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EFFECT OF SECONDARY AND MICRONUTRIENTS BLENDS ON GROWTH AND YIELD OF CHICKPEA (*Cicer arietinum* L.)

Reddy Vishnu Vardhan Reddy^{1*}, S. S. Hadole¹, P. A. Sarap¹, S. M. Bhoyar², V. V. Goud³, Y. A. Reddy¹, Veeraboina Sri shatha¹, Shinde Sumit Santosh¹ and Gaurav Dilip Patil¹

¹AICRP on MSPE, Department of Soil Science, PGI, Dr. PDKV, Akola, Maharashtra, India

²Department of Soil Science, PGI and Associate Dean, College of Agriculture, Dr. PDKV, Akola, Maharashtra, India.

³AICRP on Weed Management, Department of Agronomy, PGI, Dr. PDKV, Akola, Maharashtra, India

*Corresponding author E-mail: reddivreddy0810@gmail.com

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ABSTRACT

The present investigation entitled “Effect of Secondary and Micronutrients Blends on Growth and Yield of Chickpea (*Cicer arietinum* L.)” was carried out at All India Coordinated Research Project on Weed Management, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* season of 2025-26. The field experiment was laid out in randomized block design with Ten treatments and four replications. The treatments were comprised T₁ - 100% NPK (20:40:40) kg ha⁻¹; T₂ - 100% NPKS (20:40:40:30) kg ha⁻¹; T₃ - 100% NPKS + SMB @ 15 kg ha⁻¹; T₄ - 100% NPKS + SMB @ 20 kg ha⁻¹; T₅ - 100% NPKS + SMB @ 25 kg ha⁻¹; T₆ - 100% NPKS + Micronutrients +Mg (equivalent to T₃); T₇ - 100% NPKS + Micronutrients +Mg (equivalent to T₄); T₈ - 100% NPKS + Micronutrients + Mg (equivalent to T₅); T₉ - 100% NPK + Fertis @ 9.11 kg ha⁻¹ + SZC @ 20.9 kg ha⁻¹ + SMB @ 25 kg ha⁻¹ and T₁₀ - 100% NPKS + Micronutrients + Mg (equivalent to T₉). Application of 100% NPK + Fertis @ 9.11 kg ha⁻¹ + SZC @ 20.9 kg ha⁻¹ + SMB @ 25 kg ha⁻¹ was significantly higher in plant height (cm), chlorophyll (SPAD value), leaf area plant⁻¹, dry matter accumulation plant⁻¹, grain yield and straw yield, which was found statistically at par with 100% NPKS + Micronutrients + Mg (equivalent to T₉). Significantly minimum days to first flowering and 50% of flowering was also observed with T₉ (100% NPK + Fertis @ 9.11 kg ha⁻¹ + SZC @ 20.9 kg ha⁻¹ + SMB @ 25 kg ha⁻¹). These findings conclude that soil application of 100% NPK + Fertis @ 9.11 kg ha⁻¹ + SZC @ 20.9 kg ha⁻¹ + SMB @ 25 kg ha⁻¹ increased the growth and yield of chickpea.

Key words: Micronutrients Blends, Growth, Yield, Chickpea (*Cicer arietinum* L.)

Introduction

Chickpea (*Cicer arietinum* L.) is an important annual legume crop, cultivated primarily for its protein-rich grains. It is commonly known as gram or Bengal gram and is predominantly grown during the *Rabi* season in tropical and subtropical regions with yearly rainfall above 400 mm. Chickpea is broadly classified into Desi and Kabuli types based on grain size, shape, colour and grain-coat characteristics. Desi types generally have smaller, angular grain with a thicker, pigmented seed coat and constitute the major share of global cultivation, whereas Kabuli types have larger, rounded or ram-head-shaped grains with a thin, cream-coloured grain coat and are mainly preferred

for whole-grain consumption.

Chickpea is an important source of plant-based protein, dietary fibre, minerals and vitamins and therefore contributes substantially to food and nutritional security. Its grains contain about 12.6-30.6% protein and provide 334-446 kcal 100 g⁻¹ of energy (Badola *et al.*, 2023; Kinfé *et al.*, 2015). It is also a good source of lipids, particularly linoleic and oleic acids, and essential minerals such as iron and zinc (Xiao *et al.*, 2023; Srungarapru *et al.*, 2022). In India, chickpea is widely consumed as whole grain, dhal, roasted grain and flour and forms an important component of traditional diets.

Globally, chickpea ranks second among pulses in

cultivated area and third in production. India is the leading producer, with about 9.66 million ha under chickpea during 2025-26, producing 12.51 million tonnes at an average productivity of 1295 kg ha⁻¹. Maharashtra, Madhya Pradesh, Rajasthan and Uttar Pradesh are the major chickpea-producing states. Despite its adaptability to relatively low-fertility conditions, chickpea productivity remains below its potential in many regions, partly due to inadequate and imbalanced nutrient supply.

Continuous cropping, intensive cultivation, high-yielding varieties and inadequate replenishment of nutrients have contributed to nutrient depletion and declining soil fertility. In addition to major nutrients, deficiencies of sulphur (S), zinc (Zn), boron (B), iron (Fe), manganese (Mn), copper (Cu) and other essential nutrients are increasingly recognized as constraints to chickpea production. Each ton of chickpea grain in general removes nearly 121.9 kg of primary nutrients (67.3 N + 6.6 P + 48 K), 34.7 kg of secondary nutrients and micronutrients (18.7 Ca + 7.3 Mg + 8.7 S; 38 Zn + 868 Fe + 70 Mn + 11.3 Cu). And uptake of two other micronutrients (B and Mo) estimated to be 35 g (B) and 1.5 g (Mo). The extent of yield losses due to nutrient deficiencies also varies among nutrients (Ali *et al.*, 2002). Yield losses due to deficiency of nutrients can be caused in chickpea, up to 10% with nitrogen, 29-45% with phosphorus, 22-50% with iron, 100% with boron and 16-30% for sulphur, which depends on soil fertility, climate and plant factors.

Secondary and micronutrients play vital roles in photosynthesis, enzyme activity, nodulation, biological nitrogen fixation, protein synthesis and reproductive development. Their deficiencies can adversely affect plant growth, flowering, pod formation and grain development, ultimately reducing yield. Therefore, supplementation of secondary nutrients such as S, Ca and Mg and micronutrients such as Zn, Fe, Mn, Cu, B and Mo along with the recommended N, P, K is important for maintaining balanced nutrition and improving crop performance.

In view of these considerations, the present study was undertaken to evaluate the effect of secondary and micronutrients blends on the growth and yield of chickpea under Vertisols conditions of Maharashtra.

Materials and Methods

The research work entitled “Effect of secondary and micronutrients blends on growth and yield of chickpea” was conducted during the *Rabi* season of 2025-26 at AICRP on Weed management, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The topography of experimental

plot was fairly uniform and levelled. The coordinates of the experimental site 20°42' North latitude and 77°02' East longitude, with altitude of 307.4 meter above mean sea level.

Weather Conditions during the cropping season

The weather condition prevailing during the *Rabi* season of 2025-26 cropping season was recorded and analysed. The total rainfall received during the cropping season was 88.8 mm with 8 rainy days, whereas the mean maximum temperature ranged between 27.0 to 36.2°C, while minimum temperature ranged between 6.2 to 22.6°C. Mean relative humidity during experiment period recorded at 7.30 a.m. ranged between 60 to 95%, whereas at 2.30 p.m. ranged between 16 to 81%. The mean daily evaporation ranged from 1.7 to 7.5 mm, and bright sunlight hours received during the cropping season was 0.3 to 9.4 hrs.

Soil Characteristics, Crop Details and Field Management

The experimental field consisted of deep black clay soil (Vertisols) with relatively uniform topography. chickpea variety PDKV Kanak was sown on 15 October 2025 and harvested on 08 February 2026. The experimental plot measured 3.6 m × 4.0 m, with a spacing of 45 cm between rows and 10 cm between plants. The seed rate was maintained at 80 kg ha⁻¹ and the crop was sown by drilling method. The crop was grown under rainfed conditions and received the prevailing rainfall during the growing season. At physiological maturity, the plants in each plot were uprooted for harvesting. The harvested plants were dried and threshed separately and yield observations were recorded. To all the treatments NPK 20:40:40 kg ha⁻¹ was applied through urea, DAP and MOP (as basal dose). The 30 kg ha⁻¹ sulphur is applied to all treatments except treatment T₁ and it is applied through different fertilizers *i.e* bentonite sulphur, fertis, sulphur zinc complex, secondary and micronutrients blend (SMB) and sulphur of (Magnesium, zinc, iron, manganese and copper sulphates) as per the treatment. Micronutrients were applied by ferrous sulphate, manganese sulphate, zinc sulphate, copper sulphate, borax, ammonium molybdate (as basal application). The magnesium was applied through magnesium sulphate (as basal application). In treatment T₂ sulphur is applied through bentonite sulphur. In treatments T₃, T₄ and T₅, sulphur is applied through secondary and micronutrients blend (SMB) and remaining sulphur is applied through bentonite sulphur. In treatments T₆, T₇, T₈ and T₁₀, sulphur is applied through magnesium, zinc, iron, manganese and copper sulphates and remaining dose of sulphur is applied through bentonite

sulphur. In treatment T₉, 8.2 kg ha⁻¹ sulphur is applied through fertis, 14 kg ha⁻¹ sulphur is applied through Sulphur Zinc complex (SZC) and 7.8 kg ha⁻¹ sulphur is applied through secondary and micronutrients blends. All the fertilizers are applied as basal application, only SMB is applied as top dressing at 25 DAS.

Experimental Design and Treatments:

The field experiment was laid out in a randomized block design with ten treatments and four replications. The treatment details were as follows:

- T₁ : 100% NPK (20:40:40) kg ha⁻¹
- T₂ : 100% NPKS (20:40:40:30) kg ha⁻¹
- T₃ : 100% NPKS + Secondary and Micronutrients Blend (SMB) @ 15 kg ha⁻¹
- T₄ : 100% NPKS + Secondary and Micronutrients Blend (SMB) @ 20 kg ha⁻¹
- T₅ : 100% NPKS+ Secondary and Micronutrients Blend (SMB) @ 25 kg ha⁻¹
- T₆ : 100% NPKS + Micronutrients +Mg (equivalent to T₃)
- T₇ : 100% NPKS + Micronutrients + Mg (equivalent to T₄)
- T₈ : 100% NPKS + Micronutrients + Mg (equivalent to T₅)
- T₉ : 100% NPK + Fertis @ 9.11 kg ha⁻¹ + Sulphur zinc complex (SZC) @ 20.9 kg ha⁻¹ + Secondary and Micronutrients blend (SMB) @ 25 kg ha⁻¹
- T₁₀ : 100% NPKS + Micronutrients + Mg (equivalent to T₉).

Observations recorded and Method Adopted

Plant height (cm):

The plant height at 30, 60 and 90 DAS was measured from the base to the terminal leaf of tagged five plants which were selected randomly in each net plot, the mean values were expressed in cm.

Chlorophyll (SPAD values):

A Minolta chlorophyll meter (Model SPAD 502, Minolta Co., Japan) was used to measure SPAD values. Observations were recorded at the third leaf from the top (Centre position avoiding the midrib). Measurements were taken between 9:00-11:00 AM to minimize diurnal variation. The same leaf and their position, growth stage was maintained for all treatments. Measurements were taken from five tagged plants at 30 and 60 DAS and the mean value was calculated.

Leaf area plant⁻¹ (cm²):

Leaf area was determined at 30 and 60 days after sowing (DAS). Five representative plants were randomly selected from each experimental plot at each observation stage. The leaves from the sampled plants were collected and their total leaf area was measured in laboratory using a leaf area meter.

Dry matter accumulation plant⁻¹ (g):

Five plants from each treatment plot were carefully uprooted and washed to remove any adhered soil. The samples were then shade-dried for 2-3 days before being oven-dried at 65°C until a constant dry weight was achieved. The final dry weight of the samples was recorded and expressed in grams per plant. Dry matter accumulation was recorded at 30, 60 and 90 DAS.

Days to first flowering and 50% of flowering (DAS):

The days to first flowering and 50% of flowering were recorded from date of sowing to the appearance of the first flower and flowering in approximately 50% of the plants, respectively, in each plot across all treatments and replications.

Grain and straw yield (kg ha⁻¹):

The harvested produce from each plot was separately bundled, sun dried and weighed using a spring balance to record biological yield. After threshing and cleaning, grain yield was recorded from each net plot, while straw yield was calculated by subtracting grain yield from the corresponding biological yield of the respective plot.

$$\text{Grain (or) Straw yield (kg ha}^{-1}\text{)} = \frac{\text{Grain (or) Straw yield per plot kg}}{\text{Net plot area (m}^2\text{)}} \times 10,000$$

Observations and Statistical Analysis

Observations on growth parameters and yield were recorded at appropriate growth stages using standard experimental procedures. The data were analysed using analysis of variance appropriate for a randomised block design, as described by Gomez and Gomez (1984). The significance of treatment effects was tested using the F-test, and critical difference (CD) values at the 5% probability level (P = 0.05) were calculated for comparisons among treatment means wherever significant differences were observed.

Result and Discussion

Effect of secondary and micronutrients blends on plant height of chickpea

The data presented in Table 1 shown the effect of secondary and micronutrients blends on plant height (cm) of chickpea. At 30 DAS, the plant height is non-significant,

Table 1: Effect of secondary and micronutrients blends on plant height of chickpea.

Treatments		Plant height (cm)		
		30 DAS	60 DAS	90 DAS
T ₁	100% NPK (20:40:40) kg ha ⁻¹	28.88	45.20	46.90
T ₂	100% NPKS (20:40:40:30) kg ha ⁻¹	29.75	45.30	47.23
T ₃	100% NPKS + SMB @ 15 kg ha ⁻¹	29.48	46.28	48.68
T ₄	100% NPKS + SMB @ 20 kg ha ⁻¹	29.50	47.35	49.58
T ₅	100% NPKS + SMB @ 25 kg ha ⁻¹	29.53	48.23	50.18
T ₆	100% NPKS + Micronutrients + Mg (equivalent to T ₃)	29.88	46.25	48.43
T ₇	100% NPKS + Micronutrients + Mg (equivalent to T ₄)	30.13	47.13	49.45
T ₈	100% NPKS + Micronutrients + Mg (equivalent to T ₅)	30.20	48.18	50.13
T ₉	100% NPK + Fertis @ 9.11 kg ha ⁻¹ + SZC @ 20.9 kg ha ⁻¹ + SMB @ 25 kg ha ⁻¹	30.75	49.33	51.33
T ₁₀	100% NPKS + Micronutrients + Mg (equivalent to T ₉)	30.88	49.13	51.15
SE (m) ±		1.05	0.26	0.27
CD at 5%		NS	0.76	0.80

the highest plant height (30.88 cm) was recorded under T₁₀, while the lowest plant height (28.88 cm) was recorded under T₁. At 60 and 90 DAS, the plant height is significant, higher plant height was recorded under T₉ (49.33 and 51.33 cm, respectively), which was at par with T₁₀ (49.13 and 51.15 cm, respectively). And lowest plant height (45.20 and 46.90 cm, respectively), was recorded under T₁.

The increased plant height under T₉ may be attributed to the balanced application of secondary and micronutrients through Fertis, SZC and SMB along with the recommended NPK. The synergistic effect of these nutrients may have enhanced overall nutrient utilization and plant growth. Sulphur and magnesium contribute to efficient nitrogen utilization and chlorophyll formation, while micronutrients support various enzymatic activities and biological nitrogen fixation. Together, these effects may have promoted better vegetative growth, resulting in increased plant height in chickpea. The present findings are in close agreement with Meena *et al.*, (2013), Kumar *et al.*, (2017), Singh *et al.*, (2026) regarding increased plant height in chickpea with application of secondary and micronutrients with RDF.

Effect of secondary and micronutrients blends on chlorophyll (SPAD value) of chickpea

The data presented in Table 2 shown the effect of secondary and micronutrients blends on chlorophyll

Table 2: Effect of secondary and micronutrients blends on chlorophyll (SPAD value) of chickpea.

Treatments		Chlorophyll (SPAD Value)	
		30 DAS	60 DAS
T ₁	100% NPK (20:40:40) kg ha ⁻¹	42.43	46.23
T ₂	100% NPKS (20:40:40:30) kg ha ⁻¹	42.73	46.38
T ₃	100% NPKS + SMB @ 15 kg ha ⁻¹	42.50	47.43
T ₄	100% NPKS + SMB @ 20 kg ha ⁻¹	42.63	48.03
T ₅	100% NPKS + SMB @ 25 kg ha ⁻¹	42.65	48.58
T ₆	100% NPKS + Micronutrients + Mg (equivalent to T ₃)	42.90	47.38
T ₇	100% NPKS + Micronutrients + Mg (equivalent to T ₄)	43.03	47.90
T ₈	100% NPKS + Micronutrients + Mg (equivalent to T ₅)	43.15	48.33
T ₉	100% NPK + Fertis @ 9.11 kg ha ⁻¹ + SZC @ 20.9 kg ha ⁻¹ + SMB @ 25 kg ha ⁻¹	44.08	49.65
T ₁₀	100% NPKS + Micronutrients + Mg (equivalent to T ₉)	44.10	49.15
SE (m) ±		0.42	0.19
CD at 5%		NS	0.57

(SPAD value) of chickpea. At 30 DAS, chlorophyll (SPAD value) not shown any significant effect, but maximum SPAD value (44.10) was recorded under T₁₀ and minimum SPAD value (42.43) was recorded under T₁. At 60 DAS, significantly maximum SPAD value (49.65) was recorded under T₉, which was at par with T₁₀ (49.15). And minimum SPAD value (46.23) was recorded under T₁.

Increased SPAD value in T₉ may be due to the balanced supply of secondary and micronutrients. As sulphur and magnesium support chlorophyll and protein synthesis, while Fe, Zn and Mn enhance chlorophyll formation, enzyme activity and photosynthesis, resulting in higher chlorophyll content. The present findings are in agreement with Pal *et al.*, (2019), Dass *et al.*, (2022) and Yadav *et al.*, (2026). These findings indicate that balanced nutrition through secondary and micronutrients enhances chlorophyll synthesis and photosynthetic activity, leading to increased SPAD values.

Effect of secondary and micronutrients blends on leaf area of chickpea

The data presented in Table 3 shown the effect of secondary and micronutrients blends on leaf area (cm² plant⁻¹) of chickpea. At 30 DAS, leaf area shown non significantly effect, but maximum leaf area (194.8 cm² plant⁻¹) was recorded under T₁₀, while the minimum leaf area (137.2 cm² plant⁻¹) was recorded under T₁. At 60 DAS, significantly maximum leaf area (424.1 cm² plant⁻¹)

Table 3: Effect of secondary and micronutrients blends on leaf area of chickpea.

Treatments		Leaf area (cm ² plant ⁻¹)	
		30 DAS	60 DAS
T ₁	100% NPK (20:40:40) kg ha ⁻¹	137.2	271.1
T ₂	100% NPKS (20:40:40:30) kg ha ⁻¹	159.7	284.6
T ₃	100% NPKS + SMB @ 15 kg ha ⁻¹	141.7	319.5
T ₄	100% NPKS + SMB @ 20 kg ha ⁻¹	149.6	345.3
T ₅	100% NPKS + SMB @ 25 kg ha ⁻¹	155.2	374.6
T ₆	100% NPKS + Micronutrients + Mg (equivalent to T ₃)	168.7	304.8
T ₇	100% NPKS + Micronutrients + Mg (equivalent to T ₄)	173.2	331.8
T ₈	100% NPKS + Micronutrients + Mg (equivalent to T ₅)	177.7	363.3
T ₉	100% NPK + Fertis @ 9.11 kg ha ⁻¹ + SZC @ 20.9 kg ha ⁻¹ + SMB @ 25 kg ha ⁻¹	187.8	424.1
T ₁₀	100% NPKS + Micronutrients + Mg (equivalent to T ₉)	194.8	414.0
SE (m) ±		13.38	5.48
CD at 5%		NS	15.92

¹) was recorded under T₉, which was on par with T₁₀ (414.00 cm² plant⁻¹). While the minimum leaf area (271.1 cm² plant⁻¹) was recorded under T₁.

The greater leaf area under T₉ might be due to sustainable availability of sulphur, magnesium and micronutrients, which improved chlorophyll formation, enzyme activation and photosynthate production, thereby encouraging greater leaf expansion. Similar findings were corroborated by Singh *et al.*, (2016), Pal *et al.*, (2019) and Ajjannavar *et al.*, (2021), they reported that improved chlorophyll content with different combinations of secondary and micronutrients with RDF and other nutrient sources.

Effect of secondary and micronutrients blends on dry matter accumulation of chickpea

The data presented in Table 4 shown the effect of secondary and micronutrients blends on dry matter accumulation plant⁻¹ of chickpea. At 30 DAS dry matter accumulation shown non-significant effect. But highest dry matter accumulation (12.94 g plant⁻¹) was found under T₁₀, while the lowest dry matter accumulation (11.58 g plant⁻¹) was found under T₁. At 60 and 90 DAS, significantly higher dry matter accumulation (28.98 and 32.34 g plant⁻¹, respectively) was found under T₉, which was significantly at par with T₁₀ (28.91 and 32.07 g plant⁻¹ respectively). While, lowest dry matter accumulation (25.96 and 29.06 g plant⁻¹ respectively) was found under

Table 4: Effect of secondary and micronutrients blends on dry matter accumulation of chickpea.

Treatments		DMA (g plant ⁻¹)		
		30 DAS	60 DAS	90 DAS
T ₁	100% NPK (20:40:40) kg ha ⁻¹	11.58	25.96	29.06
T ₂	100% NPKS (20:40:40:30) kg ha ⁻¹	12.16	26.51	29.56
T ₃	100% NPKS + SMB @ 15 kg ha ⁻¹	11.62	26.71	29.89
T ₄	100% NPKS + SMB @ 20 kg ha ⁻¹	11.78	27.51	30.73
T ₅	100% NPKS + SMB @ 25 kg ha ⁻¹	12.05	28.39	31.48
T ₆	100% NPKS + Micronutrients + Mg (equivalent to T ₃)	12.44	26.69	29.83
T ₇	100% NPKS + Micronutrients + Mg (equivalent to T ₄)	12.62	27.38	30.00
T ₈	100% NPKS + Micronutrients + Mg (equivalent to T ₅)	12.86	28.22	31.35
T ₉	100% NPK + Fertis @ 9.11 kg ha ⁻¹ + SZC @ 20.9 kg ha ⁻¹ + SMB @ 25 kg ha ⁻¹	12.88	28.98	32.34
T ₁₀	100% NPKS + Micronutrients + Mg (equivalent to T ₉)	12.94	28.91	32.07
SE (m) ±		0.37	0.16	0.22
CD at 5%		NS	0.47	0.66
DMA: Dry matter accumulation				

T₁ (100% NPK 20:40:40 kg ha⁻¹).

The greater dry matter accumulation in T₉ may be attributed to balanced secondary micronutrient nutrition, which enhanced photosynthetic efficiency, nutrient assimilation and biomass production. The present findings are in accordance with Singh *et al.*, (2016), Ajjannavar *et al.*, (2021), Padol *et al.*, (2023) and Mishra *et al.*, (2025). who reported greater total dry matter accumulation at different stages of chickpea with application of secondary and micronutrients along with NPK RDF.

Effect of secondary and micronutrients blends on days to first flowering and 50% flowering of

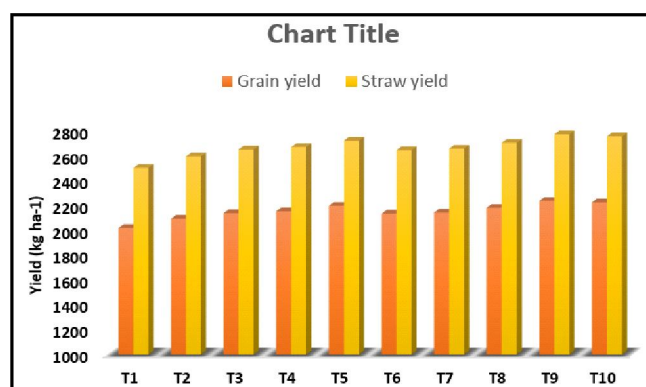
**Fig. 1:** Effect of secondary and micronutrients blends on yield of chickpea.

Table 5: Effect of secondary and micronutrients blends on flowering of chickpea.

Treatments		Flowering (DAS)	
		First flowering	50% of flowering
T ₁	100% NPK (20:40:40) kg ha ⁻¹	45.75	52.00
T ₂	100% NPKS (20:40:40:30) kg ha ⁻¹	44.00	51.00
T ₃	100% NPKS + SMB @ 15 kg ha ⁻¹	41.75	50.25
T ₄	100% NPKS + SMB @ 20 kg ha ⁻¹	40.50	48.75
T ₅	100% NPKS + SMB @ 25 kg ha ⁻¹	39.25	46.75
T ₆	100% NPKS + Micronutrients + Mg (equivalent to T ₃)	42.00	50.50
T ₇	100% NPKS + Micronutrients + Mg (equivalent to T ₄)	41.00	49.75
T ₈	100% NPKS + Micronutrients + Mg (equivalent to T ₅)	39.50	47.50
T ₉	100% NPK + Fertis @ 9.11 kg ha ⁻¹ + SZC @ 20.9 kg ha ⁻¹ + SMB @ 25 kg ha ⁻¹	36.25	42.25
T ₁₀	100% NPKS + Micronutrients + Mg (equivalent to T ₉)	38.50	45.50
SE (m) ±		0.62	0.39
CD at 5%		1.81	1.16

chickpea

The data presented in Table 5 shown that secondary and micronutrients blends significantly affected the days to first flowering and 50% of flowering in chickpea. Significantly minimum days to first flowering (36.25 DAS) and 50% of flowering (42.25 DAS) was observed under T₉ and maximum days to first flowering (45.75 DAS) and 50% of flowering (52.00 DAS) was observed under T₁.

The earliness in flowering may be attributed due to balanced sulphur, magnesium and micronutrient nutrition, which enhanced photosynthesis, enzyme activity and hormonal regulation, thereby promoting an earlier transition to the reproductive phase. The findings agree with Woldearegay (2017) and Shadravan *et al.*, (2018), who reported that sulphur and micronutrient application promoted early flowering and reproductive development in chickpea.

Effect of secondary and micronutrients blends on yield of chickpea

The data presented in Table 6 and Fig. 1 shown that effect of secondary and micronutrients blends significantly influenced in grain and straw yield of chickpea. Treatment T₉ recorded higher grain and straw yield (2233 and 2768 kg ha⁻¹, respectively), which was significantly at par with T₁₀ (2221 and 2753 kg ha⁻¹, respectively). While, T₁ recorded the lowest grain and straw yield.

The higher grain and straw yields under T₉ may be

Table 6: Effect of secondary and micronutrients blends on grain and straw yield of chickpea.

Treatments		Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
T ₁	100% NPK (20:40:40) kg ha ⁻¹	2015	2499
T ₂	100% NPKS (20:40:40:30) kg ha ⁻¹	2090	2592
T ₃	100% NPKS + SMB @ 15 kg ha ⁻¹	2136	2648
T ₄	100% NPKS + SMB @ 20 kg ha ⁻¹	2150	2666
T ₅	100% NPKS + SMB @ 25 kg ha ⁻¹	2192	2718
T ₆	100% NPKS + Micronutrients + Mg (equivalent to T ₃)	2131	2641
T ₇	100% NPKS + Micronutrients + Mg (equivalent to T ₄)	2140	2654
T ₈	100% NPKS + Micronutrients + Mg (equivalent to T ₅)	2178	2700
T ₉	100% NPK + Fertis @ 9.11 kg ha ⁻¹ + SZC @ 20.9 kg ha ⁻¹ + SMB @ 25 kg ha ⁻¹	2233	2768
T ₁₀	100% NPKS + Micronutrients + Mg (equivalent to T ₉)	2221	2753
SE (m) ±		13.69	16.61
CD at 5%		39.74	48.22

attributed to the balanced supply of secondary and micronutrients which improved crop growth, chlorophyll (SPAD value), leaf area development and dry matter accumulation throughout the crop growth period. The present findings are in close agreement with Meena *et al.*, (2013), Pooja *et al.*, (2019), Ajjannavar *et al.*, (2021), and Yadav *et al.*, (2026). They reported that increased grain and straw yield with increased doses of secondary and micronutrients over the control in various combinations of secondary and micronutrients.

Conclusion

The study demonstrated that the application of 100% NPK + Fertis @ 9.11 kg ha⁻¹ + SZC @ 20.9 kg ha⁻¹ + SMB @ 25 kg ha⁻¹ shown higher growth and yield response in chickpea. This treatment recorded a grain yield of 2233 kg ha⁻¹ and a straw yield of 2768 kg ha⁻¹. Its performance was significantly comparable with application of 100% NPKS + Micronutrients + Mg (equivalent to T₉), which produced 2221 kg ha⁻¹ grain yield and 2753 kg ha⁻¹ straw yield. The treatment 100% NPK + Fertis @ 9.11 kg ha⁻¹ + SZC @ 20.9 kg ha⁻¹ + SMB @ 25 kg ha⁻¹ has shown maximum plant height, chlorophyll (SPAD value), leaf area plant⁻¹ and dry matter accumulation plant⁻¹ and earliness to first flowering and 50% of flowering.

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