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Quality and economics of fenugreek as influenced by effect of foliar application of *panchagavya* and banana pseudostem sap

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Abstract
A field experiment on "Effect of foliar application of *panchagavya* and banana pseudostem sap on growth and seed yield of fenugreek" was carried out at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* 2020-21. The results revealed that significant improvement in seed yield, straw yield, protein content, highest gross realization (₹64,746/ha) and net realization (₹34,259/ha) was noted with an application of treatment T_4 (*Panchagavya* @ 4% spray at pre flowering + pod setting stage) over other treatments but which remained at par with treatment T_{10} with respect to seed yield, straw yield, protein content and gross realization ₹62,748 and T_3 (*Panchagavya* @ 4% spray at pod setting) for net realization (₹32,863). The highest value of benefit: cost ratio (2.14) was accrued with treatment T_3 closely followed by treatment T_4 with BCR of 2.12.

Keywords: *Panchagavya*, Banana pseudostem sap, quality, economics. Fenugreek

Introduction
Seed spices are a vital group of agricultural commodities in our country's economy. Spices play an essential role in human diets because of the pleasant flavour and perfume they provide to food, which adds much to the enjoyment of eating. Fenugreek (*Trigonella foenum-graecum*) is India's third most popular seed spice (after coriander and cumin).

This crop is grown on around 1,22,000 acres in India, yielding roughly 1,89,000 tonnes (Anonymous, 2019a) [5]. The fenugreek area in Gujarat is roughly 7,326 ha, with a yield of approximately 14,173 MT and a productivity of 1,935 kg/ha, the highest in the country (Anonymous, 2019b) [6]. The two most prominent fenugreek-producing states in India are Rajasthan and Gujarat.

Fenugreek is a legume that originated in Southeastern Europe, the Mediterranean region, and Western Asia, but is today produced mostly in India, as well as in other countries of Asia, Northern Africa, Europe, and the United States. Fenugreek seeds have carminative, galactagogue, antibacterial, and antiviral effects and are fragrant yet bitter. Fenugreek seed comprises 13.7 percent water, 20% protein, 50% carbohydrate, 5% fat, 3.0% mineral content, and 25% dietary fibres, lipids, cellulose starch, ash, calcium, iron, and -carotene (USDA, 2001) [4]. Furthermore, leaves include calcium, zinc, iron, phosphorus, riboflavin, carotene, thiamine, niacin, and vitamin C. (Rao, 2003) [2]. It is a medicinal herb with anti-diabetic, anti-cancer, anti-microbial, and Hypocholesterolemic effects (Nagananda *et al*., 2010) [11].

Organic farming has gained popularity in recent years as a result of the recognition of intrinsic benefits. Organic sources such as *panchagavya*, vermiwash, banana pseudostem sap, and Jeevamrut, used alone or in combination, boost soil fertility, growth, and production of fenugreek. Organic foliar spray appears to be helpful in enhancing nutrient use efficiency. As an excellent source of potassium, calcium, and magnesium, pseudostem sap derived from the banana plant is now employed as a liquid fertilizer in agricultural crops. Salunkhe (2010) [15] investigated the elemental composition of banana pseudostem samples and discovered that banana pseudostem contained macro elements ranging from 1.00 to 1.12 percent N, 0.50 to 0.71 percent P, 2.39 to 20.2 percent K, and micro nutrients ranging from 259.0 to 323.2 mg/kg Fe, 47.3 to 241.3 mg/kg Mn, 10.1 to 107.4 mg/kg Zn, and 13.4 to 83.6 mg/kg Cu. Banana pseudo stem enriched sap also includes plant growth regulators such as GA3 and cytokynin, and this mixture is infected with various microorganisms like as *Rhizobium*, *Azotobacter*, and others, which play an important role in increasing crop output.

In recent years, the use of fermented cow dung, urine, ghee, curd, and milk, known as panchagavya, has gained significant popularity in Indian agriculture, owing primarily to the efforts of small groups of farmers. *Panchagavya* biochemical qualities indicated that it contains practically all of the important nutrients including N, P, K and micronutrients necessary for plant development, as well as growth hormones like IAA and GA required for crop growth (Selvaraj *et al*., 2007) [3].

Materials and Methods

The experiment was conducted on plot number B-9 at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* season of the year 2020-21 under Randomized Block Design (RBD) consisting of 10 treatments with four replications.

Geographically, Sardarkrushinagar is situated at 24º-19' North latitude and 72º-19' East longitude with an altitude of 154.52 metre above the mean sea level. It is situated in the North Gujarat Agro-climatic Zone. The soil of the experimental plot was loamy sand in texture and slightly alkaline in reaction. Ten treatments comprising of 100% RDF (20:40:0, kg NPK/ha), 4% *panchagavya* spray (at pre flowering, at pod setting: at pre flowering + pod setting), 1% enriched banana pseudostem sap spray (at pre flowering, at pod setting and at pre flowering + pod setting), 1.5% enriched banana pseudostem sap spray (at pre flowering, at pod setting and at pre flowering + pod setting). The crop fenugreek and variety 'Gujarat Methi 2' were seeded on November 12th, 2020 with a recommended seed rate of 12 kg/ha and a row spacing of 30 cm. The seeds were manually spread at a depth of 4-5 cm in previously opened furrows and well covered with dirt. The experimental plots were fertilized in accordance with the treatments. Urea and SSP were used to fertilize the crops with nitrogen and phosphorus. Each treatment received a representative sample of seed. The samples were dried in an oven at 650 C for 24 hours before being processed using a mechanical grinder. The nitrogen content of the seed was then determined using the micro kjheldahl's technique (Waranke and Barber, 1974) [16]. Protein content in seed was calculated by multiplying nitrogen content of seed (%) with 6.25 (Bhuiya and Chowdhary, 1974) [1]. Later on, statistical analysis is carried out as per method of analysis of variance at 5% level of significance for F-test. The monetary parameter like cost of cultivation, gross return, net return and benefit: cost ratio was worked out as per the standard method.

Results and Discussion

Yield (kg/ha)

The results revealed that significantly higher seed yield (1,438 kg/ha) and haulm yield (3,613 kg/ha) of fenugreek was produced with treatment T_4 (*Panchagavya* @ 4% spray at pre flowering and pod setting stage) over rest of the treatments but it was found statistically at par with treatments T_{10}, T_3, T_9 and T_7 respectively. However, the minimum seed yield (1,102 kg/ha) and haulm yield (2,472 kg/ha) was noted in treatment T_1 (100% RDF 20:40:0, kg NPK/ha). This might be due to the nutrients in *panchagavya*, which include macronutrients such as nitrogen, phosphorus, and potassium, as well as micronutrients required for plant growth and development. Smaller amounts of growth hormones like IAA and GA present in *panchagavya* may have created stimuli in the plant system, increasing the production of growth regulator in the cell system, and the action in the plant system stimulated the necessary growth and development of the plant, resulting in a higher yield when foliar fed. *Panchagavya* increased the synthesis of growth-promoting chemicals, which enhanced growth and yield characteristics, and hence seed and haulm yield. These findings are consistent with those of Patel *et al*. (2013) [14], Choudhary *et al*. (2014) [9], and Yadav *et al*. (2016) [18], Panchal *et al*. (2017) [12], Yadav *et al*. (2017) [17], Patel *et al*. (2018) [13] and Gowthamchand *et al*. (2019) [10].

Quality parameter: Protein content (%)

The data pertaining to protein content in seed of fenugreek was statistically analysed and presented in Table 2 as well as graphically depicted in Figure 1. An appraisal of data presented (Table 2) revealed that significantly higher protein content (24.03%) in seed was obtained with treatment T_4 (*Panchagavya* @ 4% spray at pre flowering and pod setting stage) over rest of the treatments, except T_{10}, which was found at par with protein content of 22.95%. However, the lower protein content (18.90%) was noted with treatment T_1 (100% RDF 20:40:0, kg NPK/ha).

Treatment T_4 (*Panchagavya* @ 4 percent spray at pre flowering and pod setting stage) resulted in significantly greater protein content. This might be owing to improved soil nutrient status and plant nutrient absorption, which was reflected in reproductive health and seed quality. An increase in protein content might be attributed to an appropriate supply of nitrogen. Nitrogen is required for protein synthesis, whereas phosphorus is required for specific co-enzymes involved in protein synthesis. As a result, a rise in the concentration of nitrogen and phosphorus in the plant resulted in an increase in the protein content of the seed. These findings are consistent with those of Choudhary *et al*. (2018) [8], Gowthamchand *et al* (2019) [10]. Choudhary *et al*. (2017) [7] found that using *panchagavya* at 4% increased the protein content of blackgram seeds during the branching and flowering stages compared to the control.

Economics

On the basis of prevailing market price of fenugreek seed and different variable and non-variable inputs, the cost of cultivation, gross and net realization as well as benefit: cost ratio (BCR) of various treatments were worked out and presented in Table 2. Gross and net realization are illustrated graphically in Figure 2.

Gross and net realization (₹/ha)

A perusal of data furnished in Table 2 revealed that application of treatment T_4 (*Panchagavya* @ 4% spray at pre flowering and pod setting stage) achieved the maximum gross (₹64,746/ha) and net (₹34,259/ha) realization.

Benefit: cost ratio (BCR)

An appraisal of data (Table 2) on BCR indicated that the maximum BCR value (2.14) was observed with treatment T_3 (*panchagavya* @ 4% spray at pod setting) followed by treatment T_4 (*Panchagavya* @ 4% spray at pre flowering and pod setting stage) with BCR value of 2.12.

Table 1: Effect of foliar application of *panchagavya* and banana pseudostem sap on seed and haulm yield of fenugreek

Treatment	Seed yield (kg/ha)	Haulm yield (kg/ha)
T_1: 100% RDF (20:40:0, kg NPK/ha)	1,102	2,472
T_2: *Panchagavya* @ 4% spray at pre flowering	1,250	3,116
T_3: *Panchagavya* @ 4% spray at pod setting	1,373	3,348
T_4: *Panchagavya* @ 4% spray at pre flowering + pod setting	1,438	3,613
T_5: Enriched banana pseudostem sap @ 1% spray at pre flowering + pod setting	1,122	2,575
T_6: Enriched banana pseudostem sap @ 1% spray at pod setting	1,138	3,019
T_7: Enriched banana pseudostem sap @ 1% spray at pre flowering + pod setting	1,314	3,166
T_8: Enriched banana pseudostem sap @ 1.5% spray at pre flowering + pod setting	1,217	3,023
T_9: Enriched banana pseudostem sap @ 1.5% spray at pod setting	1,361	3,342
T_{10}: Enriched banana pseudostem sap @ 1.5% spray at pre flowering + pod setting	1,401	3,354
S.Em. ±	53	117
C.D.(P=0.05)	155	339
C.V. %	8.32	7.53

Table 2: Effect of foliar application of *panchagavya* and banana pseudostem sap on quality and economics of fenugreek

Treatment	Protein content (%)	Gross realization (₹/ha)	Cost of cultivation (₹/ha)	Net realization (₹/ha)	B:C ratio
T_1: 100% RDF (20:40:0, kg NPK/ha)	18.90	49,024	27,564	21,460	1.78
T_2: *Panchagavya* @ 4% spray at pre flowering	21.70	56,232	28,753	27,479	1.96
T_3: *Panchagavya* @ 4% spray at pod setting	22.01	61,616	28,753	32,863	2.14
T_4: *Panchagavya* @ 4% spray at pre flowering + pod setting	24.03	64,746	30,487	34,259	2.12
T_5: Enriched banana pseudostem sap @ 1% spray at pre flowering + pod setting	19.48	50,030	30,262	19,768	1.65
T_6: Enriched banana pseudostem sap @ 1% spray at pod setting	20.43	51,558	30,262	21,296	1.70
T_7: Enriched banana pseudostem sap @ 1% spray at pre flowering + pod setting	21.75	58,892	33,505	25,387	1.76
T_8: Enriched banana pseudostem sap @ 1.5% spray at pre flowering + pod setting	21.66	54,726	31,712	23,014	1.73
T_9: Enriched banana pseudostem sap @ 1.5% spray at pod setting	21.93	61,124	31,712	29,412	1.93
T_{10}: Enriched banana pseudostem sap @ 1.5% spray at pre flowering + pod setting	22.95	62,748	36,406	26,342	1.72
S.Em. ±	0.47	-	-	-	-
C.D.(P=0.05)	1.36	-	-	-	-
C.V. %	4.35	-	-	-	-

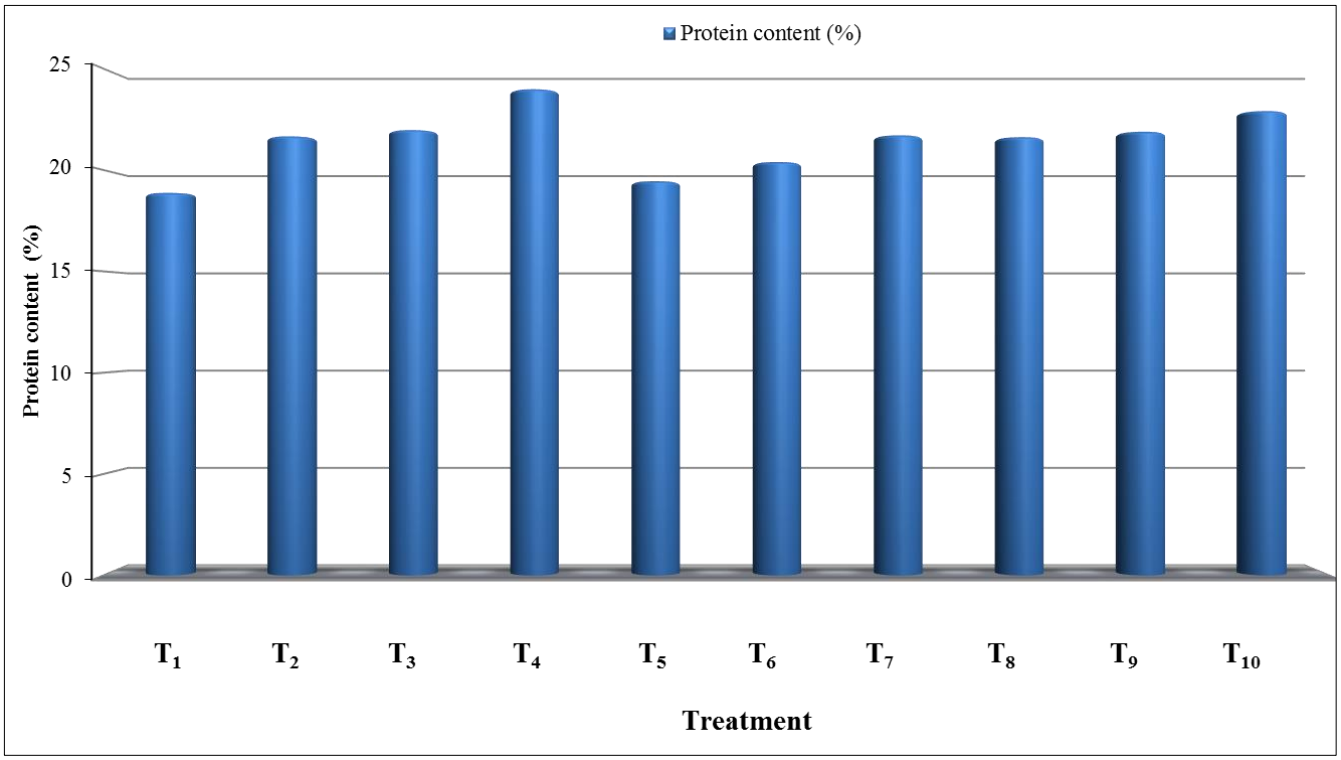

Fig 1: Protein content of fenugreek as influenced by foliar application of *panchagavya* and banana pseudostem sap

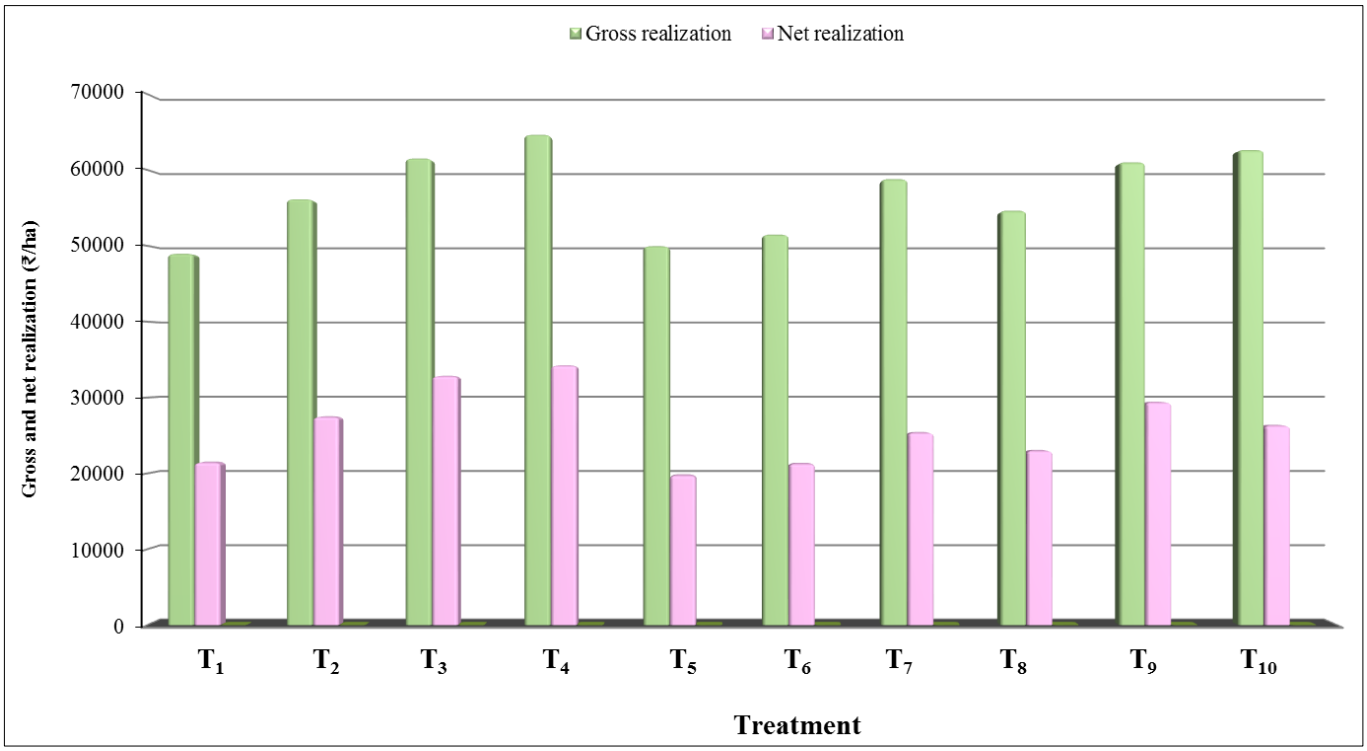

Fig 2: Gross and net realization as influenced by foliar application of *panchagavya* and banana pseudostem sap

Conclusion

On the basis of findings of the present investigation, it is indicated that foliar application of 4% *panchagavya* at pod setting stage was found effective for enhancing yield and economic feasibility in fenugreek. Whereas, quality of fenugreek was improved when the same concentration was also sprayed at pre-flowering stage in addition to pod setting stage.

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