Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
JPP 2018; 7(3): 2420-2424
Received: 05-03-2018
Accepted: 10-04-2018

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# Effect of organics on growth, yield, quality and economics of fenugreek (*Trigonella foenum-graecum* L.) grown under organic farming system

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**Abstract**
A field experiment was conducted at certified organic farm, Navsari Agricultural University, Navsari during *rabi* season of 2016-2017 to study the effect of organics on growth, yield, quality and economics of fenugreek. Among the solid organics, application of NADEP compost @ 5 t ha$^{-1}$ recorded significantly higher plant height, number of branches plant$^{-1}$, green biomass, number of pods plant$^{-1}$, number of seeds pod$^{-1}$, test weight, protein content in seeds, seed and straw yield and was found statistically at par with application of vermicompost @ 2.5 t ha$^{-1}$. In liquid organics, significantly higher plant height, number of branches plant$^{-1}$, green biomass, number of pods plant$^{-1}$, number of seeds pod$^{-1}$, test weight, seed yield, straw yield and protein content in seeds were obtained with the soil application of enriched banana pseudostem sap @ 5 L ha$^{-1}$ and statistically remained at par with treatment receiving *panchagvya* @ 20 L ha$^{-1}$. In case of interaction, the combined application of NADEP compost @ 5 t ha$^{-1}$ and enriched banana pseudostem sap @ 5 L ha$^{-1}$ recorded significantly higher fenugreek seed and straw yield. From the economic point of view, combined application of NADAP compost @ 5 t ha$^{-1}$ and enriched banana pseudostem sap @ 5 L ha$^{-1}$ resulted the maximum net profit of Rs. 72746 ha$^{-1}$ with BCR of 2.28 followed by treatment combination of vermicompost @ 2.5 t ha$^{-1}$ and enriched banana pseudostem sap @ 5 L ha$^{-1}$ with net profit of Rs.70597 ha$^{-1}$ and BCR of 2.27.

**Keywords:** solid organics, liquid organics, growth, yield, quality and economics

## Introduction
Fenugreek (*Trigonella foenum-graecum* L.) locally known as 'methi' belonging to the family-Leguminosae and Sub family-Papilionacea is widely used as spice and condiment to add flavour in various foods (Dwivedi *et. al.*, 2006) [7]. Fenugreek is the third highest important seed spice in India (after coriander and cumin). Rajasthan and Gujarat are the main fenugreek producing states in India. In India, the area under fenugreek is about 90,500 hectare with an annual production of 1, 10, 530 tonnes (Source: Cardamoms: Estimate by Spices Board, Calicut, 2014-15). Gujarat is the leading state in fenugreek production and it grows mainly in Mehsana, Patan, Sabarkantha, Banaskantha and Kheda districts. The average productivity of fenugreek in the country seems to be very low (1215 kg ha$^{-1}$) which required to be increased (Lal *et al.*, 2015) [18]. Fenugreek's fresh tender leaves are also taken as vegetable which are rich in iron, calcium, vitamins and essential amino acid. The seeds contain protein, alkaloid trigonelline (bitter taste), choline, fatty oil, water, mineral matter, carbohydrate, calcium, phosphorus, fiber, iron and vitamins (Habib *et al*., 1971) [10]. The seed is bitter in taste due to presence of alkaloid known as "Trigonelline" which is considered as basic material for the synthesis of cellulose, hemicelluloses and amino acids. Its roots are endowed with mini factory to synthesize nitrogen for plant. Thus, its cultivation enriches the soil in nitrogen. The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable food production. The excessive use of agro-chemicals for the last few years resulted in soil degradation, ground water and environmental pollution leading to ecological imbalances. In this context, a keen awareness has to be created on the adoption of organic farming as a remedy to maneuver the ill effects from chemical farming. Many studies showed that organic nutrients could enhance the vegetative growth and yield of seed spices like fennel (Darzi *et al.*, 2008) [4] and coriander (Lal and Singh, 2016) [16]. Recent trends in agriculture are centered on reducing the use of inorganic fertilizers by organic manures and biofertilizers (Gyaneshwar *et al.*, 2002 and Darzi *et al.*, 2011) [9, 5]. Different organic sources also play an important strategy in order to improve the biological, chemical and physical conditions of the soil, acquiring each time greater importance not only for the yields usually reached but also for the economic application and contribution to environment protection. In view of better growth,

yield, quality and more economic returns of fenugreek gain by adopting organic farming system the present study was carried out to find out the effect of organics on growth, yield, quality and economics of fenugreek.

## Materials and Methods

A field experiment was carried out at Organic Farm, Navsari Agricultural University, Navsari during *rabi* season of 2016-17. The experimental soil had pH 7.78 and electrical conductivity 0.44 dS $m^{-1}$. The soil was medium in organic carbon (0.79%), available nitrogen (258.12 kg $ha^{-1}$), available $P_2O_5$ (45.58 kg $ha^{-1}$) and available $K_2O$ (273.52 kg $ha^{-1}$). The experiment was laid out in factorial randomized block design with three replications. There were twelve treatment combinations consisting of three levels of solid organics ($S_0$: Control, $S_1$: NADEP compost @ 5 t $ha^{-1}$ and $S_2$: Vermicompost @ 2.5 t $ha^{-1}$) and four levels of liquid organics ($L_0$: Control, $L_1$: *Panchagavya* @ 20 L $ha^{-1}$, $L_2$: *Jeevamrut*a @ 200 L $ha^{-1}$, $L_3$: Banana pseudostem sap @ 5 L $ha^{-1}$). The solid organics were applied one day before sowing and liquid organics were incorporated in soil by drenching as per treatments. Chemical compositions of solid and liquid organics are given in Table 1 and Table 2. The fenugreek variety Gujarat Methi-2 was sown manually at 30 cm row to row spacing keeping seed rate of 20 kg $ha^{-1}$. Standard agronomic practices were adopted for raising healthy crop. Observations were recorded on five tagged plants in each treatment for growth and yield attributes. Net returns of each treatment were calculated by deducting the total cost of cultivation from the gross return. The Benefit Cost Ratio (BCR) was calculated by dividing gross returns with cost of cultivation. The collected data for various parameters were statistically analysed using Fisher's analysis of variance (ANOVA) technique and the treatments were compared at 5% level of significance.

## Result and Discussion

### Effect of solid organics

**Growth attributing characters:** Results regarding germination percentage in fenugreek did not show significant effect with the application of solid organics. The application of NADEP compost @ 5 t $ha^{-1}$ ($S_1$) showed significantly higher plant height (8.86 cm and 35.26 cm), number of branches $plant^{-1}$ (3.13 and 6.56**)** and yield of green biomass (1521 kg $ha^{-1}$ and 4090 kg $ha^{-1}$) at 30 and 60 DAS, respectively and remained at par with application of vermicompost @ 2.5 t $ha^{-1}$ (Table 3). The increase in growth attributing characters might be due to ideal C:N ratio of NADEP compost with comparatively higher nitrogen content. Addition of organic manure also enhanced soil structure which reduced the soil crusting and provide better soil environment for plant growth. These results are in conformity with the findings of Singh *et al.* (2015) [28], Naikwade *et al.* (2011) [19] and Vedpathak (2016) [31].

**Yield and yield attributes:** Application of solid organics *viz;* NADEP compost @ 5 t $ha^{-1}$ significantly affected on number of pods $plant^{-1}$(29.06), number of seeds $pod^{-1}$(14.75), test weight (12.43 g), seed yield (1137 kg $ha^{-1}$) and straw yield (2049 kg $ha^{-1}$) of fenugreek and stood statistically at par with the application of vermicompost @ 2.5 t $ha^{-1}$ (Table 4). Pawar and Tambe (2012) [25] indicating the enhanced plant vigor growth due to higher level of organic inputs which were found to be useful in increasing photosynthetic activities and there by accumulation of more carbohydrates and higher dry matter with higher levels of organic inputs. These growth attributes are also in accordance with the finding of Naikwade *et al.* (2011) [19], Kumar *et al.* (2014) [15], Agarwal *et al.* (2012) [1] and Vedpathak, (2016) [31].

**Quality:** Application of solid organics were failed to show any significant effect on fiber content of fenugreek seed. In case of protein content application of NADEP compost @ 5 t $ha^{-1}$ recorded significantly higher protein content (17.46%) in fenugreek seed (Table 4). Nitrogen is the major constituent of protein and inclusion of N rich NADEP compost enhanced significantly N content in seed which might have increased seed protein content of fenugreek. The results are in close conformity with those of Paikra and Dwivedi (2012) [21], Tak *et al.* (2014) [30] and Khan *et al.* (2008) [12].

### Effect of liquid organics

**Growth attributing characters:** Soil application of liquid organics didn't show any significant effect on germination per cent of fenugreek but significantly affected plant height (8.80 cm and 36.13 cm), number of branches $plant^{-1}$ (3.14 and 6.47**)** and yield of green biomass (1504 kg $ha^{-1}$ and 3954 kg $ha^{-1}$) at 30 and 60 DAS, respectively with the application of enriched banana pseudostem sap @ 5 L $ha^{-1}$ ($L_3$) and remained at par with the *panchgavya* @ 20 L $ha^{-1}$ ($L_1$) and *jeevamruta* @ 200 L $ha^{-1}$ ($L_2$) (Table 3). The conspicuous impact of liquid organics on growth attributes of fenugreek might be due to their rapidly available form of nutrients, which are easily absorbed, leading to faster growth and development of fenugreek components. Fermented liquid organic manures contain macro and micro-nutrients, many vitamins, essential amino acids, numerable microorganism and growth promoting substances like IAA, GA *etc*. (Palekar, 2006; Natarajan, 2007 and Sreenivasa *et al.*, 2010) [22, 20, 29] which help in improving plant growth, metabolic activity and resistance to pest and diseases. Similar results were also obtained by Gore and Sreenivasa (2011) [8], Satashiya *et al.* (2012) [26], Patil *et al.* (2013) [24] and Jondhale *et al.* (2014) [11].

**Yield and yield attributes:** Soil application of enriched banana pseudostem sap @ 5 L $ha^{-1}$ produced significantly higher number of pods $plant^{-1}$ (29.03), number of seeds $pod^{-1}$ (14.80), test weight (12.10 g), seed yield (1093 kg $ha^{-1}$) and straw yield (1987 kg $ha^{-1}$) of fenugreek which stood at par with treatment panchagvya @ 20 L $ha^{-1}$ (Table 4). Banana pseudostem sap, *panchagvaya* and *jeevamruta* are rich source of several plant essential nutrients hence soil application of this liquid organics provides balance nutrition to the crop. Growth hormones present in these liquid organic manures helps in root development, mineral absorptions, photosynthesis and ultimately crop yield and easy assimilation of nutrients supplied through liquid organics to the crop. Devakumar *et al*. (2011) also reported that both *jeevamrut*a and *panchgavya* have enhanced the growth of nitrogen fixers in locally available substrates such as FYM, pressmud, compost and digested biogas slurry. Similar findings were also reported by Kumar *et al.* (2011) [14], Kumar *et al*. (2012) [13], Choudhary *et al.* (2013) [33] and Shinde *et al.* (2015) [27].

**Quality:** Soil applied liquid organics didn't show significant effect of fiber content in fenugreek seeds but soil application of enriched banana pseudostem sap @ 5 L $ha^{-1}$ ($L_3$) gained significantly higher seed protein content (17.11%) and

statistically remained at par with treatment receiving *panchagvya* @ 20 L ha$^{-1}$ (Table 4). The improvement in protein content might be attributed due to higher uptake of nitrogen during growth period which increased photosynthesis, synthesis of protoplasm and protein. These finding are in general agreement with the experimental results of Patil *et al*. (2012) [23] and Shinde *et al.* (2015) [27].

**Interaction effect**

The combined application of NADEP compost @ 5 t ha$^{-1}$ and enriched banana pseudo stem sap @ 5 L ha$^{-1}$ ($S_1L_3$) recorded significantly higher fenugreek seed and straw yield and was found statistically at par with treatment combination $S_1L_1$, $S_1L_2$, $S_2L_1$, $S_2L_2$ and $S_2L_3$ (Table 5). The combined application of solid and liquid organics in soil enhance the rate of mineralization due to solubilizing effect of liquid organics on solid organics, resulted early and easily availability plant essential nutrient to crop. Liquid organics like banana pseudostem sap, *panchgavya, Jeevamruta etc*. promote the decomposition of solid organics and enhance plant growth due to presence of plant growth regulator, microbes, organic acid *etc*. in liquid organics. Similar trends were also reported by Kumar *et al.* (2012) [13], Patil *et al.* (2012) [23], Laharia *et al.* (2013) [16] and Anuja and Vijayalakshmi (2014) [2].

**Economics:** Economic benefit is the ultimate goal for crop growers. The economics in terms of gross and net returns for the different solid and liquid organics were worked out and presented in Table 6. Combined application of NADAP compost @ 5 t ha$^{-1}$ ($S_1$) and enriched banana pseudostem sap @ 5 L ha$^{-1}$ ($L_3$) resulted the maximum net profit of Rs. 72746 ha$^{-1}$ with BCR of 2.28 followed by $S_2L_3$ treatment with net profit of Rs.70597 ha$^{-1}$ with BCR of 2.27 (Table 6). Thus, combine application of these two combinations were found economical, profitable and proved higher remunerative. Similar economics were obtained by Singh and Kushwah (2006) [34], Singh *et al.* (2011) [35], Biswas *et al*. (2012) [32], Chaudhari *et al.* (2013) and Salunkhe *et al*. (2013) [36].

**Table 1:** Chemical compostion of solid organics

| Manure | TOC | N | P | K | S | Fe | Mn | Zn | Cu |
|---|---|---|---|---|---|---|---|---|---|
| | (%) | | | | | ( mg kg$^{-1}$) | | | |
| NADEP compost | 19.06 | 1.12 | 0.78 | 1.36 | 0.67 | 1188 | 96 | 42 | 25 |
| Vermicompost | 20.1 | 1.09 | 0.65 | 1.4 | 0.55 | 1550 | 97 | 35 | 12 |

**Table 2:** Chemical compostion of liquid organics

| Liquid organic | N | P | K | Fe | Mn | Zn | Cu |
|---|---|---|---|---|---|---|---|
| | (mg L$^{-1}$) | | | | | | |
| *Panchagavya* | 1000 | 175 | 194 | 29 | 0.87 | 0.68 | 0.05 |
| *Jeevamruta* | 770 | 166 | 53 | 79 | 4.00 | 2.60 | 1.30 |
| Enriched b. sap | 8570 | 175 | 1150 | 44 | 14.5 | 4.61 | 0.8 |

**Table 3:** Effect of solid and liquid organics on growth attributes of fenugreek

| Treatment | Germination (%) | Plant height (cm) | | No. of branches plant$^{-1}$ | | Green biomass (kg ha$^{-1}$) | |
|---|---|---|---|---|---|---|---|
| | | 30DAS | 60DAS | 30DAS | 60 DAS | 30 DAS | 60DAS |
| **Solid organics (S)** | | | | | | | |
| $S_0$ | 83 | 6.78 | 26.47 | 2.32 | 5.02 | 916 | 2910 |
| $S_1$ | 91 | 8.86 | 35.26 | 3.13 | 6.56 | 1521 | 4090 |
| $S_2$ | 87 | 8.84 | 33.80 | 2.91 | 6.34 | 1415 | 3925 |
| S.Em. (±) | 3.92 | 0.29 | 1.67 | 0.16 | 0.24 | 62.27 | 135.16 |
| CD at 5% | NS | 0.84 | 4.89 | 0.47 | 0.71 | 182.63 | 396.40 |
| **Liquid organics (L)** | | | | | | | |
| $L_0$ | 84 | 7.43 | 28.14 | 2.37 | 5.37 | 1103 | 3346 |
| $L_1$ | 89 | 8.50 | 32.59 | 2.99 | 6.27 | 1329 | 3728 |
| $L_2$ | 85 | 7.91 | 30.52 | 2.65 | 5.79 | 1200 | 3538 |
| $L_3$ | 92 | 8.80 | 36.13 | 3.14 | 6.47 | 1504 | 3954 |
| S.Em. (±) | 4.52 | 0.33 | 1.93 | 0.19 | 0.28 | 71.90 | 156.07 |
| CD at 5% | NS | 0.97 | 5.65 | 0.54 | 0.82 | 210.88 | 457.72 |
| **Interaction (S X L)** | | | | | | | |
| S.Em. (±) | 7.84 | 0.57 | 3.33 | 0.32 | 0.48 | 124.54 | 270.31 |
| CD at 5% | NS | NS | NS | NS | NS | NS | NS |
| CV % | 15.53 | 12.12 | 18.14 | 19.96 | 14.01 | 16.80 | 12.86 |

**Table 4:** Effect of solid and liquid organics on yield attributes, yield and quality of fenugreek

| Treatment | Number of pods plant$^{-1}$ | Number of seeds pod$^{-1}$ | Test Weight (g) | Seed yield | Straw yield | Protein content | Fiber |
|---|---|---|---|---|---|---|---|
| | | | | (kg ha $^{-1}$) | | (%) | |
| **Solid organics (S)** | | | | | | | |
| $S_0$ | 22.72 | 10.89 | 9.20 | 788 | 1432 | 14.47 | 7.48 |
| $S_1$ | 29.06 | 14.75 | 12.43 | 1137 | 2049 | 17.46 | 7.65 |
| $S_2$ | 28.48 | 14.26 | 11.95 | 1083 | 2005 | 16.72 | 7.64 |
| S.Em. (±) | 1.01 | 0.54 | 0.36 | 29.20 | 47.24 | 0.18 | 0.05 |
| CD at 5% | 2.97 | 1.59 | 1.06 | 85.64 | 138.56 | 0.54 | NS |
| **Liquid organics (L)** | | | | | | | |
| $L_0$ | 24.14 | 11.86 | 9.97 | 837 | 1533 | 15.00 | 7.52 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_1$ | 27.56 | 13.48 | 11.80 | 1067 | 1950 | 16.50 | 7.61 |
| $L_2$ | 26.29 | 13.07 | 10.91 | 1012 | 1846 | 16.23 | 7.56 |
| $L_3$ | 29.03 | 14.80 | 12.10 | 1093 | 1987 | 17.11 | 7.66 |
| S.Em. (±) | 1.17 | 0.63 | 0.42 | 33.72 | 54.55 | 0.21 | 0.06 |
| CD at 5% | 3.43 | 1.84 | 1.23 | 98.88 | 160.00 | 0.62 | NS |
| **Interaction (S X L)** | | | | | | | |
| S.Em. (±) | 2.03 | 1.09 | 0.73 | 58.40 | 94.49 | 0.37 | 0.11 |
| CD at 5% | NS | NS | NS | 171.27 | 277.13 | NS | NS |
| CV % | 13.11 | 14.15 | 11.24 | 10.09 | 8.95 | 3.94 | 2.43 |

**Table 5:** Interaction effect of solid and liquid organics on seed and straw yield of fenugreek

| Solid organics / Liquid organics | Seed yield (kg ha$^{-1}$) | | | Straw yield (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|
| | **$S_0$** | **$S_1$** | **$S_2$** | **$S_0$** | **$S_1$** | **$S_2$** |
| **$L_0$** | 776 | 925 | 811 | 1390 | 1652 | 1556 |
| $L_1$ | 794 | 1211 | 1196 | 1458 | 2218 | 2173 |
| $L_2$ | 784 | 1153 | 1098 | 1409 | 2079 | 2050 |
| $L_3$ | 797 | 1258 | 1225 | 1470 | 2247 | 2243 |
| S.Em. (±) | 58.40 | | | 94.49 | | |
| CD at 5% | 171.27 | | | 277.13 | | |
| CV % | 10.09 | | | 8.95 | | |

**Table 6:** Effect of solid and liquid organics on economics of fenugreek

| Treatment | Yield (kg ha$^{-1}$) | | Gross return (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net return (Rs ha$^{-1}$) | BCR |
|---|---|---|---|---|---|---|
| | Seed | Straw | | | | |
| $S_0L_0$ | 776 | 1390 | 78957 | 41396 | 37561 | 1.91 |
| $S_0L_1$ | 794 | 2050 | 81417 | 41996 | 39421 | 1.94 |
| $S_0L_2$ | 784 | 1992 | 80425 | 41996 | 38429 | 1.92 |
| $S_0L_3$ | 797 | 2492 | 82225 | 41896 | 40329 | 1.96 |
| $S_1L_0$ | 925 | 2740 | 95273 | 56396 | 38877 | 1.69 |
| $S_1L_1$ | 1211 | 3276 | 124376 | 56996 | 67380 | 2.18 |
| $S_1L_2$ | 1153 | 3099 | 118399 | 56996 | 61403 | 2.08 |
| $S_1L_3$ | 1258 | 3875 | 129642 | 56896 | 72746 | 2.28 |
| $S_2L_0$ | 811 | 2564 | 83697 | 55146 | 28551 | 1.52 |
| $S_2L_1$ | 1196 | 3137 | 122737 | 55746 | 66992 | 2.20 |
| $S_2L_2$ | 1098 | 2774 | 112608 | 55746 | 56862 | 2.02 |
| $S_2L_3$ | 1225 | 3742 | 126243 | 55646 | 70597 | 2.27 |

## Conclusion

Based on the results of the experimentation, application of NADAP compost @ 5 t ha$^{-1}$ or vermicompost @ 2.5 t ha$^{-1}$ along with soil application of enriched banana pseudostem sap @ 5 L ha$^{-1}$ increased growth, yield, quality and economics of fenugreek under organic farming system in South Gujarat condition.

## References


1. Agarwal A, Vishwanath, Singh D. Evaluation of composts made through different methods on vegetable pea. Pantnagar Journal of Research. 2012; 10(1).
2. Anuja S, Vijyalakshmi CN. Effect of organic nutrients on growth and yield of vegetable cowpea. The Asian Journal of Horticulture. 2014; 9(1):136-139.
3. Choudhary KM, Patel MM, Pagar RD. Effect of foliar application of panchagavya and leaf extracts of endemic plants on groundnut (*Arachis hypogaea* L.). Legume Research. 2013; 37(2):223-226.
4. Darzi MT, Ghalavand A, Rejali F. Effect of mycorrhiza, vermicompost and phosphate biofertilizers application on flowering, biological yield and root colonization in fennel (*Foeniculum vulgare* L). Iranian Journal of Crop Science. 2008; 10:88-109.
5. Darzi MT, Haj S, Hadi MR, Rejali F. Effect of vermicompost and phosphate bio-fertilizer application on yield and yield components in Anise (*Pimpinella anisum* L.) Iranian Journal of Medicinal and Aromatic Plants. 2011; 4:452-465.
6. Devakumar NS, Shubha GG, Rao E, khan I. Studies on soil fertility, cow urine and panchagavya levels on growth and yield of maize. Building organic Brigdes at the organic world congress. Istanbul, Turkey. 2014, 1-4.
7. Dwivedi AK, Singh S, Ranjan R. Suitable varieties of fenugreek for Jharkhand spices and medicinal and Aromatic plants in eastern region, 2006, 95-101.
8. Gore NS, Sreenivasa MN. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. Karnataka Journal of Agricultural Science. 2011; 24(2):153-157.
9. Gyaneshwar P, Kumar NG, Parekh LJ, Poole PS. Role of soil microorganisms in improving P nutrition of plants. Plant. Soil. 2002; 245:83-93.
10. Habib AF, Swamy RJ, Menskai SN. Salt tolerance in methi at germination stage. Current Science. 1971, 40-67.
11. Jondhale DG, Kolambe BN, Shinde RD. Performance of organic rice grown over application of different organic sources with reference to growth parameters in south Gujarat. Trends in Bioscience. 2014; 7(23):3908-3910.
12. Khan HZ, Malik MA, Saleem MF. Effect of rate and source of organic material on the production potential of spring maize *(Zea mays* L.). Pakistan J Agric. Sci. 2008; 45(1):40-43.
13. Kumar HSR, Janakiraman N, Sheshadri T, Gowda JV, Mahantesh V. Integrated organic nutrient supply systems on growth and yield of groundnut (*Arachis hypogaea* L.). Environment & Ecology. 2012; 30(1):118-121.

14. Kumar RS, Ganesh P, Tharmaraj K, Saranraj P. Growth and development of black gram (*Vigna mungo*) under foliar application of Panchagavya as organic source of nutrient. Current Botany, 2011; 2(3):09-11.
15. Kumar V, Kumar A, Singh MK, Singh B. Effect of different NADEP composts on growth and yield of dolichos bean (*Dolichos lablab* L.). Annals of Horticulture. 2014; 7(2):173-175
16. Laharia GS, Patil DU, Damre PK. Effect of organic sources on fertility, nutrient uptake and yield of soybean. Crop Research. 2013; 45(1-3):155-159.
17. Lal G, Singh R. Comprehensive evaluation of coriander (*Coriandrum sativum* L.) varieties under different organic modules. Indian Journal of Agricultural Sciences. 2016; 86:31-36.
18. Lal G, Singh B, Mehta RS, Singh R, Maheria SP. Performance of fenugreek (*Trigonella foenum-graecum* L.) as influenced by sulphur and zinc. International Journal of Seed Spices. 2015; 5:29-33.
19. Naikwade PV, Mogle U, Jadhav B. Comparative study of aerobic and anaerobic composts prepared from autumn leaves on *Zea mays* L. Science Research Reporter. 2011; 1(2):77-82.
20. Natarajan K. Panchagavya for plant. *Proc. National Conference Glory Gomatha*, Dec. 1-3, 2007, S. V. Veterinary Univ., Tirupati, 2007, 72-75.
21. Paikra PR, Dwivedi S. Effect of different agro-input management practices on growth, yield and nutrient of urdbean varieties in Chhattisgarh plains. Current Advances in Agricultural Sciences. 2012; 4(1):67-71.
22. Palekar S. Shoonya bando valada naisargika krushi, published by Swamy Anand *Agni Prakashana*, Bangalore, India, 2006.
23. Patil DU, Laharia GS, Damre PR. Effect of different organic sources on biological properties of soil, nutrient uptake, quality and yield of soybean. An Asian Journal of Soil Science. 2012; 7(2):190-193.
24. Patil TD. Effect of rates of castor cake and banana pseudostem sap on yield and quality of organically grown garlic. Ph. D. thesis submitted to NAU, Navsari (unpublished), 2013.
25. Pawar VR, Tambe AD. Response of sweet corn, sugar-75 to different organic sources. Advance. Research journal of crop improvement. 2012; 3(2):122-125.
26. Satashiya KF. Effect of different levels of banana pseudostem sap and fertilizer on yield and nutrient uptake by leafy vegetables grown under shade net house and open field condition. M. Sc. thesis submitted to NAU, Navsari, 2012.
27. Shinde RD, Parmar VP, Jondhale DG, Kolambe BN, Patel KG. Improvement in production and quality of wheat under organic nutrient management. *An* international Quality Journal of Life Science. 2015; 10(1):309-311.
28. Singh L, Gurjar PKS, Barholia AK, Haldar A, Shirivastva A. Effect of organic manures and inorganic fertilizers on growth and flower yield of marigold (*Tagetes erecta* L.) var. Pusa narangi gainda. Plant Archives. 2015; 15(2):779-783.
29. Sreenivasa MN, Naik NM, Bhat SN. Beejamruth: A source for beneficial bacteria. Karnataka Journal of Agricultural science. 2010; 17(3):72-77.
30. Tak S, Sharma SK, Reager ML. Effect of vermicompost and zink on yield attributes, yield and quality of greengram [*Vigna radiate* Var. *aureus* (L.) Wilczek] in arid western Rajasthan. International Journal of Agricultural Sciences. 2014; 10(1):138-141.
31. Vedpathak MM. Comparative studies on response of Maize (*Zea mays*) crop to organic and straight chemical fertilizers. International Journal of Research in Engineering and Applied Sciences. 2016; 6(9):93-98.
32. Biswas H, Narayan D, Lakaria BL. Effect of integrated nutrient management on soil properties and performance of aonla (*Emblica officinalis* Gaertn) based agri-horti system in Bundelkhand region. Indian Journal of Soil Conservation. 2012; 40(2):141-146.
33. Choudhary KM, Patel MM, Pagar RD. Effect of foliar application of panchagavya and leaf extracts of endemic plants on groundnut (*Arachis hypogaea* L.). Legume Research. 2013; 37(2):223-226.
34. Singh SP, Kushwah VS. Effect of integrated use of organic and inorganic sources of nutrients on potato. Indian Journal of Agronomy. 2006; 51(3):236-238.
35. Singh SP, Kushwah VS, Lal SS. Integrated nutrient management in black gram– potato–wheat sequence. Potato Journal. 2011; 38(2):170-175.
36. Salunkhe JR, Patel AM, Patil RG, Pisal RR. Effect of banana pseudostem sap as liquid fertilizer in onion. Indian Journal of Agricultuaral Research. 2013; 47(3):258-262