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STUDIES ON THE EFFECT OF DIFFERENT FORMS AND METHODS OF APPLICATION OF ZINC ON SOIL FERTILITY AND YIELD OF SWEET CORN (*ZEA MAYS* VAR. *SACCHARATA*) AND FRENCH BEAN (*PHASEOLUS VULGARIS*) CROPPING SEQUENCE

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ABSTRACT

A field experiment entitled “Effect of Different Forms and Methods of Application of Zinc on Soil Fertility and yield of Sweet corn (*Zea mays* var. *saccharata*) – French bean (*Phaseolus vulgaris*) Cropping Sequence” was carried out during the kharif and rabi season of 2024–25 at the College of Horticulture, Bagalkot. The experiment was laid out in a Randomized Block Design comprising nine treatments and replicated three times. The study employed the Sugar 75 hybrid of sweet corn and the Arka Komal variety of French bean for the experimental investigation. The treatments consisted of different forms of zinc (zinc sulphate, EDTA-Zn, FYM enriched with zinc sulphate) and methods of application (soil and foliar application). The results revealed that significantly higher values of available nitrogen (206.23 kg ha⁻¹), phosphorous (35.75 kg ha⁻¹) potassium (219.23 kg ha⁻¹) and zinc (0.58 mg kg⁻¹) at harvest of french bean were registered in the treatment T₉ with the application of FYM @ 25 t ha⁻¹ enriched with ZnSO₄ @ 50 kg ha⁻¹. Whereas soil pH, EC (dS m⁻¹) and OC (%) were not significantly affected by the application of FYM enriched with ZnSO₄. The post-harvest soil properties were found to be improved in the treatment T₉ after harvest of French bean in sweet corn-french bean cropping sequence. Also the yield and yield attributes of sweet corn as well as French bean varied significantly and found to be highest in the treatment T₅ with the application of RDF + 0.25% EDTA-Zn foliar spray at 25 and 50 DAS.

Keywords : Sweet corn, French bean, Zinc application, cropping sequence

Introduction

Sweet corn (*Zea mays* var. *saccharata*) is a widely consumed vegetable maize valued for its increasing production, palatability and rich nutritional profile (Olabode and Sangodele, 2015). As a nutrient-exhaustive crop highly sensitive to zinc (Zn) deficiency, its growth and yield depend on adequate and balanced nutrient supply, especially in India where over half of cultivated soils and nearly 50% of global cereal-growing soils are Zn-deficient, making Zn one

of the most yield-limiting micronutrients (Fageria, 2016). Zinc is crucial for enzyme activation, chlorophyll synthesis, photosynthesis, membrane stability, seed maturation and nitrogen metabolism, and its deficiency restricts biomass accumulation and cob development (Fischer *et al.*, 1997). Organic amendments and Zn-enriched FYM improve Zn availability through gradual nutrient release and formation of organic chelates, while chelated forms like Zn-EDTA enhance mobility and reduce fixation in soil (Mansuri *et al.*, 2019; Mortvedt, 1979; Hergert *et*

al., 1984). Along with soil-applied organics, foliar application of zinc sulfate and Zn-EDTA plays a crucial role in rapidly correcting zinc deficiency by delivering Zn directly to photosynthetically active leaves, overcoming soil-related fixation issues and ensuring immediate improvement in plant growth, yield attributes and quality. French bean (*Phaseolus vulgaris*), a nutritionally rich and protein-dense legume, is also highly responsive to Zn and experiences reduced growth and yield under micronutrient deficiency (Lucas and Knezek, 1972). As a leguminous crop, it contributes significantly to soil fertility and sustainability through biological nitrogen fixation, improved soil structure and enhanced organic matter content (Broughton et al., 2003; Jensen and Hauggaard-Nielsen, 2003). Integrating legumes into cereal-based systems increases cropping intensity, soil biodiversity, nutrient-use efficiency and long-term system productivity while reducing erosion, runoff and dependence on external inputs (Kumar et al., 2018). Such cereal-legume sequences ensure balanced nutrient cycling, better land-use efficiency and improved food and nutritional security. In this context, efficient Zn management including soil-applied and foliar-applied sources becomes a key factor linking the performance of both crops, as Zn used in the first season also influences nutrient availability and crop response in the succeeding legume. Therefore, considering the strong nutrient demand of sweet corn, the Zn responsiveness of french bean and the sustainability advantages of cereal-legume rotations, the present study entitled “*Studies on the effect of different forms and methods of application of zinc on soil properties and yield of sweet corn-french bean cropping sequence*” aims to evaluate how different forms and methods of Zn application influence soil properties and yield.

Materials and Method

The experiment was performed under field conditions to assess the effect of different forms and methods of application of zinc on soil fertility and yield of sweet corn (*Zea mays* var. *saccharata*) – french bean (*Phaseolus vulgaris*) cropping sequence. Two field experiments were carried out for two successive seasons viz., kharif and rabi seasons during the year 2024-25. The experiment-I carried out with sweet corn crop and the experiment-II carried out with french bean., at the Vegetable block of the College of Horticulture, Main campus, Bagalkot. The location falls under the Northern Dry Zone of Karnataka and is situated at 16°10' N latitude and 74°42' E longitude, with an elevation of 542 meters above mean sea level. The soil of experimental site was clay loam in texture

& moderately alkaline in reaction (pH=7.88) with available N (169.77 kg ha⁻¹), available P₂O₅ (26.41 kg ha⁻¹), available K₂O (183.21 kg ha⁻¹) and Zn (0.48 ppm). The experiment was laid out in randomized block design (RBD) with three replications and nine treatments. For the purpose of this investigation, the Sugar 75 sweet corn hybrid and the Arka Komal French bean variety were adopted as the experimental crops. The details of the treatments for experiment-I are as follows. **T₁**: RDF (120:60:60 NPK kg ha⁻¹, 25 t ha⁻¹ FYM), **T₂**: RDF + Soil application of ZnSO₄ @ 25.0 kg ha⁻¹ as basal dose, **T₃**: RDF + Soil application of ZnSO₄ @ 50.0 kg ha⁻¹ as basal dose, **T₄**: RDF + Soil application of chelated EDTA-Zn @ 5.0 kg ha⁻¹ as basal dose, **T₅**: RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS, **T₆**: RDF + Foliar application of ZnSO₄ @ 0.5% at 25 and 50 DAS, **T₇**: RDF + Bio-fertilizers Consortia @ 25 kg ha⁻¹, **T₈**: RDF with enriched zinc @ 25 kg ha⁻¹, **T₉**: RDF with enriched zinc @ 50 kg ha⁻¹. The plant geometry was maintained at 60 cm × 30 cm spacing in each experimental plot.

After full maturity (80-85 days), cobs from each plot were harvested and weight separately. After harvest of sweet corn, the French bean variety Arka Komal was sown in the same experimental plots. The details of the treatments for experiment-II are as follows. **T₁**: RDF (63:100 :75 NPK kg ha⁻¹, 25 t ha⁻¹ FYM), **T₂**: RDF + Soil application of ZnSO₄ @ 12.5 kg ha⁻¹ as basal dose, **T₃**: RDF + Soil application of ZnSO₄ @ 25 kg ha⁻¹ as basal dose, **T₄**: RDF + Soil application of chelated EDTA-Zn @ 2.5 kg ha⁻¹ as basal dose, **T₅**: RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS, **T₆**: RDF + Foliar application of ZnSO₄ @ 0.5% at 25 and 50 DAS, **T₇**: RDF + Bio-fertilizers Consortia @ 15 kg ha⁻¹, **T₈**: RDF with enriched zinc @ 12.5 kg ha⁻¹, **T₉**: RDF with enriched zinc @ 25 kg ha⁻¹.

Farmyard manure (25 t ha⁻¹) was uniformly incorporated two weeks before sowing, except in plots receiving zinc-enriched FYM, which were applied separately. The recommended NPK dose was supplied to all treatments, with 50% nitrogen and the full phosphorus and potassium applied at sowing using urea, DAP and MOP, and the remaining nitrogen top-dressed at 30 DAS. Basal applications included zinc sulphate (25 and 50 kg ha⁻¹ for sweet corn and 12.5 and 25 kg ha⁻¹ for french bean), biofertilizer consortia (25 and 15 kg ha⁻¹ respectively) and EDTA-Zn (5 and 2.5 kg ha⁻¹ respectively). Foliar sprays of zinc sulphate (0.5%) and EDTA-Zn (0.25%) were applied at 25 and 50 DAS for both the crops. Manual weeding was performed twice at 30 and 50 DAS and earthing up

was carried out during 30 days after sowing (DAS). Harvesting of pods for vegetable use began 65 days after sowing. Green, immature pods were subsequently harvested from all treatments up to 80 days after sowing and their fresh weights were recorded.

Enrichment of FYM with zinc sulphate: Organic inputs such as locally sourced farmyard manure (FYM) were enriched with zinc (Zn) by initiating the process 50 days before application. FYM at 25 t ha⁻¹ was uniformly mixed with an aqueous solution of ZnSO₄·7H₂O supplying 25 kg Zn ha⁻¹ on a polythene sheet, while maintaining about 70% moisture. A 1% cow dung slurry was added as a biological starter to enhance microbial activity and facilitate the fixation of applied zinc. The mixture was turned weekly, and moisture was replenished as needed throughout the enrichment period. Enrichment procedure lasts for almost 30 days. After completion, the zinc-enriched FYM was thoroughly incorporated into the respective plots before sowing to ensure uniform nutrient distribution.

Soil analysis: Surface soil samples (0–15 cm) were collected from all plots at harvest, air-dried in shade, crushed and sieved through a 2.0 mm mesh. The processed samples were analyzed for pH, EC, organic carbon, available N, P, K and S, exchangeable Ca and Mg, and micronutrients (Zn, Fe, Mn and Cu). wise after harvest and analysed as per the standard procedure. The recorded data was analysed statistically in Randomized Block Design (RBD) as per the procedure described by Panse and Sukhatme (1954).

Result and Discussion

Effect of different forms and methods of zinc application on yield and yield attributes of sweet corn

The data on yield attributes (Table 1) *viz.* cob length (cm), number of grain rows cob⁻¹, individual cob weight (g) and yield (Table 1) showed significant variation across the treatment application of different forms and methods of zinc.

The yield attributes such as no. of grain rows cob⁻¹, cob length, individual cob weight found to be significantly highest in treatment T₅ (RDF + 0.25% EDTA-Zn at 25 and 50 DAS) registered the maximum no. of grain rows cob⁻¹, cob length without husk, individual cob weight without husk (16.70, 22.89 cm and 269.47 g) respectively, which was on par with T₆ (RDF + 0.5% ZnSO₄ at 25 and 50 DAS) (22.59 cm) with 16.39, 22.59 cm and 263.77 g respectively. Whereas the lowest values were registered in T₁ (RDF) (10.50, 16.70 cm and 151.96 g) respectively. The

improvement may be attributed to the vital role of zinc in reproductive differentiation and cob structural development in maize. It is essential for the assimilation and translocation of photosynthates from the leaves to the sink organs, thereby enhancing sink strength and promoting efficient assimilate partitioning towards the developing cobs.

The variations in cob number plant⁻¹ were not significant with the application of zinc in different forms and methods (Table 1). However, the treatment application of RDF + 0.25% EDTA-Zn at 25 and 50 DAS (T₅) produced the highest cob number (1.38), whereas the T₁ (RDF) with 1.08 cobs plant⁻¹ recorded the lowest. Since cob number is an inherent varietal trait, it remains relatively unaffected by external interventions such as micronutrient supplementation or agronomic management. Lone *et al.* (2022) reported similar findings.

The increase in yield attributing characters leads to increase in yield of the crop (Table 1). Thereby, the highest green cob yield (g plant⁻¹), green cob yield (kg plot⁻¹), green cob yield (q ha⁻¹) (371.86, 27.89 and 193.68) respectively, was recorded in the treatment T₅ (RDF + 0.25% EDTA-Zn at 25 and 50 DAS) which is on par with T₆ (RDF + 0.5% ZnSO₄ at 25 and 50 DAS) with the yield of 362.52, 27.19 and 188.81 respectively. The lowest green cob yield (179.31, 13.45 and 93.39) respectively was recorded in T₁ (RDF). The superiority of this treatment may be attributed to the direct and rapid uptake of zinc through foliar spray, which corrected micronutrient deficiencies during critical growth stages and enhanced photosynthetic efficiency, assimilate partitioning and cob filling. These observations are consistent with the findings reported by Kaur *et al.* (2024) in sweet corn and Naik *et al.* (2020).

Effect of different forms and methods of zinc application on yield and yield attributes of french bean

A significant influence of zinc application was observed on pod number, pod length and green pod yield of French bean (Table 2). The treatment T₅ involving foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS consistently recorded the highest performance, producing 21.44 pods plant⁻¹, a pod length of 16.36 cm and a yield of 89.91 g plant⁻¹, 21.89 kg plot⁻¹ and 15.20 t ha⁻¹. These results were statistically on par with the foliar application of ZnSO₄ @ 0.5% (T₆), which produced 21.06 pods plant⁻¹, a pod length of 16.06 cm, and a yield of 89.58 g plant⁻¹, 21.65 kg plot⁻¹ and 14.96 t ha⁻¹. In contrast, the recommended dose of fertilizers alone recorded the

lowest values across all parameters, with 13.80 pods plant⁻¹, 10.22 cm pod length, and a yield of 66.89 g plant⁻¹, 15.03 kg plot⁻¹ and 10.44 t ha⁻¹. Zinc-supplemented treatments improved pod production by promoting pollen development, enhancing flower fertilization and increasing flower number. These effects collectively resulted in better fruit set and higher yield, as noted by Pandey *et al.* (2013b) and Dass *et al.* (2022). Zinc also plays a crucial role in auxin synthesis, enzymatic activity and protein metabolism. These processes enhance cell division and elongation in reproductive organs, producing longer and well-developed pods. The findings corroborate earlier reports in pea and tomato by Pandey *et al.* (2013a), Nagar *et al.* (2018) and Kumar *et al.* (2024c). The improvement in yield and associated traits under zinc application may be due to enhanced source–sink dynamics, promoting efficient translocation of photosynthates from leaves to developing pods (Sammauria and Yadav, 2010). The results are consistent with the observations of Barla *et al.* (2023) in mung bean, Rafique *et al.* (2015) in pea, Dass *et al.* (2022).

Post-harvest soil properties in sweet corn–french bean cropping sequence

Effect of different forms and methods of zinc application on macronutrients and zinc content in soil at harvest of sweet corn

The results showed a significant increase in the available nitrogen, phosphorous and potassium in soil with the application of FYM enriched with zinc sulphate (Table 3). The status of soil primary nutrients at harvest of sweet corn was notably influenced by the application of various forms and methods of zinc, as summarized in Table. The highest concentrations of available nitrogen (201.76 kg ha⁻¹), phosphorus (32.49 kg ha⁻¹) and potassium (215.65 kg ha⁻¹) were recorded in treatment T₉ (RDF + enriched zinc @ 50 kg ha⁻¹), which was statistically comparable to T₈ (RDF + enriched zinc @ 25 kg ha⁻¹) with 200.95, 31.64 and 214.44 kg ha⁻¹, respectively and T₇ (RDF + bio-fertilizer consortia @ 25 kg ha⁻¹) with 200.01, 31.11 and 213.92 kg ha⁻¹. In contrast, the lowest nutrient levels were observed in T₅ (RDF + foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS), measuring 164.28, 20.88 and 176.25 kg ha⁻¹, which was statistically similar to T₆ (RDF + foliar application of ZnSO₄ @ 0.5% at 25 and 50 DAS) with 165.09, 21.76 and 176.61 kg ha⁻¹. The superior availability of N, P and K under zinc-enriched FYM can be explained by intensified microbial activity and accelerated decomposition of organic matter. Organic substrates in

FYM provide energy for microbial growth, which promotes mineralization of organically bound nutrients, releasing them into plant-accessible forms. Additionally, zinc enrichment stimulates key enzymatic reactions and nutrient transformation pathways in soil, thereby enhancing the availability of major nutrients and improving overall soil fertility. Supporting evidence was documented in the cowpea crop by Yadav *et al.* (2022), Kanwar *et al.* (2014) and Rangaswamy *et al.* (2023).

Significantly highest DTPA extractable zinc content was found in the treatment application of RDF + enriched zinc @ 50 kg ha⁻¹ (T₉) with 0.56 mg kg⁻¹ which was statistically on par with the application of RDF + enriched zinc @ 25 kg ha⁻¹ (T₈) (0.56 mg kg⁻¹) and T₇ (RDF + biofertilizer consortia @ 25 kg ha⁻¹) with 0.55 mg kg⁻¹. In contrast, the treatment application of RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS (T₅) (0.42 mg kg⁻¹) recorded the minimum value and which was on par with treatment T₆ (RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS) (0.42 mg kg⁻¹) and T₁ (RDF) with 0.43 mg kg⁻¹. The significant increase in DTPA-Zn content in soil under zinc-enriched FYM treatment may be attributed to the formation of stable complexes between zinc and functional groups such as phenolic, hydroxyl, carboxylic and amino groups present in organic manure, which help sustain zinc in a more labile and plant-available pool (Tan *et al.*, 1971). Additionally, the high biodegradability of FYM enhances microbial activity and accelerates the mineralization of both native and applied zinc, while the inherent zinc content of the enriched manure further contributes to the overall increase in available zinc in the soil. The results were in line with the findings of Yadav *et al.* (2022) in cowpea crop, Mansuri *et al.* (2019) and Rangaswamy *et al.* (2023) in maize crop.

Effect of different forms and methods of zinc application on macronutrients and zinc content in soil at harvest of french bean

Significant variation across the treatments was found in the available nitrogen content in soil at harvest of french bean crop and the data is presented in Table 4. The highest available nitrogen content (206.23 kg ha⁻¹) was found in the treatment T₉ (RDF with enriched zinc @ 50 kg ha⁻¹) which was on par with T₈ (RDF with enriched zinc @ 25 kg ha⁻¹) (205.82 kg ha⁻¹) and T₇ (RDF + bio-fertilizers consortia @ 25 kg ha⁻¹) (205.08 kg ha⁻¹). While the lowest nitrogen content with 167.81 kg ha⁻¹ was registered in treatment T₅ (RDF + foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS) which was on par with T₆ (RDF + Foliar

application of ZnSO₄ @ 0.5% at 25 and 50 DAS) with 168.62 kg ha⁻¹. Enriched zinc serves as an efficient nutrient carrier, enhancing nutrient use efficiency and stimulating beneficial microbial activity in the soil. Also, the applied zinc promotes atmospheric nitrogen fixation and improves the solubility and mobility of native soil nitrogen, ultimately leading to an increased nitrogen pool and better soil fertility. Barani and Anburani (2004) also reported highest post-harvest soil nitrogen content of okra under combined application of 75% of inorganic fertilizers along with FYM (25 t ha⁻¹) and vermicompost (5t ha⁻¹). Yadav (2011) and Kanwar *et al.* (2014) reported similar findings.

The maximum available phosphorous and potassium content in soil (35.75 and 219.23 kg ha⁻¹) was recorded with treatment T₉ (RDF + enriched zinc @ 50 kg ha⁻¹), which remained statistically on par with T₈ (RDF + enriched zinc @ 25 kg ha⁻¹) registered 34.04 and 218.82 kg ha⁻¹ respectively and T₇ (RDF + biofertilizer consortia @ 25 kg ha⁻¹) with 32.92 and 218.08 kg ha⁻¹. In contrast, the minimum content (22.10 and 179.61 kg ha⁻¹) was observed under T₅ (RDF + foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS), which was statistically on par with T₆ (RDF + foliar spray of ZnSO₄ @ 0.5% at 25 and 50 DAS) recorded 23.22 and 181.12 kg ha⁻¹ respectively (Table 4). Enriched zinc improves root growth and rhizosphere activity, which enhances the solubilization and mobilization of native phosphorus and potassium through increased organic acids released in the root exudates of some crop species more especially legumes are also reported to chelate Al and Fe which help in solubilizing the native phosphates. Doolette *et al.* (2019) noted that legumes increase P resource use efficiency by mobilizing residual P from the soil. Similar observations were also reported in the cowpea crop by Kanwar *et al.* (2014) and Rangaswamy *et al.* (2023).

At harvest of french bean, the observation on DTPA extractable zinc showed significant variation

across the treatments (Table 4). The highest DTPA extractable zinc content was found in the treatment application of RDF + enriched zinc @ 50 kg ha⁻¹ (T₉) with 0.58 mg kg⁻¹ which was statistically on par with the application of RDF + enriched zinc @ 25 kg ha⁻¹ (T₈) (0.57 mg kg⁻¹) and T₇ (RDF + biofertilizer consortia @ 25 kg ha⁻¹) with 0.57 mg kg⁻¹. In contrast, the treatment application of RDF + foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS (T₅) (0.44 mg kg⁻¹) recorded the minimum value and which was on par with treatment T₁ (RDF) with 0.46 mg kg⁻¹ and T₆ (RDF + foliar application of EDTA-Zn @ 0.5% at 25 and 50 DAS) (0.45 mg kg⁻¹) which indicates the natural depletion of zinc through crop uptake without external replenishment showing the lower zinc content in the foliar treatment application. These findings are in line with Fageria and Baligar (2005), who noted that residual soil zinc availability is directly proportional to the applied zinc source and dose. These outcomes concur with the results reported by Flores *et al.* (2023) and Roy *et al.* (2014).

Conclusion

The overall findings revealed that applying micronutrients through foliar spray of EDTA-Zn @ 0.25% at 25 and 50 DAS was found beneficial in enhancing the growth and yield of sweet corn and french bean with higher economical yield in sweet corn – french bean cropping system. The practice of micronutrient application through enrichment technique improved the available nutrients status of soil. FYM enriched with zinc @ 50 kg ha⁻¹ enhances soil fertility by improving zinc availability through the formation of stable organic complexes that prevent fixation. It supplies both macro- and micronutrients in a balanced and sustained manner while improving soil structure, moisture retention and microbial activity. The organic acids and humic substances in FYM increase cation exchange capacity and nutrient mobility. Overall, zinc-enriched FYM enhances nutrient use efficiency and promotes long-term soil health and productivity.

Table 1 : Effect of application of different forms and methods of zinc on yield and yield attributes at harvest of sweet corn

Treatments	Number of cobs plant ⁻¹	Cob length (cm)	Number of rows cob ⁻¹	Cob weight (g cob ⁻¹)	Green cob yield (g plant ⁻¹)	Green cob yield (kg plot ⁻¹)	Green cob yield (q ha ⁻¹)
T ₁	1.08	16.70	10.50	151.96	179.31	13.45	93.39
T ₂	1.22	18.33	12.14	183.06	230.28	17.27	119.93
T ₃	1.28	18.53	12.33	186.75	236.33	17.72	123.08
T ₄	1.26	18.89	12.69	193.58	247.51	18.56	128.91
T ₅	1.38	22.89	16.70	269.47	371.86	27.89	193.68

T₆	1.35	22.59	16.39	263.77	362.52	27.19	188.81
T₇	1.30	20.72	14.53	228.39	304.56	22.84	158.62
T₈	1.31	20.88	14.69	231.45	309.57	23.21	161.23
T₉	1.32	21.11	14.91	235.68	316.50	23.73	164.84
SEm ±	0.04	0.46	0.46	9.36	15.33	1.14	7.02
C.D at 5%	NS	1.40	1.40	28.07	45.97	3.43	21.05

T₁: RDF (120:60:60 NPK kg ha⁻¹, 25 t ha⁻¹ FYM)

T₂: RDF + Soil application of ZnSO₄ @ 25.0 kg ha⁻¹ as basal dose

T₃: RDF + Soil application of ZnSO₄ @ 50.0 kg ha⁻¹ as basal dose

T₄: RDF + Soil application of chelated EDTA-Zn @ 5.0 kg ha⁻¹ as basal dose

T₅: RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS

T₆: RDF + Foliar application of ZnSO₄ @ 0.5% at 25 and 50 DAS

T₇: RDF + Bio-fertilizers Consortia @ 25 kg ha⁻¹

T₈: RDF with enriched zinc @ 25 kg ha⁻¹

T₉: RDF with enriched zinc @ 50 kg ha⁻¹

Table 2 : Effect of application of different forms and methods of zinc on yield and yield attributes of french bean

Treatments	No. of pods plant ⁻¹	Pod length (cm)	Green pod yield (g plant ⁻¹)	Green pod yield (kg plot ⁻¹)	Green pod yield (q ha ⁻¹)	Green pod yield (t ha ⁻¹)
T₁	13.80	10.22	66.89	15.03	104.40	10.44
T₂	15.82	11.84	74.09	16.84	117.00	11.70
T₃	16.06	12.04	74.39	17.06	118.49	11.8
T₄	16.50	12.39	74.60	17.46	121.26	12.12
T₅	21.44	16.36	89.91	21.89	152.00	15.20
T₆	21.06	16.06	89.58	21.65	149.69	14.96
T₇	18.77	14.21	81.84	19.49	135.36	13.53
T₈	18.96	14.37	82.04	19.67	136.60	13.66
T₉	19.24	14.59	82.33	19.91	137.71	13.77
SEm ±	0.60	0.48	2.39	0.55	3.98	0.38
C.D at 5%	1.82	1.45	7.19	1.66	11.93	1.15

T₁: RDF (120:60:60 NPK kg ha⁻¹, 25 t ha⁻¹ FYM)

T₂: RDF + Soil application of ZnSO₄ @ 25.0 kg ha⁻¹ as basal dose

T₃: RDF + Soil application of ZnSO₄ @ 50.0 kg ha⁻¹ as basal dose

T₄: RDF + Soil application of chelated EDTA-Zn @ 5.0 kg ha⁻¹ as basal dose

T₅: RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS

T₆: RDF + Foliar application of ZnSO₄ @ 0.5% at 25 and 50 DAS

T₇: RDF + Bio-fertilizers Consortia @ 25 kg ha⁻¹

T₈: RDF with enriched zinc @ 25 kg ha⁻¹

T₉: RDF with enriched zinc @ 50 kg ha⁻¹

Table 3 : Primary nutrient and DTPA-extractable zinc content in soil at harvest of sweet corn as influenced by application of different forms and methods of zinc

Treatment details	Available N (kg ha ⁻¹)	Available P ₂ O ₅ (kg ha ⁻¹)	Available K ₂ O (kg ha ⁻¹)	DTPA-Zn (mg kg ⁻¹)
RDF (120:60:60 NPK kg ha ⁻¹ , 25 t ha ⁻¹ FYM)	181.44	25.13	194.58	0.43
RDF + Soil application of ZnSO ₄ @ 25.0 kg ha ⁻¹ as basal dose	182.87	26.19	195.87	0.47
RDF + Soil application of ZnSO ₄ @ 50.0 kg ha ⁻¹ as basal dose	183.54	26.74	196.26	0.48
RDF + Soil application of chelated EDTA-Zn @ 5.0 kg ha ⁻¹ as basal dose	182.12	25.71	195.10	0.50
RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS	164.28	20.88	176.25	0.42
RDF + Foliar application of ZnSO ₄ @ 0.5% at 25 and 50 DAS	165.09	21.76	176.61	0.42
RDF + Bio-fertilizers Consortia @ 25 kg ha ⁻¹	200.01	31.11	213.92	0.55
RDF with enriched zinc @ 25 kg ha ⁻¹	200.95	31.64	214.44	0.56
RDF with enriched zinc @ 50 kg ha ⁻¹	201.76	32.49	215.65	0.56
SEm ±	5.38	1.11	5.85	0.01
C.D at 5%	16.14	3.33	17.54	0.04

Table 4 : Primary nutrient and DTPA-extractable zinc content in soil at harvest of French bean as influenced by application of different forms and methods of zinc

Treatment details	Available N (kg ha ⁻¹)	Available P ₂ O ₅ (kg ha ⁻¹)	Available K ₂ O (kg ha ⁻¹)	DTPA - Zn (mg kg ⁻¹)
RDF (63:100 :75 NPK kg ha ⁻¹ , 25 t ha ⁻¹ FYM)	185.94	26.39	198.94	0.46
RDF + Soil application of ZnSO ₄ @ 12.5 kg ha ⁻¹ as basal dose	187.14	28.63	200.14	0.51
RDF + Soil application of ZnSO ₄ @ 25 kg ha ⁻¹ as basal dose	187.71	29.75	200.51	0.51
RDF + Soil application of chelated EDTA-Zn @ 2.5 kg ha ⁻¹ as basal dose	186.86	27.51	199.86	0.52
RDF + Foliar application of EDTA-Zn @ 0.25% at 25 and 50 DAS	167.81	22.10	179.61	0.44
RDF + Foliar application of ZnSO ₄ @ 0.5% at 25 and 50 DAS	168.62	23.22	181.12	0.45
RDF + Bio-fertilizers Consortia @ 15 kg ha ⁻¹	205.08	32.92	218.08	0.57
RDF with enriched zinc @ 12.5 kg ha ⁻¹	205.82	34.04	218.82	0.57
RDF with enriched zinc @ 25 kg ha ⁻¹	206.23	35.75	219.23	0.58
SEm ±	5.73	0.93	5.85	0.01
C.D at 5%	17.19	2.80	17.54	0.04

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