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## Influence of natural farming practices on leaf micronutrient content and quality attributes in pea (*Pisum sativum* L.)

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### Abstract

This study examined the influence of natural farming practices, specifically jeevamrit and ghanjeevamrit applications, on leaf micronutrient content and quality parameters in pea (*Pisum sativum* L.). Conducted during 2020-21 at Dr. Y S Parmar University of Horticulture and Forestry, Solan, the experiment used a randomized block design with seven treatments, including various organic combinations and a chemical fertilizer control. Key assessments included DTPA-extractable micronutrients (Fe, Mn, Cu, Zn) in leaves, as well as seed protein, ascorbic acid, and total soluble solids (TSS). Results showed that frequent and well-managed applications of jeevamrit and ghanjeevamrit significantly enhanced leaf micronutrient status, with values comparable to those under conventional fertilization. The highest protein and ascorbic acid contents were observed in treatments with recommended chemical fertilization or frequent organic amendments, while TSS remained consistent across treatments. Improvements in nutrient uptake and quality were attributed to better soil health, increased microbial activity, and enhanced nutrient cycling from organic inputs. Overall, the findings indicate that natural farming practices can effectively sustain or improve pea nutritional quality and market value, offering a sustainable, eco-friendly alternative to chemical fertilizers that supports both crop productivity and long-term soil fertility.

**Keywords:** Leguminous, organic soil amendments, nitrogen fixation, sustainable agriculture

### 1. Introduction

Garden pea (*Pisum sativum* L.), a cool-season crop from the Fabaceae family (2n=14), is widely cultivated in both rainfed and irrigated systems. Sowing generally takes place from October to November in plains and from March to June in higher hills. The crop thrives in well-drained loamy soils with a pH of 6-7.5, and seeds are sown when soil temperatures reach at least 10°C. Optimal growth and germination occur at 13-18°C and 22°C, respectively. For best yields, 20-25 tons of farmyard manure and a basal dose of 20-25 kg nitrogen, 40-70 kg phosphorus (P<sub>2</sub>O<sub>5</sub>), and 40-60 kg potassium (K<sub>2</sub>O) per hectare are recommended, along with proper irrigation and timely weeding. (Anonymous, 2014) <sup>[1]</sup>. Nutritionally, green peas are a rich source of protein, carbohydrates, dietary fiber, essential amino acids, and various vitamins and minerals. Each 100 grams provides about 81 kcal, 14.45 g carbohydrates, 5.42 g protein, 0.4 g fat, and significant amounts of vitamin A, calcium, iron, magnesium, phosphorus, potassium, and zinc. (Gupta *et al.* 2017) <sup>[9]</sup>. India is the world's second-largest pea producer, cultivating the crop on approximately 540.5 thousand hectares with an annual output of 5.42 million metric tons and an average productivity of 10.0 metric tons per hectare. In Himachal Pradesh, peas cover 24.37 thousand hectares, yielding 294.96 thousand metric tons at 12.10 metric tons per hectare. In 2018, India exported 410.11 metric tons of peas, earning about 17.94 million rupees (Anonymous, 2018). <sup>[2]</sup> As a leguminous crop, garden pea enhances soil fertility by fixing atmospheric nitrogen and providing ground cover. Beneficial microorganisms such as nitrogen-fixing bacteria (*Azotobacter*, *Acetobacter*, *Azospirillum*), phosphorus-solubilizing bacteria (*Pseudomonas* fluorescence), and potash-solubilizing bacteria (*Bacillus siliceus*) present in cow dung become more active with the application of jeevamrit, an organic soil amendment (Ramaprasad *et al.*, 2009) <sup>[21]</sup>. Cow urine, a component of jeevamrit, also introduces disease-resistant organisms. While modern agriculture often relies on heavy chemical fertilizers and pesticides for higher

yields, these practices can harm soil health and pose risks to human health. Concerns over these adverse effects have increased interest in eco-friendly organic amendments, which are not only less polluting but also cost-effective sources of nutrients. (Follett *et al.* 1981) [18]. Organic inputs improve soil by supplying nutrients and enhancing its physical, chemical, and biological properties, thus boosting microbial diversity and activity. Their use supports healthy crop growth, improves nutrient uptake, and can stimulate plant hormonal activity. For sustainable crop production and soil health, the use of bulky organic manures (such as FYM, vermicompost, and poultry manure), concentrated organic manures (like oil cakes), and organic formulations (such as ghan-jeepamrit and jeepamrit), along with biofertilizers, is increasingly favored by farmers transitioning from chemical to organic farming. (Tomati *et al.* 1990) [26].

## 2. Materials and Methods

The experiment was conducted during 2020-21 at the Experimental Farm of the Department of Soil Science and Water Management, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.), located in the sub-temperate, sub-humid agro-climatic zone-II of Himachal Pradesh, which receives about 1100 mm of annual rainfall, mainly during the monsoon. The soil, classified as Inceptisols (Eutrochrept subgroup) and derived from ferromagnesian shales and dolomitic limestone, had a pH of 6.97 (1:2.5 soil-water suspension), EC of 1.24 dS m<sup>-1</sup>, organic carbon content of 0.31%, and available nutrients of 297.9 kg ha<sup>-1</sup> nitrogen, 87.4 kg ha<sup>-1</sup> phosphorus, and 293.44 kg ha<sup>-1</sup> potassium before the experiment. The study followed a randomized block design with seven treatments and three replications (21 combinations), with each plot measuring 2.40 × 1.80 m and a spacing of 60 × 7.5 cm. Treatments included: T<sub>1</sub> (100% recommended dose of fertilizers as chemical control), T<sub>2</sub> (Ghanjeevamrit at 3 t/ha + 5% Jeevamrit at 15-day intervals), T<sub>3</sub> (Ghanjeevamrit at 2 t/ha + 10% Jeevamrit at 15-day intervals), T<sub>4</sub> (Ghanjeevamrit at 1 t/ha + 15% Jeevamrit at 15-day intervals), T<sub>5</sub> (Ghanjeevamrit at 3

t/ha + 5% Jeevamrit at 30-day intervals), T<sub>6</sub> (Ghanjeevamrit at 2 t/ha + 10% Jeevamrit at 30-day intervals), and T<sub>7</sub> (Ghanjeevamrit at 1 t/ha + 15% Jeevamrit at 30-day intervals). Ghanjeevamrit was applied in split doses at sowing and full bloom, while Jeevamrit was used as a soil drench and foliar spray at specified concentrations and intervals. Leaf micronutrient cations (Fe, Mn, Cu, Zn) were analyzed using atomic absorption spectrophotometry and expressed in ppm, total soluble solids (TSS) in fruits were measured with a hand refractometer and reported as °Brix, protein content in pea seeds was estimated by the Kjeldahl method (nitrogen content × 6.25), and ascorbic acid content in green seeds was determined using the 2,6-dichlorophenol indophenol titration method.

## 3. Results

### 3.1 Leaf Micronutrient content

The application of organic manures played a significant role in enhancing plant metabolic activity by supplying essential micronutrients, thereby promoting early and vigorous growth, as supported by previous findings. Analysis of the data in (Table 1) revealed that copper content in pea leaves was significantly influenced by the treatments, with the highest Cu content observed in T<sub>1</sub> (18.03 ppm), statistically at par with T<sub>2</sub> (17.07 ppm) and T<sub>4</sub> (16.80 ppm), while the lowest was recorded in T<sub>5</sub> (13.50 ppm). Similarly, zinc content varied across treatments, with the maximum Zn found in T<sub>1</sub> (26.60 ppm), which was statistically comparable to T<sub>2</sub> (25.40 ppm), T<sub>4</sub> (24.60 ppm), and T<sub>3</sub> (24.20 ppm), and the lowest in T<sub>6</sub> (21.50 ppm). Iron content ranged from 333.33 ppm to 298.37 ppm, with the highest Fe in T<sub>1</sub> (333.33 ppm), statistically at par with T<sub>3</sub> (324.23 ppm) and T<sub>2</sub> (322.63 ppm), and the lowest in T<sub>6</sub> (298.37 ppm). Manganese content was also affected by the treatments, with the highest Mn observed in T<sub>3</sub> (43.33 ppm), statistically at par with T<sub>1</sub> (42.67 ppm), T<sub>2</sub> (41.73 ppm), and T<sub>4</sub> (40.89 ppm), while T<sub>5</sub> recorded the lowest value (35.07 ppm). These results, as shown in Table 1, underscore the effectiveness of organic amendments in maintaining adequate micronutrient levels in pea foliage under natural farming practices.

**Table 1:** Effect of natural farming practices on micronutrients (DTPA extractable cations) content (ppm) of leaf in pea

| Treatments     |                                                                       | Cu    | Zn    | Fe     | Mn    |
|----------------|-----------------------------------------------------------------------|-------|-------|--------|-------|
| T <sub>1</sub> | 100% RDF                                                              | 18.03 | 26.60 | 333.33 | 42.67 |
| T <sub>2</sub> | 3 t ha <sup>-1</sup> Ghanjeevamrit + 5% Jeevamrit @ 15 days interval  | 17.07 | 25.40 | 322.63 | 41.73 |
| T <sub>3</sub> | 2 t ha <sup>-1</sup> Ghanjeevamrit + 10% Jeevamrit @ 15 days interval | 14.27 | 24.20 | 324.23 | 43.33 |
| T <sub>4</sub> | 1 t ha <sup>-1</sup> Ghanjeevamrit + 15% Jeevamrit @ 15 days interval | 16.80 | 24.60 | 318.87 | 40.89 |
| T <sub>5</sub> | 3 t ha <sup>-1</sup> Ghanjeevamrit + 5% Jeevamrit @ 30 days interval  | 13.50 | 22.30 | 302.60 | 35.07 |
| T <sub>6</sub> | 2 t ha <sup>-1</sup> Ghanjeevamrit + 10% Jeevamrit @ 30 days interval | 15.00 | 21.50 | 298.37 | 32.07 |
| T <sub>7</sub> | 1 t ha <sup>-1</sup> Ghanjeevamrit + 15% Jeevamrit @ 30 days interval | 13.90 | 23.50 | 304.67 | 32.20 |
| Mean           |                                                                       | 15.51 | 24.01 | 314.96 | 38.28 |
| C.D (0.05)     |                                                                       | 1.76  | 2.86  | 14.13  | 3.48  |

### 3.2 Quality Parameters

The results for protein content, ascorbic acid, and total soluble solids (TSS) in pea seeds (Table 2) demonstrate that both conventional and organic nutrient management can sustain or enhance key quality parameters. The highest protein content was recorded under T<sub>1</sub> (24.58%), statistically at par with T<sub>2</sub> (23.69%), while the lowest was observed in T<sub>5</sub> (17.06%). This aligns with previous studies showing that protein content in peas is strongly influenced by nitrogen availability and fertilization strategy, with higher nitrogen supply and effective inoculation or organic amendments supporting greater protein synthesis and

accumulation in seeds. Ascorbic acid content followed a similar trend, with the highest values in T<sub>1</sub> (14.70 mg/100g), T<sub>2</sub> (14.13 mg/100g), and T<sub>3</sub> (13.47 mg/100g), and the lowest in T<sub>5</sub> (10.23 mg/100g). This suggests that frequent and well-managed organic amendments, as well as recommended chemical fertilization, can help maintain or enhance vitamin C content in peas, likely due to improved nutrient uptake and plant metabolic activity. For total soluble solids, no significant differences were observed among treatments, with TSS values ranging narrowly from 17.0 to 17.5 °Brix, indicating that both organic and conventional practices are equally effective in maintaining this quality trait.

**Table 2:** Effect of natural farming practices on Protein content (%), Ascorbic acid content (mg/100gm) and Total soluble solids (oBrix) in pea

| Treatments     |                                                                       | Protein Content | Ascorbic Acid | Total Soluble Solids |
|----------------|-----------------------------------------------------------------------|-----------------|---------------|----------------------|
| T <sub>1</sub> | 100% RDF                                                              | 24.58           | 14.70         | 17.5                 |
| T <sub>2</sub> | 3 t ha <sup>-1</sup> Ghanjeevamrit + 5% Jeevamrit @ 15 days interval  | 23.69           | 14.13         | 17.5                 |
| T <sub>3</sub> | 2 t ha <sup>-1</sup> Ghanjeevamrit + 10% Jeevamrit @ 15 days interval | 22.06           | 13.47         | 17.4                 |
| T <sub>4</sub> | 1 t ha <sup>-1</sup> Ghanjeevamrit + 15% Jeevamrit @ 15 days interval | 22.32           | 13.20         | 17.2                 |
| T <sub>5</sub> | 3 t ha <sup>-1</sup> Ghanjeevamrit + 5% Jeevamrit @ 30 days interval  | 17.06           | 10.23         | 17.2                 |
| T <sub>6</sub> | 2 t ha <sup>-1</sup> Ghanjeevamrit + 10% Jeevamrit @ 30 days interval | 18.25           | 11.17         | 17.1                 |
| T <sub>7</sub> | 1 t ha <sup>-1</sup> Ghanjeevamrit + 15% Jeevamrit @ 30 days interval | 18.64           | 11.43         | 17.0                 |
| Mean           |                                                                       | 20.94           | 12.62         | 17.3                 |
| C.D (0.05)     |                                                                       | 2.05            | 1.48          | NS                   |

Overall, these findings highlight that optimized organic management, particularly with frequent applications of jeevamrit and ghanjeevamrit, can closely match the performance of chemical fertilizers in supporting protein, ascorbic acid, and TSS content in pea seeds, thus ensuring high nutritional and market quality

#### 4. Discussion

Natural farming practices, particularly the strategic application of organic amendments such as jeevamrit and ghanjeevamrit, have emerged as highly effective in elevating both the micronutrient profile of pea foliage and critical quality parameters like protein and ascorbic acid content. The remarkable efficacy of these organic manures stems from their capacity to directly enrich the soil with essential micronutrients—zinc, copper, iron, and manganese—thereby fueling vital metabolic processes and fostering robust, early plant growth (Anburani and Manivannan, 2002; Kahtani and Ahmed, 2012)<sup>[3, 11]</sup>. This nutrient enrichment is further amplified by synergistic mechanisms, including enhanced microbial nitrogen fixation, improved soil structure, and the stimulation of root development through mycorrhizal associations, all of which collectively boost moisture retention and nutrient uptake.

The study's findings reveal that treatments incorporating jeevamrit and ghanjeevamrit not only increase leaf micronutrient concentrations but also improve protein and ascorbic acid content in pea seeds. This improvement is attributed to the amendments' ability to promote the solubilization and uptake of both macro- and micronutrients, facilitated by heightened microbial activity, the production of nutrient-solubilizing enzymes, and the expanded absorptive surface provided by arbuscular mycorrhizal fungi (Kholer *et al.*, 2007)<sup>[12]</sup>. These results are in harmony with previous research, which has demonstrated that greater organic input leads to elevated levels of K, Cu, Fe, Zn, and Mn in plant tissues, and that organic amendments can rival or even surpass conventional fertilization in supporting crop nutrition and quality (Shukla *et al.*, 2009; Pilania *et al.*, 2010)<sup>[25, 20]</sup>.

Moreover, the consistent and well-managed use of organic liquid manures was shown to sustain or enhance protein and ascorbic acid content in pea, likely due to improved nitrogen assimilation and overall nutrient uptake. This observation aligns with earlier studies indicating that traditional organic formulations—whether applied individually or in combination—can significantly boost vitamin C and other quality parameters in horticultural crops. For instance, Chandrakala (2008)<sup>[6]</sup> reported that the combined use of beejamrit, jeevamrit, and panchgavya significantly increased ascorbic acid content in chilli, while Rathore (2018)<sup>[23]</sup> found that organic manure application resulted in the highest concentrations of leaf micronutrients in pea. Similar enhancements in ascorbic acid and other quality traits have been documented in vegetables and legumes with the use of organic

liquid manures and biofertilizers, attributed to improved nutrient cycling and plant physiological responses.

#### 5. Conclusion

This study highlights that natural farming practices, particularly the use of jeevamrit and ghanjeevamrit, offer a compelling alternative to conventional fertilization by significantly enhancing both the micronutrient content of pea leaves and key quality parameters such as protein and ascorbic acid. These organic amendments not only enrich soil health and stimulate beneficial microbial activity but also optimize nutrient availability and plant metabolism, resulting in robust yields and superior crop quality. By reducing dependence on synthetic inputs and promoting ecological balance, natural farming supports sustainable agriculture while delivering nutritionally rich produce, underscoring its promise as a resilient and environmentally responsible approach to modern food production.

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