Evaluation of Bush Type French Bean Varieties through Organic Farming in South Chhotanagpur Plateau of Eastern India

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ABSTRACT

**Background:** French bean (Phaseolus vulgaris L.) is an important protein-rich winter vegetable of our country but extensively grown in south Chhotanagpur plateau of Jharkhand during both kharif and rabi seasons. However, indiscriminate uses of agrochemicals lead to production of poor quality pods of the crop due to residual toxicity. Hence, the current study was aimed to evaluate the performance of crop varieties under different organic growing conditions.

**Methods:** The present investigation was carried out by adopting five bush type varieties of French bean (V1: Arka Komal, V2: Swarna Priya, V3: HAFB-2, V4: HAFB-4 and V5: Falcon). They were grown independently under two growing conditions viz. organic farming (O) where FYM, vermicompost and Shasyagavya were used as organic inputs and absolute control (O) where no organic input was applied. These varieties were grown with their four replications in each of the experimental situate following RCBD experimental design. Different yield and its attributes and proximate quality traits were studied under both growing conditions for their evaluation.

**Result:** Findings revealed that most of the studied traits were influenced by organic growing condition with significant differences among varieties to pod length, pods per plant, pod weight, green pod yield, ascorbic acid, TSS and protein content. Consequently, the maximum green pod yield (17.55 t ha⁻¹) was estimated in HAFB-4 under organic growing condition as against 7.57 t ha⁻¹ under the absolute control condition. Different proximate quality traits were also expressed independently under different varietal situates but responded better under organic growing condition than its respective absolute control counterpart.

**Key words:** French bean, Organic farming, Quality, Yield.

INTRODUCTION

The eastern Indian plateau of Jharkhand is famous for its quality vegetable production. However, residual toxicity of indiscriminately using chemical inputs most specifically pesticides impedes the quality yield (Hill et al., 2018). Besides, high-cost chemical farming is not always affordable to most of the small and marginal growers of the region. The south Chhotanagpur plateau region has red laterite acidic soils with very low organic matter content and meagre water holding capacity. Organic farming, an environment friendly approach, has the capability to cope-up those constraints of adverse growing conditions and has the potential to produce superior quality yield with more profitability (Reganold and Wachter, 2016). Almost all experiments conducted on organic farming in our country emphasized on the utilization of biofertilizers along with different bulky organic manures which content very low plant nutrients. Hence, the requirement of those organic manures is quite high. Nevertheless, the non-availability of huge amount of bulky organic manures and poor economic condition of the farmers of this plateau region restrict the commercial scale organic cultivation of French beans. Through the present investigation, an attempt was taken to popularize organic farming by utilizing liquid organic manure ‘Shasyagavya’ which significantly reduced the quantity of bulky organic manure requirements. The liquid organic manures namely Panchagavya, Beejamrutha, Jeevamrutha, Shasyagavya, cow urine etc., when applied with bulky organic manures can release nutrients effectively as per the necessity of the crop to sustain greater productivity (Sornalath et al., 2018; Mahto and Dutta, 2018; Sutar et al., 2019). In this context, the current investigation focused on the application of liquid organic manure ‘Shasyagavya’ which can easily be prepared by the growers themselves with almost nil investment. Besides, this technique will be an alternative and a low-cost farming approach for the small and marginal farmers of the eastern Indian plateau, to produce comparatively less toxic pods of French beans. The performance of crop varieties depends on their growing...
environment as well as their genetic make-up. So, all varieties of the crop may not be equally responded under organic growing condition. Considering all the above aspects, the present investigation was carried out to identify suitable varieties of French bean under organic farming condition in the eastern Indian plateau of Jharkhand.

MATERIALS AND METHODS

Experimental site, season and crop sequence
The investigation was conducted in Organic Experimental Farm, Getalsud situated at 23°26'36"N latitude; 85°32'45"E longitude with the altitude of 508.0 m under the Faculty Centre for Agriculture, Rural and Tribal Development and Management of Ramakrishna Mission Vivekananda Educational and Research Institute, Ramakrishna Mission Ashrama, Ranchi during two successive rabi seasons of 2017-18 and 2018-19 following Okra-French bean-Amaranth crop sequence.

Experimental materials and organic crop husbandry
The performance of five bush type varieties of French bean viz. Vᵢ: Arka Komal; Vᵢ: Swarna Priya; Vᵢ: HAFB-2; Vᵢ: HAFB-4; and Vᵢ: Falcon were evaluated under organic farming condition and compared with the absolute control growing condition where no organic input was applied. As organic intervention (here denoted as, Oᵢ), FYM @ 3.0 t ha⁻¹ and vermicompost @ 1.0 t ha⁻¹ were incorporated with the experimental plots seven days before sowing and Shasyagavya (10%) @ 1.0 litre m⁻² was applied as soil drenching liquid organic manure five times at 15 days interval initiated after 15 days of sowing. As prophylactic plant protection measure, neem leaves extract (10%) was applied thrice at fortnightly interval started at 15 days after sowing. Yellow sticky traps @ one for every 10 m² area of the experimental plot were installed to check sucking pests. Against pathogenic infections, whey water was diluted three times with normal water and then mixed with turmeric powder @ 10 g per litre of diluted solution and finally it was applied thrice at 15 days interval commenced from 21 days after sowing. While under the absolute control growing condition (here denoted as, Oᵢ₀), no intervention was given.

Preparation of Shasyagavya
Shasyagavya, a liquid organic manure was prepared by mixing fresh cow dung: cow urine: kitchen waste: water @ 1: 1: 1: 2 proportions (cow dung and cow urine should be of indigenous cow’s origin) and kept the mixture for nine (9) days to ferment. The mixture was stirred by a wooden ladle clockwise and anticlockwise direction twice daily during the morning and evening hours. After nine (9) days of fermentation, the formulation of its 50% concentration was obtained (considering one part of cow urine against two parts of water) and required concentration was prepared by diluting with water concerning the formula, \( VᵢSᵢ = VᵢSᵢ \) (where, \( Vᵢ \) and \( Vᵢ \) represent the initial and final volume and \( Sᵢ \) and \( Sᵢ \) represent the initial and final strength, respectively).

Experimental design and seeding
Randomized Complete Block Design (RCBD) was adopted in conducting field experiment by incorporating five (5) varieties with their four (4) replications under two growing conditions (Oᵢ and Oᵢ₀) in forty (40) experimental plots each of 2.25 m x 2.25 m sizes. Seeds were treated with Rhizobium @ 20 g kg⁻¹ before sowing them at 45 cm inter row and 15 cm intra row spacing.

Observations recorded
As yield and its attributes, pod length (cm), number of green pods plant⁻¹, pod weight (g) and the green pod yield (t ha⁻¹) were taken time to time for the study. Similarly, several proximate quality attributes like dry weight (%), ascorbic acid (mg 100g⁻¹), TSS (°Brix) and protein content (%) from the edible portion of freshly harvested beans were estimated.Standard methodologies were adopted for estimation of dry weight [AOAC, 2008], ascorbic acid [Highet and West, 1942], TSS [by ERMA Hand Refractometer] and protein [by Kjeldahl Method] content of freshly harvested pods of different varieties.

Statistical analysis
Data on different yield and its attributes and proximate quality traits under both organic intervention (Oᵢ) and absolute control (Oᵢ₀) were analyzed as per the standard procedure for Analysis of Variance (Gomez and Gomez, 1984). The significance of varieties was tested by ‘F’ test and standard error of mean (SEm) was computed in all cases. The difference in the mean under different varietal situations was tested by using critical difference (CD) at 5% level of significance. The comparative performance between organic intervention (Oᵢ) and absolute control (Oᵢ₀) conditions was expressed as percentage change over the absolute control (Oᵢ₀) considering the pooled mean values. For interpretation of data both years pooled mean values were considered.

RESULTS AND DISCUSSION

Yield and its attributes
Pod length in different varieties greatly influenced by the application of organic manures and showed significant differences (P≤0.05) with the maximum pod length (14.50 cm) as recorded in HAFB-4 (Vᵢ) under organic intervention, whereas, it was only 8.93 cm for the same variety under absolute control growing condition. The pod length increased in all varietal situates under organic intervention culminated with the 44.50%–64.95% increase over the absolute control (Table 1). The increase in pod length may be associated with the availability of more plant nutrients along with the congenial growing environment under organic intervention. The organic amended in the form of Shasyagavya, vermicompost and FYM when added to the soil increases the availability of plant nutrients which may probably be due to presence of huge microbial population in liquid organic manure ‘Shasyagavya’ and their activity leads to better water holding capacity and consequently more availability of
Table 1: Per se performance of pod length and number of pods plant of French bean varieties as influenced by organic and by default organic growing conditions.

| Variety          | Pod length (cm) | Pods Plant | Percentage change over O0 100% | Pods Plant | Percentage change over O0 100% |
|------------------|-----------------|------------|-------------------------------|------------|-------------------------------|
| V-Arka Komal     | 9.81            | 12.07      | 47.70                         | 0.00       | 0.00                          |
| V-Swarna Priya   | 8.99            | 12.05      | 39.66                         | 0.00       | 0.00                          |
| V-HAFB-2         | 8.59            | 12.01      | 35.96                         | 0.00       | 0.00                          |
| V-Falcon         | 7.98            | 11.93      | 40.85                         | 0.00       | 0.00                          |
| V-Sem*           | 2.11            | 9.81       | 42.15                         | 0.00       | 0.00                          |

Annotations: NS: Non-significant; O0: Organic Intervention [(FYM @ 3.0 t ha\(^{-1}\) + Vermicompost @ 1.0 t ha\(^{-1}\) + Shasyagavya @10% Concentration @ 1.0 litre m\(^{-1}\) + Organic Plant Protection Measures] and O0: Absolute Control (without any intervention).

The pod length as documented in the present investigation corroborated well with the earlier findings of Mahadevaiah et al. (2011). Number of pods per plant recorded non-significant differences among varieties under both organic and absolute control growing condition. However, under organic intervention (O0), the number of pods per plant was higher than that of its absolute control (O0) growing counterpart (Table 1). Therefore, 34.46% to 44.43% more number of pods per plant was harvested from different studied varieties under organic intervention as compared to the absolute control. The greater number of pods per plant under organic growing condition may probably be due to obtainability of required plant nutrients from the favourable combination of liquid organic manure ‘Shasyagavya’ and bulky organic manures namely vermicompost and FYM. Similar trend of findings on number of pods per plant also recently documented by Gowthamchand et al. (2020) with the application of liquid organic manures in combination with the bulky organic manures.

Pod weight was greatly influenced by the application of organic sources of nutrients. The highest pod weight being recorded in HAFB-4 (7.00 g) under organic intervention (O0), while only 4.36 g in absolute control (O0) with 60.55% more weight as realized under organic growing condition (Table 2). The higher pod weight under organic growing condition in all varietal situations is the consequences of better growth and congenial growing environment. The findings on pod weight as recorded here closely confirmed by the earlier reports (Singh and Chauhan, 2009). All the studied yield and its attributes greatly influenced by the application of organic liquid and bulky manures and subsequently higher yield was recorded in all varieties under organic intervention than absolute control condition (Table 2). Green pod yield showed significant differences among varieties under both growing conditions culminated with the highest yield (17.55 t ha\(^{-1}\)) in HAFB-4 (V\(_4\)) while the lowest (15.40 t ha\(^{-1}\)) being recorded in Swarna Priya (V\(_1\)) under organic intervention. Absolute control growing condition, on the contrary, recorded the highest yield (7.86 t ha\(^{-1}\)) in Arka Komal (V\(_1\)) as against the lowest (7.46 t ha\(^{-1}\)) being recorded in Swarna Priya (Table 2). The organic growing condition recorded nearly 100% or more yield increment in different varieties than absolute control growing condition. This observation clearly indicated the feasibility of Shasyagavya, vermicompost and FYM on the expression of yield and its attributes of the crop varieties. As different yield and its attributes greatly influenced by the application of different sources of organic manures especially in the case of V\(_4\) (HAFB-4) hence the more yield was realized in this variety followed by V\(_1\) (Arka Komal) and V\(_2\) (HAFB-2). Quite lower level of the yield was estimated from those varieties of the crop under absolute control growing condition and this may be due to non-or reduced availability of plant nutrients. Several researchers reported that organic liquid manure in combination with vermicompost, FYM might have helped faster decomposition.
Table 2: Per se performance of pod weight and green pod yield of French bean varieties as influenced by organic and by default organic growing conditions.

| Variety          | Pod weight (g) | Green pod yield (t ha⁻¹) | 2017-18 | 2018-19 | Pooled |
|------------------|----------------|--------------------------|---------|---------|--------|
|                  | 2017-18 | 2018-19 | 2017-18 | 2018-19 | 2017-18 |
| Arka Komal       | 7.10     | 6.80     | 7.20     | 7.15     | 7.17    |
| Swarna Priya     | 4.11     | 4.29     | 4.11     | 4.30     | 4.21    |
| HAFB-2           | 4.49     | 4.13     | 4.38     | 4.38     | 4.36    |
| Falcon           | 4.32     | 4.39     | 4.40     | 4.40     | 4.40    |
| Shasyagavya      | 7.30     | 7.60     | 7.40     | 7.50     | 7.45    |
| Shasyagavya @10% | 6.60     | 6.60     | 6.60     | 6.60     | 6.60    |

Ascorbic acid content, on the other hand, decreased slightly in almost all varietal situates under organic intervention (O). Though significant differences being recorded under both growing conditions when pooled mean values of both years’ results were considered (Table 3). Under absolute control growing condition (O), the highest ascorbic acid (38.26 mg 100 g⁻¹) recorded in V₃ (Arka Komal) but it was 34.70 mg 100 g⁻¹ under organic intervention with 9.30% reduced level of ascorbic acid content as recorded in the same variety than those with absolute control growing condition (Table 3).

TSS content was greatly influenced by the application of organic manures and thereby higher TSS content was recorded in most of the varieties under organic intervention (O) than absolute control (O). The highest TSS (4.43°Brix) was recorded in V₃ (Swarna Priya) under organic intervention but it was estimated as 2.95°Brix in absolute control (Table 4). TSS content in different varieties increased 22.55% to 70.21% under organic growing condition over the absolute control.

Protein content in different varieties varies significantly under both growing conditions. Pooled mean values showed higher protein content in organically grown varieties with the highest (2.49%) in V₃ (Swarna Priya) but the lowest (1.86%) being estimated from V₅ (Falcon) (Table 4). Absolute control growing condition showed lower protein content than its respective organic growing counterpart. Therefore, 1.09% to 57.59% more protein synthesized in different varieties under organic growing condition than absolute control (Table 4).

Almost all studied quality attributes significantly influenced by the application of organic manures in the form of vermicompost, FYM and Shasyagavya. Liquid organic manure ‘Shasyagavya’ may provide huge number of microbial population in plant growing environment. Those
### Table 3: *Per se* performance of dry weight and ascorbic acid content of French bean varieties as influenced by organic and by default organic growing conditions.

| Variety       | Dry weight (%) | Ascorbic acid (mg 100g⁻¹) |
|---------------|----------------|-----------------------------|
|               | 2017-18 | 2018-19 | Pooled | Percentage | 2017-18 | 2018-19 | Pooled | Percentage |
|               | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     |
| V_1- Arka Komal | 7.84   | 8.40   | 6.37   | 8.38   | 7.10   | 8.39   | 18.17   | 37.88   | 34.39   | 35.00   | 38.26   | 34.70   | 38.64   | 34.39   | 35.00   | -9.30   |
| V_2-Swarna Priya | 6.37   | 8.00   | 5.88   | 7.58   | 6.12   | 7.79   | 27.23   | 34.54   | 39.39   | 39.09   | 37.50   | 35.00   | 36.36   | 34.54   | 39.39   | -1.81   |
| V_3-HAFB-2     | 6.37   | 7.60   | 5.88   | 8.23   | 6.12   | 7.92   | 29.36   | 33.18   | 39.39   | 33.48   | 37.50   | 33.48   | 37.50   | 33.48   | 37.50   | -11.12  |
| V_4-HAFB-4     | 7.84   | 9.07   | 4.90   | 7.23   | 6.37   | 8.15   | 28.04   | 35.64   | 36.36   | 36.48   | 36.36   | 36.48   | 36.36   | 36.48   | 36.36   | -1.93   |
| V_5-Falcon     | 6.37   | 8.27   | 4.90   | 7.62   | 5.63   | 7.95   | 41.21   | 35.61   | 34.17   | 36.36   | 37.12   | 36.36   | 37.12   | 36.36   | 37.12   | 4.32    |
| SEm±           | 0.32   | 0.28   | 0.45   | 0.40   | 0.20   | 0.26   | ...     | 1.77    | 0.79    | 6.19    | 2.76    | 0.50    | 0.70    | ...     | ...     |
| CD_p<0.05      | NS     | 0.57   | NS     | NS     | 0.43   | NS     | ...     | NS      | NS      | NS      | 1.10    | 1.52    | ...     | ...     | ...     |

Annotations: NS: Non-significant; O_i: Organic Intervention ([FYM @ 3.0 t ha⁻¹ + Vermicompost @ 1.0 t ha⁻¹ + Shasyagavya @10% Concentration @ 1.0 litre m⁻²] + Organic Plant Protection Measures] and O_o: Absolute Control (without any intervention).

### Table 4: *Per se* performance of TSS and protein content of French bean varieties as influenced by organic and by default organic growing conditions.

| Variety       | TSS (°Brix) | Protein (%) |
|---------------|-------------|-------------|
|               | 2017-18 | 2018-19 | Pooled | Percentage | 2017-18 | 2018-19 | Pooled | Percentage |
|               | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     | O_i     |
| V_1- Arka Komal | 2.03   | 3.22   | 2.67   | 4.77   | 2.35   | 4.00   | 70.21   | 1.69    | 2.16    | 2.00    | 2.76    | 1.85    | 2.46    | 32.97   | ...     |
| V_2-Swarna Priya | 2.40   | 3.12   | 3.50   | 5.74   | 2.95   | 4.43   | 50.17   | 1.49    | 2.18    | 1.67    | 2.80    | 1.58    | 2.49    | 57.59   | ...     |
| V_3-HAFB-2     | 2.93   | 3.10   | 2.73   | 5.01   | 2.83   | 4.06   | 43.46   | 1.93    | 1.95    | 2.03    | 2.48    | 1.98    | 2.22    | 12.12   | ...     |
| V_4-HAFB-4     | 2.27   | 3.06   | 3.30   | 4.90   | 2.78   | 3.98   | 43.17   | 1.96    | 1.86    | 1.87    | 2.34    | 1.91    | 2.10    | 9.59    | ...     |
| V_5-Falcon     | 2.93   | 3.20   | 3.80   | 5.05   | 3.37   | 4.13   | 22.55   | 2.02    | 1.94    | 1.66    | 1.77    | 1.84    | 1.86    | 1.09    | ...     |
| SEm±           | 0.51   | 0.23   | 0.35   | 0.15   | 0.15   | 0.11   | ...     | 0.03    | 0.01    | 0.07    | 0.03    | 0.07    | 0.10    | ...     | ...     |
| CD_p<0.05      | NS     | NS     | NS     | 0.32   | 0.33   | 0.25   | ...     | 0.06    | 0.02    | 0.14    | 0.06    | 0.16    | 0.21    | ...     | ...     |

Annotations: NS: Non-significant; O_i: Organic Intervention ([FYM @ 3.0 t ha⁻¹ + Vermicompost @ 1.0 t ha⁻¹ + Shasyagavya @10% Concentration @ 1.0 litre m⁻²] + Organic Plant Protection Measures] and O_o: Absolute Control (without any intervention).
microbes help to release nutrients from vermicompost and FYM. As a consequence, higher degrees of quality traits expression observed in organic growing environ.

Studies of Joshi et al. (2015) reported higher dry weight, more TSS and protein in plant growing environment supplemented with vermicompost. The more accessibility of available nitrogen from organic sources of manures enhanced higher quantity of protein synthesis in plant grown through organic intervention. The ranges of protein content as estimated in the present investigation corroborated closely with the earlier findings of Yadav (2015) where he stated 2.65%-3.09% protein content in green pods of Aparna, Arka Suvidha and Arka Sharath.

However, ascorbic acid content was recorded more under absolute control growing condition and this is obvious because under adverse growing condition especially under reduced level of nitrogen supply, accumulation of vitamin-C is induced (Woese et al., 1997). Protein synthesis in plants induces with the increasing supply of nitrogen but reduces the carbohydrate production under excessive nitrogen available condition. Because vitamin-C is made from carbohydrates, the synthesis of vitamin C is reduced likewise.

CONCLUSION
The findings revealed that organic intervention with liquid organic formulation 'Shasyagavya' to its 10% concentration in combination with vermicompost and FYM may be a suitable alternative to grow French beans organically for production of at least comparatively safer green pods. Not only the yield attributes and eventually the yield of French beans enhanced with the application of those organic manures but also the proximate quality parameters expressed positively and thus produced better quality green pods. In this context, V₁ (HAFB-4) followed by V₁ (Arka Komal) and V₂ (HAFB-2) emerged as good performing bush type varieties of French bean concerning expression of their yield and quality traits under organic growing condition. This low-cost organic production technology may therefore be recommended for commercial scale cultivation of HAFB-4, Arka Komal and HAFB-2 varieties of French bean to produce at least less toxic green pods in the south Chhotanagpur region of the eastern Indian plateau.

REFERENCES
AOAC. (2008). Official Methods of Analysis (17th Edn.). The Association of Official Analytical Chemists, Gaithersburg, MD, USA. Methods 925.10, 65.17, 974.24, 992.16.
Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research, 2nd Edition, John Wiley and Sons, New York, p. 680.
Gowthamchand, N.J., Ganapathi and Soumya, T.M. (2020). Effect of Bulky Manures and Fermented Liquid Organics on Growth, Yield, Nutrient Uptake and Economics of French Bean (Phaseolus vulgaris L.) Under Rainfed Condition. International Journal of Agriculture, Environment and Biotechnology. 13(1): 51-58.
Hight, D.M. and West, E.S. (1942). A procedure for the determination of ascorbic acid based upon the use of a standardized solution of 2,6-dichlorophenol indophenol in xylene. The Journal of Biological Chemistry. 146: 655-662.
Hill, J., Singh, S., Ranjan, P., Nishant, (2018). Technical Report - April 2018. Misuse of chemical pesticides in Jharkhand: What should be done? Ranchi: Society for Promotion of Wastelands Development (SPWD), Eastern Region Office. pp. 35-40.
Joshi, R., Singh, J. and Vig, A.P. (2015). Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth, yield and quality of plants. Reviews in Environmental Science and Bio/Technology. 14(1):137-159.
Kumar, R.P., Singh, O.N., Yogeshwar, S., Sachchidanand, D. and Singh, J.P. (2009). Effect of integrated nutrient management on growth, yield, nutrient uptake and economics of French bean (Phaseolus vulgaris). Indian Journal of Agricultural Sciences. 79(2): 122-128.
Mahadeviah, P., Hebbab, S.S. and Nair, A.K. (2011). Growth and yield of French bean (Phaseolus vulgaris L.) under organic farming. Journal of Applied Horticulture. 13(1): 71-73.
Mahto, S.K. and Dutta, A.K. (2018). Influence of different low-cost organic inputs on growth, yield and quality of French bean (Phaseolus vulgaris L.) cv. Swarna Priya. Indian Journal of Agricultural Research. 52(6): 661-665.
Reganold, J.P. and Wachter, J.M. (2016). Organic agriculture in the twenty-first century. Nature Plants. 2(2): 1-8.
Selvaraj, N. (2003). Report on the Work Done on Organic Farming at Horticulture Research Station, Tamil Nadu Agricultural University, Coty, India. pp. 2-5.
Sornalatha, S., Tamilarasi, M. and Esakkiammal, B. (2018). Efficacy of Organic Fertilizer on the Growth and Yield of (Luffa acutangula) Ridge Gourd Based on Cow Products. International Journal of Recent Research Aspects. 5 (Special Issue: Conscientious Computing Technologies, April-2018): 424-429.
Sutar, R., Sujith, G.M. and Devakumar, N. (2019). Growth and yield of Cowpea [Vigna unguiculata (L.) Walp] as influenced by jeevamrutha and panchagavya application. Legume Research-An International Journal. 42(6): 824-828.
Singh, N.I. and Chauhan, J.S. (2009). Response of French Bean (Phaseolus vulgaris L.) to Organic Manures and Inorganic Fertilizer on Growth and Yield Parameters Under Irrigated Condition. Nature and Science. 7(5):52-54.
Woese, K., Lange, D., Boess, C. and Bögl, K.W. (1997). A comparison of organically and conventionally grown foods-results of a review of the relevant literature. Journal of the Science of Food and Agriculture. 74(3): 281-293.
Yadav, B.V.S. (2015). Performance of Vegetable French Bean (Phaseolus vulgaris L.) as Influenced by Varieties and Sowing Dates under Southern Zone of Andhra Pradesh. PhD Dissertation, Dr. Y.S.R. Agricultural University, Y.S.R. District andhra Pradesh.