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# RESPONSE OF FENUGREEK TO ORGANIC AND INORGANIC SOURCE OF NUTRIENTS ON PHENOLOGICAL DEVELOPMENT AND PRODUCTION POTENTIAL

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## SUMMARY

Nutrients play an important role in increasing quantity and quality of the crop produce. Consequently, an experiment was conducted for two years in a split plot design with 32 treatment combinations consisting of two varieties and four levels of vermicompost as main plot treatments and four levels of phosphorus as sub plot treatments. The fenugreek variety HM-103 showed its superiority over HM-57 for all the growth, seed yield attributing characters and benefit to cost ratio. Application of vermicompost at 4.0 t/ha significantly increased seed yield (16.83 q/ha), straw yield (32.50 q/ha) and biological yield (20.14 q/ha) to the tune of 45.08, 10.32 and 20.14% over control, respectively, which was at par with higher dose (5 t/ha). Likewise, the application of phosphorus 40 kg/ha significantly increased seed yield (16.04 q/ha), straw yield (33.31 q/ha) and biological yield (49.16 q/ha) to the tune of 15.15, 15.90 and 15.21% over control, respectively, which was significantly at par with higher dose, i.e. 60 kg/ha. Hence, in the Northern plains of India fenugreek variety HM-103 is more profitable with the application of vermicompost 4 t/ha and phosphorus 40 kg/ha.

**Key words :** Vermicompost, phosphorus, variety, fenugreek, phenological, economics

Fenugreek (*Trigonella foenum-graecum* L.) belongs to *Trigonella* genus of leguminosae family. The two important species are *Trigonella foenum-graecum* (Common Methi) and *Trigonella corniculata* (Kasuri Methi). It is an annual herbaceous multipurpose crop grown during the winter season in north India (Kumar *et al.,* 2013). The seed is mainly used as a condiment and in the pharmaceutical industry especially in preparation of ayurvedic medicines, while young plants are used as a vegetable and forage (Panghal *et al*., 2015). Fenugreek serves as a good source of protein for both animals as well as human beings (Kirti and Arya 2019). The major fenugreek producing countries are India, Argentina, Egypt, France, Morocco, Spain, Bulgaria and Pakistan. In India, fenugreek is mainly grown in Rajasthan, Gujarat, Haryana, West Bengal and Uttaranchal.

The production and productivity of crop are controlled by many factors such as genetic potential of the variety, supply of balanced nutrients and agronomic practices. Exclusive use of chemical fertilizers cannot sustain the fertility of soil since they do not supply balanced dose of all the nutrients. Organic manures alone cannot fulfill the demand of all the nutrients in a balanced manner. Integration of optimum doses of chemical fertilizers and organic manures are essential for sustainable production as well as maintaining the fertility status of soil (Godara *et al*., 2014).

Vermicompost have a higher nutritional value than traditional composts because of increased mineralization and a greater degree of humification in them by the action of earthworms (Doan *et al*., 2015). Vermicompost contains higher concentrations of plant-available nutrients such as nitrates, phosphates, exchangeable calcium, soluble potassium, and trace metals. When it is supplemented in soil, enhances the relative proportion of these micro and macro nutrients, thereby promoting plant growth and yield (Kumar *et al*., 2015). Combined use of inorganic and organic manures such as vermicompost enhances microbial activity of soil especially biological nitrogen fixation and supplies most of the nutrients to plant and sustain soil health (Godara *et al*., 2012).

Selection of a high yielding variety is very important as different varieties respond differently to different soil and climatic conditions. Productivity of fenugreek can be boosted by providing balanced an

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adequate dose of major plant nutrients such as nitrogen, phosphorus and potassium as per the need of plant (Kumar *et al*., 2015). Therefore, scientifically based production technology is the need of the day and judicious application of nutrients and other inputs assumes a great significance (Singh *et al*., 2018). Therefore, the present investigation was carried out to find out the optimum level of vermicompost and phosphorus for fenugreek varieties i.e. HM-57 and HM-103, and select suitable one for cultivation under semi-arid climatic conditions of the Northern Plains of India.

## MATERIALS AND METHODS

### Description of the study area

The experiment was conducted during the two consecutive Rabi seasons (2013-14 and 2014-15) on sandy soil of southern Haryana, which is situated in the semi-arid, sub tropical region of north western India in Haryana state. The elevation of this Site is 207 meters above sea level and lies at 28°84' N latitude and longitude 75°87' E. The climatic tract of this region is hot and dry winds during summer and dry severe cold in winter. The soil of the experimental field was sandy (sand 70.5%), slightly high in pH (8.89), low in organic carbon (0.29%) available nitrogen (143 kg/ha), available potash (101.5 kg/ha) and medium in available phosphorus (12 kg/ha).

### Description of climatic conditions

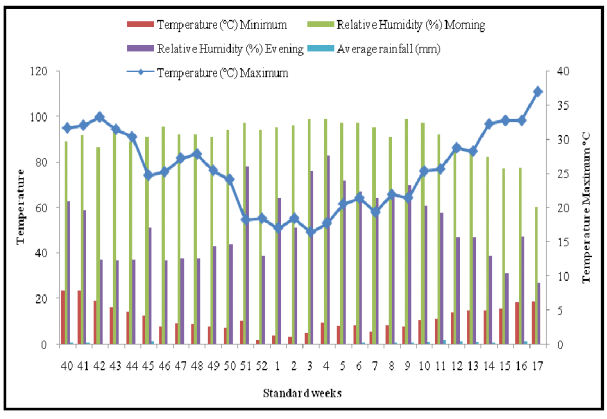
The total rainfall as well as its distribution in the region is subjected to large variation. About 80 to 90 percent of the total rainfall (420 mm) is received through southwest monsoon from July to September with few showers during winter and spring seasons. The maximum and minimum temperature show a wide degree of fluctuations during the summer and winter months during both years. The maximum average temperature was 25.5oC and 26.2oC and minimum was 11.4oC and 12.1oC during the crop period of 2013-14 and 2014-15, respectively. The mean daily morning and evening relative humidity was between 90.8% and 86.8% to 52.3% and 49.0% during both the season 2013-14 and 2014-15, respectively (Fig. 1).

### Treatments and experimental design

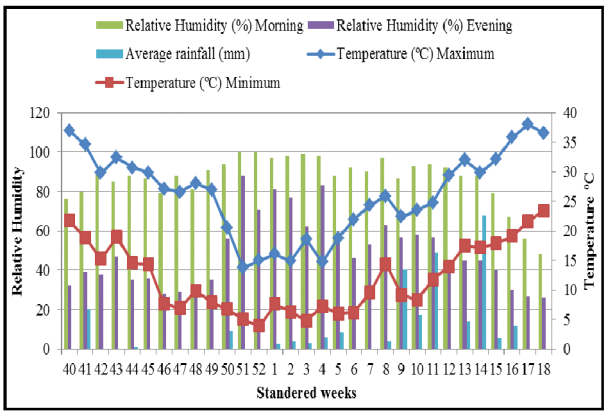
The experiments were laid out in a split plot design with 32 treatment combinations consisting of two new varieties *i.e.*, HM-57 (Hisar Sonali) and HM-103 (Hisar Suvarna) and four levels of vermicompost (0, 3, 4 and 5 tons per hectare) as main plot treatments and four levels of phosphorus (0, 20, 40 and 60 kg $P_2O_5$ per hectare) as sub plot treatments and all treatments were replicated thrice. Vermicompost was incorporated in the experimental field before sowing and phosphorus (in the form of single super phosphate) was applied basal dose as per treatments. Besides this, nitrogen was applied equally in all plots @25 kg/ha in two split doses half as basal dose and remaining half were top dressed at 35 days after sowing. The pooled data presented in the Tables are the mean values of different parameters.

### Statistical method

The statistical method described by Panse and Sukhatme (1961) was followed for the analysis of variance and interpretation of experimental results. For this using OPSTAT statistical software (http://14.139.232.166/opstat/index.asp) developed by




2013-14




2014-15

Fig. 1. Mean weekly meteorological data recorded during crop season.

Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India. All the tests of significance were made at 5% level of significance. the critical difference was computed to test the significance of difference between the means of two treatments.

**Crop raising and data recording**

The experimental field was prepared by one deep ploughing using mold bold plough and two ploughing using harrow each followed by planking to prepare suitable seedbed. Seeds were sown in rows 30 cm apart by *Kera* method using a hand plough in first week of November during both the years at the rate of 25 kg per hectare. Thinning was done to maintain the plant to plant distance of 10 cm. The crop was irrigated uniformly on the need basis. Other cultural practices were followed as per package and practices recommended a the crop.

The observations of phenological parameters were recorded periodically at an interval of 30 days from ten randomly selected plants from each treatment of each replication. The data of dry matter accumulation was recorded by taking a sample of ten plants from second row of each plot at 30, 60, 90 and 120 days after sowing (DAS) and oven dried in an electric oven till constant weight. Average of ten plants weight was computed by dividing total weight with ten to get dry matter accumulation per plant. The Crop growth rate (CGR) is the rate of crop growth which indicates rate of plant growth and expressed as gram of dry matter produced per square meter per day and it is calculated with following formula-

$$\text{Crowth Growth Rate} = \frac{W2 - W1}{(t2 - t1) \times S}$$

Where, W1 and W2 are dry matter at time t1 and t2 and S is the land area over dry matter.

The crop was harvested after the maturity of plant (125 DAS) from central rows leaving two edge rows as side effects. The net plot was harvested and after sun drying for one week the crop was weighed for calculating biological yield and threshed plot wise.

Biological yield = Seed yield + Straw yield

Seed yield obtained from each plot was subtracted from biological yield to know the straw yield. The harvest index was calculated for each treatment using the following formula-

$$\text{Harvest index (\%)} = \frac{\text{Seed yield}}{\text{Biological yield}} \times 100$$

Taking the current price of produce (Rs. 7200/q) as well as expenditure on vermicompost and phosphorus into consideration, the economics of each treatment was worked out. The estimated cost of vermicompost and single super phosphate was Rs. 3 and 5.24 per kg, respectively.

## RESULTS AND DISCUSSION

**Phenological parameters**

**Effect of variety :** The fenugreek variety HM-103 showed its superiority over HM-57 at all stages of plant growth except the first 30 days of plant life. The fenugreek variety HM-103 recorded more plant height (46.8cm), number of branches per plant (4.15) and dry matter per plant (16.45 g) which was increased 0.95%, 6.14% and 3.26% over HM-57 at 120 DAS, respectively. Dry matter accumulation and crop growth rate were increased with increasing crop period and high dry matter accumulation and crop growth rate were recorded in variety HM-103 as compared to HM-57 at all stages of growth except 0-30 days. Significantly higher crop growth rate (11.83 $g/m^2/day$) was observed in HM-103 as compared to HM-57 during crop period 91-120 DAS (Table 1). This might be due to production of more leaves and branches which ultimately increased crop growth rate. The increase in growth parameters in fenugreek variety HM-103 might be due to its genetic makeup which has reflected in higher growth. Kumar *et al*. (2015) also noticed a significant increase in growth parameters in fenugreek genotype AFg-4 under climatic conditions of Ajmer, Rajasthan. The present results support the findings of and Ahmed *et al*. (2010), Pushpa *et al*. (2012) and Kumar *et al*. (2015).

**Effect of vermicompost :** Different levels of vermicompost have significant effect on plant height, number of branches per plant, dry matter accumulation and crop growth rate at different growth stages except for 30 DAS (Table 1). Application of vermicompost 5.0 t/ha significantly increases plant height (47.86 cm), number of branches (4.30) and dry matter accumulation (17.75 g) as compared to control to the tune of 16.4, 17.3 and 24.1% respectively at 120 DAS. Crop growth rate increased with increases crop period and maximum (12.56 g/

$m^2$/day) was recorded with vermicompost 5.0 t/ha to the tune of 15.6% over the control from 91-120 days of crop period. The growth parameters recorded with application of vermicompost 5.0 t/ha were significantly at par with 4.0 t/ha. This means that the increased dose of vermicompost above 4.0 t/ha has no effect on phenological parameters of fenugreek.

The increase in plant height and number of branches due to application of vermicompost may be attributed to more availability of native nutrients in soil resulted formation of more healthy and effective root nodules (Verma *et al*., 2014) and helps in stem elongation and increase in dry matter accumulation. Similar results were reported by Jat *et al*. (2006), Deora *et al*. (2009) and Kumar *et al*. (2013) who observed increase in plant height and number of branches with application of vermicompost in fenugreek.

**Effect of phosphorus :** The increasing level of phosphorus significantly influenced plant height, number of branches per plant, dry matter accumulation per plant and crop growth rate. On the bases of means of two year data, maximum value of growth parameters were recorded with application of phosphorus at 60 kg/ha which was statistically at par with 40 kg/ha (Table 1). Progressive increase in phosphorus levels at 40 kg/ha recorded significantly higher plant height (18.57 & 11.89%, 13 & 4.9% and 22.90 & 9.05%), dry matter accumulation (22.81 & 13.13%, 35.91 & 14.76% and 25.22 & 7.89%) at 60, 90 and 120 DAS and number of branches (15.98 & 6.05%) at 120 DAS as compared to 0 (control) and 20 kg/ha. During the crop growth period 91-120 days, crop growth rate (12.45 g/$m^2$/day) increased to a tune of 16.63% with phosphorus 40 kg/ha over control.

The increases in growth parameters due to application of phosphorus might be due to physiological role of phosphorus on meristematic activity of plant tissue. The applied phosphorus might have increased nitrogenase activity which enhanced root nodulation that resulting in improved growth parameter (Mehta *et al*., 2010). These results confirm the findings of Bhunia *et al*. (2006) and Mehta *et al*. (2010) they reported significantly higher growth parameters with application of phosphorus 40 kg/ha in fenugreek.

**Yield attributes**

**Effect of variety :** The variety HM-103 exhibited significantly more number of pods per plant (41.74), number of seeds per pod (15.21), pod length (9.91 cm) and 1000 seed weight (12.14 g) which were increased to a tune of 1.3, 3.4, 5.26 and 8.64% over the variety HM-57, respectively (Table 2). This difference could be due to genetic makeup of the varieties. The higher yield of a variety may be due to more efficiency of that variety to translocate photosynthate from source to sink, more growth of pods, increased number of fertilized ovules and its retention. The varietal differences in yield attributes were also reported by Ahmed *et al*. (2010), Pushpa *et al*. (2012), Hussien & Zaki, (2013) and Kumar *et al*. (2015) in fenugreek.

The variety HM-103 significantly exceeded HM-57 in seed yield, straw yield and biological yield. Based on pooled data, the seed yield, straw yield and biological yield increased in HM-103 as compared to HM-57 by 5.13, 3.11and 3.72%, respectively. The higher yield might be due to more pod length, seeds per pod and 1000 seed weight. The varietal difference in yield potential between fenugreek varieties may be due to genetic differences between the varieties. It is worth to mention that our results are in agreement with the findings of Basu *et al*. (2009), Pushpa *et al*. (2012) and Kumar *et al*. (2015). Higher harvest index was recorded in variety HM-103 as compared to HM-57, however it was recorded non significant. Our results are in agreement with the findings of Ahmed *et al*. (2012) who reported non significant difference in harvest index among the fenugreek varieties.

**Effect of vermicompost :** The Application of vermicompost 5 t/ha recorded higher number of pods per plant (44.05), number of seeds per pod (15.40), pod length (9.90 cm) and 1000 seed weight (12.38 g) which was at par with vermicompost 4 t/ha and increases to a tune of 14.82%, 8.19%, 13.02% and 20.20% as compared to control, respectively (Table 2). Seed yield, straw yield and biological yield increased significantly with increasing levels of vermicompost up to 4.0 t/ha. It means that the increased dose of vermicompost above 4.0 t/ha has no effect on yield attributes of fenugreek. Application of vermicompost 4.0 t/ha significantly increased seed yield (16.83 q/ha), straw yield (32.50 q/ha) and biological yield (20.14 q/ha) to the tune of 45.08, 10.32 and 20.14% over control on two years average basis, respectively.

The beneficial role of vermicompost may probably be due to native and its own nutrient content and providing uninterrupted supply of macro and micro

TABLE 1
Effect of vermicompost and phosphorus levels on phenological characteristics of fenugreek varieties (Pooled data of two years)

| Treatments | Plant height (cm) | | | | Dry matter accumulation/ plant (g) | | | | Crop growth rate ($g/m^2$/day) | | | | Branches/ plant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 120 DAS | 30 DAS | 60 DAS | 90 DAS | 120 DAS | 1-30 DAS | 31-60 DAS | 61-90 DAS | 91-120 DAS | |
| **Variety** | | | | | | | | | | | | | |
| $V_1$ : HM- 57 | 1.71 | 9.21 | 30.16 | 45.65 | 0.05 | 2.95 | 7.68 | 15.93 | 0.06 | 4.03 | 6.57 | 11.47 | 3.91 |
| $V_2$ : HM- 103 | 1.73 | 9.62 | 30.88 | 46.08 | 0.05 | 3.09 | 7.94 | 16.45 | 0.06 | 4.23 | 6.84 | 11.83 | 4.15 |
| C. D. ($p \leq 0.05$) | NS | 0.12 | 0.27 | 0.37 | NS | 0.10 | 0.14 | 0.30 | NS | 0.12 | 0.18 | 0.29 | 0.14 |
| **Vermicompost** | | | | | | | | | | | | | |
| $C_0$ : Control | 1.65 | 8.35 | 28.22 | 41.62 | 0.05 | 2.66 | 6.49 | 14.30 | 0.06 | 3.69 | 5.26 | 10.86 | 3.66 |
| $C_1$ : 3.0 t/ha | 1.72 | 8.81 | 30.40 | 44.16 | 0.05 | 2.84 | 7.47 | 16.28 | 0.06 | 3.85 | 6.48 | 10.85 | 3.91 |
| $C_2$ : 4.0 t/ha | 1.74 | 10.10 | 32.05 | 47.53 | 0.05 | 3.19 | 8.56 | 17.44 | 0.06 | 4.37 | 7.39 | 12.35 | 4.17 |
| $C_3$ : 5.0 t/ha | 1.77 | 10.32 | 32.40 | 47.86 | 0.05 | 3.37 | 8.71 | 17.75 | 0.06 | 4.62 | 7.42 | 12.56 | 4.30 |
| C. D. ($p \leq 0.05$) | NS | 0.17 | 0.36 | 0.53 | NS | 0.15 | 0.19 | 0.44 | NS | 0.20 | 0.35 | 0.54 | 0.15 |
| **Phosphorus** | | | | | | | | | | | | | |
| $P_0$ : Control | 1.65 | 8.46 | 28.05 | 39.58 | 0.05 | 2.63 | 6.35 | 14.04 | 0.06 | 3.63 | 5.14 | 10.67 | 3.63 |
| $P_1$ : 20 kg/ha | 1.70 | 8.96 | 30.30 | 44.60 | 0.05 | 2.86 | 7.52 | 16.29 | 0.06 | 3.90 | 6.49 | 10.91 | 3.97 |
| $P_2$ : 40 kg/ha | 1.74 | 10.03 | 31.79 | 48.64 | 0.05 | 3.23 | 8.63 | 17.58 | 0.06 | 4.43 | 7.47 | 12.45 | 4.21 |
| $P_3$ : 60 kg/ha | 1.76 | 10.20 | 32.13 | 48.84 | 0.05 | 3.29 | 8.73 | 17.79 | 0.06 | 4.57 | 7.50 | 12.59 | 4.26 |
| C. D. ($p \leq 0.05$) | NS | 0.14 | 0.24 | 0.48 | NS | 0.15 | 0.27 | 0.31 | NS | 0.21 | 0.42 | 0.55 | 0.11 |

Note : Interaction effects among variety, vermicompost and phosphorus levels were non significant.

TABLE 2
Effect of vermicompost and phosphorus levels on seed yield characteristics of fenugreek varieties (Pooled data of two years)

| Treatments | Number of pods/ plant | Number of seeds/ pld | Pod length (cm) | Test weight (g) | Seed yield (q/ha) | | | Straw yield (q/ha) | Biological yield (q/ha) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2013-14 | 2014-15 | Mean | | | |
| **Variety** | | | | | | | | | | |
| $V_1$ : HM- 57 | 41.21 | 14.71 | 9.41 | 11.64 | 15.23 | 14.20 | 14.72 | 31.51 | 46.23 | 32.52 |
| $V_2$ : HM- 103 | 41.74 | 15.21 | 9.91 | 12.14 | 15.79 | 15.15 | 15.47 | 32.49 | 47.95 | 32.63 |
| C. D. ($p \leq 0.05$) | 0.30 | 0.26 | 0.12 | N.S. | 0.33 | 0.21 | 0.27 | 0.58 | 0.77 | N.S. |
| **Vermicompost** | | | | | | | | | | |
| $C_0$ : Control | 38.36 | 14.23 | 8.76 | 10.24 | 12.20 | 11.00 | 11.60 | 29.46 | 41.06 | 32.34 |
| $C_1$ : 3.0 t/ha | 41.12 | 14.91 | 9.21 | 11.72 | 15.31 | 14.60 | 14.96 | 30.44 | 45.39 | 32.42 |
| $C_2$ : 4.0 t/ha | 43.87 | 15.28 | 9.80 | 12.20 | 17.00 | 16.66 | 16.83 | 32.50 | 49.33 | 32.73 |
| $C_3$ : 5.0 t/ha | 44.05 | 15.40 | 9.90 | 12.38 | 17.32 | 16.65 | 16.99 | 33.42 | 50.40 | 32.81 |
| C. D. ($p \leq 0.05$) | 0.42 | 0.37 | 0.16 | 0.38 | 0.47 | 0.41 | 0.43 | 0.82 | 1.09 | N.S. |
| **Phosphorus** | | | | | | | | | | |
| $P_0$ : Control | 38.19 | 14.01 | 8.85 | 11.26 | 14.48 | 13.38 | 13.93 | 28.59 | 42.67 | 32.29 |
| $P_1$ : 20 kg/ha | 41.07 | 14.72 | 9.33 | 12.10 | 15.00 | 13.55 | 14.28 | 31.26 | 46.44 | 32.49 |
| $P_2$ : 40 kg/ha | 44.09 | 15.33 | 9.92 | 12.21 | 16.08 | 15.99 | 16.04 | 33.31 | 49.16 | 32.68 |
| $P_3$ : 60 kg/ha | 44.39 | 15.39 | 10.02 | 12.35 | 16.21 | 16.01 | 16.11 | 33.46 | 49.57 | 32.84 |
| C. D. ($p \leq 0.05$) | 0.39 | 0.24 | 0.15 | 0.23 | 0.46 | 0.41 | 0.42 | 0.68 | 1.06 | N.S. |

Note : Interaction effects among variety, vermicompost and phosphorus levels were non significant.

nutrients during entire growing season in balanced form which promotes better photosynthetic activity and enhanced carbohydrate synthesis resulting higher seed yield and higher straw yield due to more plant height and number of branches. According to Choudhary *et al.*, (2011) application of vermicompost improve availability of nutrients in balanced form which reduces leaf senescence and lower assimilate demand which resulted in higher number of pods per plant, test weight and yield of fenugreek. Kumar *et al*. (2013) and Verma

TABLE 3
Effect of different levels of vermicompost, phosphorus and varieties on economics of fenugreek

| Treatments | Fixed cost (Rs.) | Treatment cost (Rs.) | Total cost (Rs.) | Gross return (Rs.) | Net return (Rs.) | Benefit to cost ratio |
|---|---|---|---|---|---|---|
| **Variety** | | | | | | |
| $V_1$ : HM- 57 | 29688 | 1200 | 30888 | 105984 | 75096 | 2.43 |
| $V_2$ : HM- 103 | 29688 | 1200 | 30888 | 111384 | 80496 | 2.61 |
| **Vermicompost** | | | | | | |
| $C_0$ : Control | 29688 | 1200 | 30888 | 83520 | 52632 | 1.70 |
| $C_1$ : 3.0 t/ha | 29688 | 10200 | 39888 | 107712 | 67824 | 1.70 |
| $C_2$ : 4.0 t/ha | 29688 | 13200 | 42888 | 121176 | 78288 | 1.83 |
| $C_3$ : 5.0 t/ha | 29688 | 16200 | 45888 | 122328 | 76440 | 1.67 |
| **Phosphorus** | | | | | | |
| $P_0$ : Control | 29688 | 1200 | 30888 | 100296 | 69408 | 2.25 |
| $P_1$ : 20 kg/ha | 29688 | 1855 | 31543 | 102816 | 71273 | 2.26 |
| $P_2$ : 40 kg/ha | 29688 | 2510 | 32198 | 115488 | 83290 | 2.59 |
| $P_3$ : 60 kg/ha | 29688 | 3165 | 32853 | 115992 | 83139 | 2.53 |

*et al*. (2014) also reported beneficial effect of vermicompost 4.0 t/ha on yield of fenugreek. Different levels of vermicompost have non significant effect on harvest index, however, harvest index increased with increasing levels of vermicompost.

**Effect of phosphorus :** A significant increase in yield and yield attributes was observed with increasing levels of phosphorus up to 40 kg/ha which was significantly at par with higher dose *i.e.*, 60 kg/ha. Application of phosphorus 40 kg/ha recorded significantly more number of pods per plant (44.09), number of seeds per pod (15.33), pod length (9.92 cm) and 1000 seed weight (12.21 g) at harvest. A significantly increase in seed yield (16.04 q/ha), straw yield (33.31 q/ha) and biological yield (49.16 q/ha) to the tune of 15.15, 15.90 and 15.21%, respectively, was recorded with the application of phosphorus 40 kg/ha over control.

Phosphorus play key role in energy transformation, root development, improved nitrogenase activity and various metabolic processes of plant which results increased yield in fenugreek. Availability of phosphorus results in increased fruiting and flowering that result in increasing number of pods per plant, better pod formation, therefore, higher yield attributes and yield. These results confirm the findings of Gour *et al*. (2009), Mehta *et al*. (2011), Godara *et al*. (2012) and Kumar *et al*. (2013) they observed significantly improved yield with application of phosphorus 40 kg/ha in fenugreek. Different levels of phosphorus have non significant effect on harvest index in fenugreek. Godara *et al*. (2012) also reported non significant effect of different organic and inorganic source of nutrients on harvest index.

## ECONOMICS

Different levels of vermicompost, phosphorus and fenugreek varieties influence the economics (Table 3). The mean values of two years data reveal that the variety HM-103 given higher gross return (Rs. 111384), net return (Rs. 80496) as well as benefit cost ratio (2.61) as compared to HM-57. This might be due to higher seed yield of HM-103. The increasing application of vermicompost and phosphorus increased the cost of cultivation but the corresponding increase in seed yield was most economical with application of vermicompost at 4 t/ha and phosphorus at 40 kg/ha, which gives the highest net return per hectare (Rs. 78288 and Rs. 83290) and benefit cost ratio (1.83 and 2.59), respectively.

## CONCLUSION

Therefore higher productivity and profitability of fenugreek, variety HM-103 is recommended along with the application of vermicompost 4 t/ha and phosphorus 40 kg/ha.

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