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A study on the effect of different organic supplements on the ascorbic acid and riboflavin content of French bean (*Phaseolus vulgaris*)

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Abstract: Vegetables are a rich source of nutrients. Fresh vegetables like French beans (*Phaseolus vulgaris*) are known for their high protein content, fibre, water and mineral composition. They are also good source of vitamins like Ascorbic acid and Riboflavin and minerals like calcium and phosphorus. In view of the growing awareness regarding health the French beans are recommended for regular diet as vegetable proteins. However the demand for these vegetables is high when they are produced organically. An experiment to study the role of organic supplements like kitchen waste vermicompost, jeevamrutha, panchagavya and mulching on the ascorbic acid and riboflavin content of French beans was conducted at Kothavaripalli village, Madanapalle mandal of Chittoor district. Household kitchen waste was converted to vermicompost by employing *Eisenia foetida* variety of earthworms. Jeevamrutha was prepared by the procedure laid by Subash Palekar (2007) and Panchagavya by Natarajan (2007). Cotton mill waste along with paddy straw was used as mulch. Various growth and yield parameters both qualitative and quantitative were studied by using different combinations of the organics. Highest percentage of ascorbic acid (10.57%) was observed in the fresh pods with treatment T-11 (10.27) using straw mulch, vermicompost and panchagavya together followed by T-12 using straw mulch, jeevamrutha and panchagavya. For riboflavin content highest values were recorded with T-11 (0.41) and T-10 (0.40) using straw mulch, NPK (recommended dose of fertilizers) and panchagavya. The results confirm the positive role of panchagavya in increasing the vitamin content of the fresh pods.

Key words: Ascorbic acid, French beans, Jeevamrutha, Mulching, Panchagavya, Vermicompost

I. INTRODUCTION

French bean (*Phaseolus vulgaris*) is mainly grown for its pod yield rather than Rajmas in Southern parts of India including Andhra Pradesh. Different bush and pole varieties are cultivated in Andhra Pradesh for regular supply of this protein vegetable. As the small farmer's affordability for chemical fertilizers and pesticides has decreased due to high prices and low subsidies on these chemicals cultivation of vegetables by organic methods is gaining importance day by day. Also growing awareness regarding healthy food has laid stress on vegetable production by natural or organic methods. Many consumers are in search of organic markets for their vegetable needs as organically produced vegetables are not only free from harmful chemicals but also proved to have better nutritive value than chemically produced ones. As French beans is a good source of crude fibre, water, vitamin and mineral content apart from being a protein source growing French beans using different organic supplements is studied to determine the best combination for increasing vitamin content of the pods. The quantitative and qualitative yield of French beans were tested by using different combinations of kitchen waste vermicompost, jeevamrutha, panchagavya and mulch in comparison to recommended dose of fertilizers.

Many studies have proved that vegetables and fruits produced naturally without using chemical fertilizers show higher levels of organic acids and vitamins like ascorbic acid and riboflavin. Aboderin (2000) observed that ascorbic acid content increased in *Abelmoschus esculentus* and *Celosia argentea* grown in unfertilized soils when compared to those grown with chemical fertilizers. The ascorbic acid content was high in organic potatoes than in potatoes produced conventionally (Rembalkowska, 2003). Similarly vitamin B₂ or riboflavin was found to be 6.7% higher in organic rice (Nandhasri, 2008). A slight increase in vitamin C content was observed in *Lactuca sativa* and *Allium sepa* when grown on natural soil without chemical fertilizers (Puia *et al.*, 2009). A high percentage of ascorbic acid was recorded in organic vegetables and fruit juices of apple, beetroot, carrot and pear when compared to those produced by conventional method (Gastol, *et al.* 2011).

The effect of organic methods on ascorbic acid and riboflavin content of French beans is studied in the present experiment in comparison to chemical method.

II. METHODS AND MATERIALS

The experiment with Anupam variety of French beans (*Phaseolus vulgaris*) was carried out in the agricultural field of Kothavaripalli village situated in Madanapalle Mandal of Chittoor District, Andhra Pradesh. The soil was a light red loamy soil with pH of 8.3. Kitchen wastes were converted into vermicompost by using cowdung slurry and *Eisenia foetida* variety of earthworms and applied in 4 split doses, 10DAS, 30DAS, 50DAS

and 70DAS @8MT/ha. Chemical fertilizers were applied in three split doses 15DAS, 35DAS and 60DAS. Jeevamrutha was used as 5% spray applied to the soil as well as foliar spray on 15DAS, 30DAS, @ 6.5% on 45DAS and 60DAS, @ 10% on day 75. Panchagavya @3% was given as foliar spray on 20,35,50,65 and 80DAS. The plants were irrigated once in 4 days through drip irrigation. Straw mulch was laid with rice straw and cotton mill waste after the plants attained a height of 25 cms. The fertilizers and manures were applied to the crop as per the following treatments:

1. T-0 Control - Soil only
2. T-1 - NPK @ 25:75:50
3. T-2 - Vermicompost @ 8MT/ha
4. T-3 - Jeevamrutha @ 500lts/ha
5. T-4 - Panchagavya @ 3% as foliar spray
6. T-5 - Straw mulch @ 15 cms above soil
7. T-6 - NPK + Panchagavya
8. T-7 - Vermicompost + Panchagavya
9. T-8 - Jeevamrutha + Panchagavya
10. T-9 - Straw mulch + Panchagavya
11. T-10 – Straw mulch + NPK + Panchagavya
12. T-11 – Straw mulch + Vermicompost + Panchagavya
13. T-12 – Straw mulch + Jeevamrutha + Panchagavya

The fresh pods were collected at regular intervals and ascorbic acid content was determined by the method given by Plummer and Jayaraman. Riboflavin content of the pods was determined by modified AACC method (1976).

TABLE – 1 ASCORBIC ACID CONTENT MEAN VALUE FOR THREE YEARS (2010-2012) OVER 4 REPLICATIONS EACH

Treatment	1 st season	2 nd season	3 rd season	Average
T ₀ (Control)	5.42	6.35	6.59	6.12
T ₁ NPK @ 8:25:18 kgs/ acre	6.84	7.57	7.35	7.25
T ₂ VC 4 tons/acre	6.78	8.27	9.15	8.06
T ₃ JV @ 200lts /acre	6.13	7.8	7.64	7.19
T ₄ PG @ 3% FS	7.42	8.78	10.06	8.75
T ₅ SM @ 15cms height	6.23	7.29	8.41	7.31
T ₆ NPK + PG	8.25	9.05	10.17	9.15
T ₇ VC + PG	9.2	9.17	10.74	9.7
T ₈ JV + PG	8.72	9.48	9.89	9.36
T ₉ SM + PG	9.06	9.21	9.82	9.36
T ₁₀ SM + NPK + PG	9.6	10.06	9.82	9.82
T ₁₁ SM + VC + PG	10.9	10.33	10.49	10.57
T ₁₂ SM + JV + PG	10.6	10.21	10	10.27

STATISTICAL ANALYSIS (3X13 ANOVA)

Source	Type III Sum of Squares	df	Mean square	F	p value	Sig
Seasons	34.693	2	17.347	99.464	0.000	**
Treatments	272.587	12	22.716	130.249	0.000	**
Seasons*Treatments	31.079	24	1.295	7.425	0.000	**
Error	20.405	117	0.174			
Corrected Total	358.764	155				

A R Squared = .943(Adjusted R Squared = .925)

Note: ** = Significant at 0.01 level

TABLE – 2 RIBOFLAVIN CONTENT AVERAGE FOR THREE YEARS (2010-2012) OVER 4 REPLICATIONS EACH

Treatment	1 st season	2 nd season	3 rd season	Average
T ₀ (Control)	0.10	0.10	0.09	0.096
T ₁ NPK @ 8:25:18 kgs/ acre	0.29	0.32	0.31	0.30
T ₂ VC 4 tons/acre	0.31	0.35	0.35	0.33
T ₃ JV @ 200lts /acre	0.18	0.28	0.30	0.25
T ₄ PG @ 3% FS	0.32	0.31	0.34	0.32
T ₅ SM @ 15cms height	0.20	0.24	0.24	0.22
T ₆ NPK + PG	0.30	0.30	0.34	0.31
T ₇ VC + PG	0.34	0.36	0.40	0.36
T ₈ JV + PG	0.30	0.32	0.33	0.31
T ₉ SM + PG	0.32	0.32	0.34	0.32
T ₁₀ SM + NPK + PG	0.38	0.41	0.43	0.40
T ₁₁ SM + VC + PG	0.38	0.42	0.43	0.41
T ₁₂ SM + JV + PG	0.34	0.37	0.41	0.37

Source	Type III Sum of Squares	df	Mean square	F	p value	Sig
Seasons	0.049	2	0.025	61.195	0.000	**
Treatments	1.016	12	0.085	211.003	0.000	**

Seasons*Treatments	0.035	24	0.001	3.626	0.000	**
Error	0.047	117	0.000			
Corrected Total	1.147	155				
A R Squared = .959(Adjusted R Squared = .946)						

Note: ** = Significant at 0.01 level

III. RESULTS AND DISCUSSION

Vitamins are organic compounds that are required for various biological functions. In general, vitamins are not synthesized in the human body, but deficiency of them may lead to certain diseases. Both Ascorbic acid and Riboflavin (vitamin B₂) are water soluble vitamins found abundantly in fresh fruits, vegetables and green leaves. Riboflavin also known as vitamin B₂ or G is widely distributed in plants, soybeans, green leaves and fresh vegetables. Milk and eggs are good source of this vitamin. It is an important constituent of FMN (Flavin Mono Nucleotide) and FAD (Flavin Adenine Dinucleotide) which acts as coenzyme in cellular oxidation reduction reactions. Chemically riboflavin is a yellow nitrogen containing alcohol. It is found in two forms in animals, riboflavin phosphate and Flavin. Riboflavin deficiency leads to retardation of body growth and abnormal vascularization of cornea of the eye.

Ascorbic acid or Vitamin C is the first chemically identified vitamin abundant in citrus fruits, berries, melons, tomatoes and leafy vegetables. It is an important anti-oxidant vitamin also found sufficiently in green and fresh vegetables like French beans. It has strong reducing property and is oxidized to de hydro ascorbic acid. Its deficiency causes symptoms of scurvy such as falling of teeth, cracking of bones, bleeding etc. It is also found to prevent infections by accelerating phagocytosis. However it is quickly destroyed by oxidation during cooking.

It is evident from table – 1 that regarding the ascorbic acid content the effect of straw mulch along with vermicompost and foliar spray of panchagavya (T-11) was more significant with a highest value of 10.57 mg/100 gm. of fresh pods. T-12 using straw mulch, jeevamrutha and foliar spray of panchagavya showed a value of 10.27mg/100 gm. In all other treatments where Panchagavya was used there was a significant increase in ascorbic acid level. The treatments where vermicompost and panchagavya were used separately showed considerably greater levels of ascorbic acid and when they were used together with straw mulch exerted more influence on increasing the levels of ascorbic acid. Though Jeevamrutha could not influence to produce more ascorbic acid content it could yield more ascorbic acid when used along with straw mulch and panchagavya. It is evident from the data that panchagavya was more efficient in increasing the ascorbic acid levels compared to vermicompost, jeevamrutha or straw mulch. The T-11 recorded a huge increase of 72.71% of ascorbic acid when compared to the control and an increase of 45.79% over T-1 (NPK). The T-12 showed a 67.81% increase over control and 41.65% over T-1 which indicates that producing French beans through organic farming improves the nutrient content to a maximum extent.

Table – 2 shows that highest Riboflavin content (0.41µg/100gm.) was obtained from pods produced by T-11 using straw mulch, vermicompost and foliar spray of panchagavya. T-10 using straw mulch, NPK (recommended dose of fertilizers) and foliar spray of panchagavya recorded 0.40µg/100gm of Riboflavin. Vermicompost along with panchagavya was found to show better effect on this parameter. It is also evident from the table that NPK coupled with panchagavya could produce more riboflavin whereas the treatments where jeevamrutha was used could not influence this parameter significantly. The role of vermicompost, panchagavya and NPK showed greater influence on riboflavin content independently as well as used together with straw mulch. The T-11 recorded 42.70% higher riboflavin content than control and 13.6 % increase over T-1 followed by T-10 which recorded 41.6% increase in riboflavin content over control and 13.3 % increase over T-1. Hence it is evident that organic methods increase the vitamin content of the vegetable produce.

By the two tables it is evident that T-11 using vermicompost along with panchagavya and straw mulch influenced both ascorbic acid and riboflavin levels in the pods. However Jeevamrutha along with straw mulch and panchagavya was second in increasing the ascorbic acid, while NPK along with straw mulch and panchagavya had equally good effect on riboflavin content. In this experiment also there is an increase in ascorbic acid content using organic supplements. This study emphasizes the role of organics in increasing the vitamin content of French bean pods.

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