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Effect of water soluble fertilizer on growth, yield and yield attributes of chickpea (*Cicer arietinum* L.)

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Abstract

A pot experiment entitled “Effect of water soluble fertilizer on growth, yield and yield attributes of chickpea (*Cicer arietinum* L.)” was conducted at Net House, Department of Soil Science & Agricultural Chemistry, College of Agriculture, Junagadh Agricultural University, Junagadh on clayey texture soils during *Rabi* season of 2023-24 having medium in available N and available P_2O_5 , high in K_2O and medium in available S and alkaline in reaction. The results revealed that soil application of 20-40-00 kg ha⁻¹ NPK and foliar application of 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS found superior over other treatments with respect to plant height (42.43 cm), number of branches per plant (6.53), number of nodules per plant (52.67), number of pods per plant (27.17), seed yield (9.25 g plant⁻¹) and straw yield (9.89 g plant⁻¹).

Keywords: Chickpea, WSF, growth, yield

Introduction

Chickpea (*Cicer arietinum* L.) is an essential annual pulse crop that belongs to the genus: *Cicer*, Family Leguminosae or Fabaceae and is also recognized as “Bengal gram”. Chickpea is classified into desi (chromosome number $2n = 14, 16$) and kabuli chickpea (chromosome number $2n = 16$). Chickpea are a vital food because of their high nutritional content, especially in regions of the world that are vulnerable to famine. Chickpea is mainly consumed in the form of processed whole seed and dal however used for preparing a variety of sweets, condiments and snacks, which are very beneficial for stomach ailments and blood purification. Chickpea is grown in India on 9.59 million ha and produces of 11.04 million tons with national average productivity of 1151 kg/ha during 2023-24. In Gujarat, during the year 2023-24, it was cultivated in an area of 0.62 million ha with production of 1.07 million tons of grains with the average productivity of 1714 kg/ha (Anon., 2024) [2].

Foliar feeding is the most effective and economic way to improve plant nutrient efficiency (Dixit and Elamathi, 2007) [4]. Application of nutrient through foliar spray at appropriate stages of crop growth becomes important for their utilization and better performance of the crop (Anandhakrishnaveni *et al.*, 2004) [1]. Nitrogen and Phosphorous were applied through soil but nowadays these fertilizers were applied through water soluble fertilizer as foliar spray to avoid losses and increase efficiency of fertilizers. In recent years, speciality fertilizers had been introduced exclusively for foliar feeding and fertilization which serve better for foliar application and may contain different ratios of N, P and K with or without other nutrients with high solubility and so amenable for foliar nutrition (Shruthi and Vishwanath, 2018) [7].

Water soluble fertilizers are having specific characteristics *viz.*, 100% water soluble, safe and effective, provide entire spectrum of nutrients needed for a wide variety of plants, source for immediate availability, formulated to be compatible with most common pesticides and fungicides and uniform in analysis.

Research on the Effect of water soluble fertilizer on growth, yield and yield attributes of chickpea (*Cicer arietinum* L.) has practical utility in terms of optimizing agricultural practices for increased crop productivity, resource use efficiency and environmental sustainability.

Materials and Methods

The experimental soil was clayey in texture and moderately alkaline in reaction with pH 8.1 and EC 0.46 dS m⁻¹. The soil was medium in available nitrogen (323 kg ha⁻¹), medium in available phosphorus (53.86 kg ha⁻¹), high in available potassium (304.5 kg ha⁻¹) and medium in available sulphur (19.62 ppm). There were 11 treatments of T₁- Absolute control (No fertilizer), T₂- only RDF (20-40-00 N-P₂O₅-K₂O kg ha⁻¹), T₃- RDF + 2% spray of 12-61-00 (20 DAS), T₄- RDF + 2% spray of 00-52-34 (40 DAS), T₅- RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS), T₆- 75% RDF + 2% spray of 12-61-00 (20 DAS), T₇- 75% RDF + 2% spray of 00-52-34 (40 DAS), T₈- 75% RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS), T₉- 50% RDF + 2% spray of 12-61-00 (20 DAS), T₁₀- 50% RDF + 2% spray of 00-52-34 (40 DAS), T₁₁- 50% RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS) replicated thrice in CRD. In this study, plant height, number of branches per plant, number of pods per plant, seed yield and straw yield were recorded at harvest and number of nodules per plant at 45 DAS.

Results and Discussion

Effect on growth parameters

Plant height and no. of branches per plant is typical characters of crop which has erect growth habit. Plant height and no. of branches were significantly influenced by WSF as foliar spray. The data presented in (Table 1) showed that different treatments significantly influenced growth parameter at harvest. Significantly higher plant height (42.43) was observed by T₅ (RDF + 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS) which was found at par with treatments T₄ (RDF + 2% spray of 00-52-34 at 40 DAS), T₃ (RDF + 2% spray of 12-61-00 at 20 DAS) and T₈ (75% RDF + 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS). Significantly lower value observed in T₁ (37.03), which might be due to unavailability of nutrients which might lower the growth of plant and significantly higher number of branches per plant (6.53) was recorded with treatment T₅ (RDF + 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS) which was found at par with treatments T₄ (RDF + 2% spray of 00-52-34 at 40 DAS), T₇ (75% RDF + 2% spray of 00-52-34 at 40 DAS) and T₃ (RDF + 2% spray of 12-61-00 at 20 DAS). While the treatment T₁ recorded significantly lowest value (4.57).

These results are in confirmatory with the findings of Singh *et al.* (2021) [8] found that foliar application of 75% RDF + foliar application of 2% DAP + 2% Urea + 2% WSF at 60 and 80 DAS recorded significantly higher plant height (60.28 cm) in chickpea over the control. Takankhar *et al.* (2017) [9] found that the foliar application of RDF + 19-19-19 @ 1.0% at vegetative stage, RDF + 00-52-34 @ 1.0% at flowering stage and RDF + 13-00-45 @ 1.0% at grain filling stage recorded significantly the highest number of branches plant⁻¹ over the control in chickpea.

The data presented in (Table 1) showed that different

treatments significantly influenced number of nodules plant⁻¹. Significantly the highest number of nodules plant⁻¹ (52.67) was noted at T₅ (RDF + 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS) at 45 DAS over the other treatments. It was remained at par with treatment T₃ (RDF + 2% spray of 12-61-00 at 20 DAS). The lowest value of number of nodules plant⁻¹ (24.33) observed under treatment (T₁).

These findings are in close agreement with the results obtained by Bhavya *et al.* (2020) [3] found that foliar application of monopotassium phosphate and 19-19-19 each @ 1% at 30 and 45 DAS along with package of practice (RDF of 13-25-25 N, P₂O₅ and K₂O kg ha⁻¹) shows the increase in number of nodules (36.92) at 45 DAS maximum in root nodulation and higher over its control in green gram.

Effect on yield attributes

Application of WSF significantly influenced the yield attributes like number of pods per plant (Table 2). The highest number of pods per plant (27.17) was noted at T₅ (RDF + 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS). It was remained at par with treatments T₄ (RDF + 2% spray of 00-52-34 at 40 DAS). While the lowest number of pods plant⁻¹ (17.80) was found in the treatment (T₁).

Similar results observed by Yadav *et al.* (2023) [10] found that the foliar application of NPK (19:19:19) @ 0.5% at pre-flowering and pod- initiation stage recorded higher number of pods plant⁻¹ (63.43) over all other treatments in field pea. The improvement in number of pods plant⁻¹ was due to additive effect of macro nutrients with better translocation of nutrients.

Effect on seed and straw yield

Chickpea seed and straw yield were significantly influenced due to different treatments tried in the experiment. Significantly higher seed yield (9.25 g plant⁻¹) and straw yield (9.89 g plant⁻¹) were obtained in treatment T₅ (RDF + 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS). Whereas, it was remained statistically at par with T₄ (RDF + 2% spray of 00-52-34 at 40 DAS) and T₃ (RDF + 2% spray of 12-61-00 at 20 DAS) in respect to both. However, significantly lowest seed yield (6.50 g plant⁻¹) and straw yield (6.36 g plant⁻¹) were observed in treatment T₁.

Similar results observed by Sakthi *et al.* (2020) [6] found that seed yield in black gram was significantly impacted due to application of RDF + Foliar spray of 1% 19:19:19 on 15 DAS + Foliar spray of 1% 12:61:00 on 30 DAS + Foliar spray of 1% 13:00:45 on 45 DAS recorded the maximum values for yield-attributing characters that is seed yield (1097.54 kg ha⁻¹) over control. The similar results were quoted by Kumari *et al.* (2019) [5] found that straw production ranged from 1367 to 2012 kg ha⁻¹. Green gram crops fertilized with RDF (20:40:20:20 N:P₂O₅:K₂O:S kg ha⁻¹) and sprayed with N:P:K (19:19:19) @ 2% produced the highest straw yield (2012 kg ha⁻¹) followed by RDF + N:P:K (19:19:19) @ 1% (1367 kg ha⁻¹) and this is significantly superior over control in green gram.

Table 1: Effect of WSF on growth of chickpea

	Treatments	Plant height (cm)	Number of branches plant ⁻¹	Number of nodules plant ⁻¹ At 45 DAS
T ₁	Absolute control	37.03	4.57	24.33
T ₂	Only RDF (20-40-00 N-P ₂ O ₅ -K ₂ O kg ha ⁻¹)	38.10	5.53	44.00
T ₃	RDF + 2% spray of 12-61-00 (20 DAS)	41.03	5.80	50.67
T ₄	RDF + 2% spray of 00-52-34 (40 DAS)	41.70	6.17	47.67
T ₅	RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS)	42.43	6.53	52.67
T ₆	75% RDF + 2% spray of 12-61-00 (20 DAS)	39.23	5.43	43.00
T ₇	75% RDF + 2% spray of 00-52-34 (40 DAS)	39.03	5.87	44.33
T ₈	75% RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS)	40.30	5.53	36.67
T ₉	50% RDF + 2% spray of 12-61-00 (20 DAS)	38.20	5.67	26.00
T ₁₀	50% RDF + 2% spray of 00-52-34 (40 DAS)	39.07	5.27	27.33
T ₁₁	50% RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS)	38.57	5.40	29.67
	S.E.m. ±	1.08	0.28	1.12
	C.D. at 5%	3.16	0.82	3.30
	C.V.%	4.73	8.64	5.02

Table 2: Effect of WSF on yield and yield attributes of chickpea

	Treatments	No. of pods plant ⁻¹	Seed yield (g plant ⁻¹)	Straw yield (g plant ⁻¹)
T ₁	Absolute control	17.80	6.50	6.36
T ₂	Only RDF (20-40-00 N-P ₂ O ₅ -K ₂ O kg ha ⁻¹)	18.87	7.54	7.19
T ₃	RDF + 2% spray of 12-61-00 (20 DAS)	24.80	8.83	9.06
T ₄	RDF + 2% spray of 00-52-34 (40 DAS)	26.07	9.10	9.67
T ₅	RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS)	27.17	9.25	9.89
T ₆	75% RDF + 2% spray of 12-61-00 (20 DAS)	18.00	6.95	7.63
T ₇	75% RDF + 2% spray of 00-52-34 (40 DAS)	22.63	8.50	7.87
T ₈	75% RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS)	20.62	8.09	8.52
T ₉	50% RDF + 2% spray of 12-61-00 (20 DAS)	19.40	7.94	8.04
T ₁₀	50% RDF + 2% spray of 00-52-34 (40 DAS)	18.13	7.25	7.88
T ₁₁	50% RDF + 1% spray of 12-61-00 (20 DAS) + 1% spray of 00-52-34 (40 DAS)	20.07	8.00	8.45
	S.E.m. ±	0.73	0.24	0.40
	C.D. at 5%	2.13	0.71	1.17
	C.V.%	5.93	5.26	8.36

Conclusion

On the basis of one-year experimental data, it can be concluded that the soil application of recommended dose of fertilizer 20-40-00 N-P₂O₅-K₂O kg ha⁻¹ along with foliar application of 1% spray of 12-61-00 at 20 DAS + 1% spray of 00-52-34 at 40 DAS exhibited its superiority in respect to parameters like, growth, yield and yield attributes on medium black calcareous soil of South *Saurashtra* Agro-Climatic Zone. Overall, the application of water soluble fertilizers play effective role in improving yield of chickpea.

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