling length (cm)	Seedling Vigour Index	Seedling dry weight (mg)	Protein content of seed (mg)/100mg
T ₁ - 100% RDF (60: 50: 50 N,P ₂ O ₅ , K ₂ O kg ha ⁻¹) + <i>Rhizobium</i> + PSB	635.33	88.67 (70.41)	0.047	4.41	388.70	11.30	5.80
T ₂ - 75% RDF + <i>Rhizobium</i> + PSB	532.67	89.33 (70.93)	0.056	4.06	362.83	10.35	5.83
T ₃ - 50% RDF + <i>Rhizobium</i> + PSB	562.67	88.67 (70.33)	0.049	3.67	324.95	9.42	6.20
T ₄ - 75% RDF + FYM @ 3000 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	586.64	88.00 (69.72)	0.049	4.77	420.12	9.92	7.40
T ₅ - 50% RDF + FYM @ 6000 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	615.39	88.33 (70.07)	0.049	5.37	474.57	11.56	7.50
T ₆ - 75% RDF + VC @ 500 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	640.40	89.00 (70.77)	0.049	5.55	493.27	11.79	7.97
T ₇ - 50% RDF + VC @ 1000 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	665.71	91.00 (72.58)	0.048	6.20	564.55	13.64	8.40
T ₈ - 75% RDF + PM @ 500 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	680.75	89.67 (71.66)	0.049	6.50	582.91	14.07	8.80
T ₉ - 50% RDF + PM @ 1000 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	721.40	92.00 (73.56)	0.051	8.53	784.59	16.49	9.36
T ₁₀ - 75% RDF + NC @ 319 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	637.17	91.67 (73.37)	0.047	5.12	469.20	11.83	7.53
T ₁₁ - 50% RDF + NC @ 638 kg ha ⁻¹ + <i>Rhizobium</i> + PSB	660.70	90.00 (71.66)	0.048	5.78	519.79	12.92	8.00
T ₁₂ - 100% RDF (60: 50: 50) N, P ₂ O ₅ , K ₂ O kg ha ⁻¹ (Control)	636.04	86.00 (68.01)	0.045	4.19	361.16	9.59	5.40
Mean	631.24	89.36 (71.09)	0.048	5.35	478.89	11.91	7.35
S.Em \pm	6.25	1.50	0.003	0.45	38.764	0.75	0.13
C.D (P=0.05)	18.46	N.S.	N.S.	1.32	114.43	2.23	0.37

*Figures in parenthesis indicates the angular transformed values

Speed of germination (% day⁻¹)

Data on speed of germination as influenced by various treatments presented in Table 1. It could be observed from the data that there is no significant difference was observed among the treatment combinations of integrated nutrient management. However, the maximum speed of germination of 0.056% day⁻¹ was recorded by the application of 75% RDF + *Rhizobium* + PSB (T₂) and the lowest speed of germination (0.045% day⁻¹) was recorded in control.

The rate of germination might be due to bolder seeds that contain greater metabolites for consumption of embryonic growth during germination as reported by Kumar and Uppar (2007) in moth bean.

Seedling length (cm)

Among the different nutrient combinations (Table 1), the application of 50% RDF + poultry manure @ 1000 kg ha⁻¹ + *Rhizobium* + PSB (T₃) recorded maximum seedling length of 8.53 cm. Seedling length was highest in the treatment T₃ is due to that the nutrition of fenugreek plants in that nutrient combination which reflected on seed quality and also accumulation of higher quantities of seed constituents like carbohydrates, protein and other enzymes. Increase in seedling length may be because of bolder seeds, having higher test weight which contains greater metabolites for resumption of embryonic growth during germination and these metabolites release certain enzymes responsible for degradation of macromolecules into micro molecules within the seed for the increase of seedling length. The similar results were also reported by Ahmed *et al.* (1997) in pea and Kumar and Uppar (2007) in moth bean.

Seedling vigour Index

Results pertaining to seedling vigour index presented in Table 1 revealed that the significant differences were observed among the different combinations of integrated nutrient management. Application of 50% RDF + poultry manure @ 1000 kg ha⁻¹ + *Rhizobium* + PSB (T₃) recorded maximum seedling vigour index of 784.59. Application of organic manures and inorganic fertilizers along with bio-fertilizers inoculation enhances the accumulation of higher quantities of seed constituents like carbohydrates, proteins as enzymes which increased the seedling vigour index of bolder seeds that contain greater metabolites for resumption of embryonic growth during germination. In addition to these metabolites release of certain enzymes responsible for degradation of macromolecules into micro molecules within the seed as stated by Ahmed *et al.* (1997) in pea, Yadav and Khurana (2005) in fennel and Kumar and Uppar (2007) in moth bean.

Seedling dry weight (mg)

Data in respect of seedling dry weight presented in Table 1. The application of 50% RDF + poultry manure @ 1000 kg ha⁻¹ + *Rhizobium* + PSB (T₃) recorded maximum seedling dry weight (16.49 mg). Accumulation of higher quantities of seed constituents like carbohydrates in the seed is due to the nutrition of fenugreek plants with the nutrient combination of 50% RDF + poultry manure @ 1000 kg ha⁻¹ + *Rhizobium* + PSB, reflected on seed through the characters like bolder seed, test weight and higher seedling length there by increased the seedling dry weight (Yadav and Khurana, 2005). Further, these

metabolites release certain enzymes responsible for degradation of macromolecules into micro molecules within the seed responsible for the higher growth of seedling increased the dry weight. Similar results were also reported by Ahmed *et al.* (1997) in pea and Kumar and Uppar (2007) in moth bean.

Protein content of seed (mg/ 100mg)

It was observed from the data (Table 1) that application of organic manures, inorganic fertilizers and bio-fertilizers inoculation significantly influenced the protein content of seed.

Among the treatments, maximum protein content of seed (9.36 mg) was recorded with the application of 50% RDF + poultry manure @ 1000kg ha⁻¹ + *Rhizobium* + PSB (T₃) followed by the application of 75% RDF + poultry manure @ 500kg ha⁻¹ + *Rhizobium* + PSB (T₃) of 8.80 mg over control (5.40 mg).

Maximum protein content in seed due to the nitrogen in inorganic source alone or in combination with organic source increased the protein content as the nitrogen is a basic constituent of protein and higher rate of nitrogen application and nitrogen availability through microbial activity which resulted in increase of protein content in seed as reported by Nagre (1991) in soyabean and Adhikary and Gantayet (2012) in chilli. The supplementary application of organic manure and *Rhizobium* increased nitrogen availability and nitrogen use efficiency thereby increasing protein synthesis. Similar findings were also reported by Kumawat and Manohar (1994) in gram and Jasrotics and Sharma (1999) in french bean.

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