Asian Journal of Soil Science and Plant Nutrition

Volume 10, Issue 3, Page 488-494, 2024; Article no.AJSSPN.122122
ISSN: 2456-9682

Effect of Foliar Nutrition on Growth, Yield and Yield Attributes of Chickpea (*Cicer arietinum* L.) under Medium Black Calcareous Soil

J. J. Vaghani [a++*], D. R. Vala [b#], R. V. Patel [c†] and T. C. Poonia [c‡]

[a] Department of Soil Science and Agril. Chemistry, College of Agriculture, Junagadh Agricultural University, Amreli, Gujarat, India.
[b] Department of Soil Science and Agril. Chemistry, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India.
[c] College of Agriculture, Junagadh Agricultural University, Mota Bhandariya (Amreli), Gujarat, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ajsspn/2024/v10i3360

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/122122

Original Research Article

Received: 18/06/2024
Accepted: 21/08/2024
Published: 24/08/2024

ABSTRACT

A study was conducted to laid out under medium black calcareous soil during *rabi* 2019-20 at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. The experiment followed a randomized block design (RBD) with three

[++] *Associate Professor;*
[#] *M. Sc. Scholar;*
[†] *Agriculture Officer;*
[‡] *Assistant Professor;*
**Corresponding author: Email: jjvaghani@gmail.com;*

Cite as: *Vaghani, J. J., D. R. Vala, R. V. Patel, and T. C. Poonia. 2024. "Effect of Foliar Nutrition on Growth, Yield and Yield Attributes of Chickpea (Cicer Arietinum L.) under Medium Black Calcareous Soil". Asian Journal of Soil Science and Plant Nutrition 10 (3):488-94. https://doi.org/10.9734/ajsspn/2024/v10i3360.*

replications, comprising with 10 treatments. The results of the field study indicated that growth, yield and yield attributes of chickpea was significantly influenced by foliar nutrition. The growth, yield and yield attributes parameters *viz*., plant height (44.50 cm), no. of branches per plant (9.31), no. of nodules per plant (9.88), no. of pods per plant (42.65) and test weight (16.30 g), seed (2395 kg ha^{-1}) and stover yield (3675 kg ha^{-1}) were recorded significantly higher under 100% RDF + 1.0 % (Mono Ammonium Phosphate) at 30 and 45 DAS, at harvest, but plant population and number of seeds per pod did not affect significantly with foliar application of WSF at harvest. At 50 DAS plant height (34.78 cm) and number of branches per plant (6.35) are also significantly highest.

Keywords: Chickpea; foliar application; water soluble fertilizers; growth; yield attributes; yield.

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a member of family Fabaceae that is widely cultivated for its typically yellow-brown, pea like seeds. Chickpea is fourth largest pulse crop in the world. About 90 per cent of chickpea in the world is grown under rainfed conditions, where drought is one of the major constraints. India is the largest producer of chickpea contributing more than 75 per cent of the world population. In India, chickpea total production is 99.38 lakh tones in 95.47 lakh ha with a productivity of 1041 kg ha^{-1} [1]. In Gujarat, total production of chickpea is 6.35 lakh MT from an area of 4.05 lakh ha and productivity is 1568 kg ha^{-1} [2]. When fertilizers are applied as foliar, it utilized more than 90 per cent by plant. While similar amount is applied to the soil, only 10 per cent is utilized. Foliar nutrition is designed to eliminate the problems like fixation and immobilization of nutrients. Recently, new generation special fertilizers have been introduced exclusively for foliar feeding and fertilization. Especially fertilizers are a better source for foliar application [3]. These fertilizers have different ratios of N, P and K which are highly water soluble and so amenable for foliar [4]. In pulses, moisture stress had drastic effect on nitrogen fixation besides plant growth. The number of *Rhizobium* in soil decline drastically as soil dries. A suitable way to feeding during and after drought is through foliar nutrition. Hence, foliar nutrition is being recognized as an important method of fertilization in modern agriculture [5].

2. MATERIALS AND METHODS

A field experiment was carried out with chickpea (var.GG-5) on medium black calcareous soil during *rabi* 2019-20 at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. As per Tables 1 & 2 the soil had $pH_{2.5}$ 7.78, $EC_{2.5}$ 0.51 dSm^{-1}, available N (236 kg ha^{-1}), P_2O_5 (28.3 kg ha^{-1}) and K_2O (278 kg ha^{-1}). The experiment was laid out in RBD with replicated thrice along with 10 treatments viz., T_1 - Control (N_0 fertilizer), T_2 - 100% RDF, T_3-100% RDF + 1.0% WSF (Urea Phosphate) at 30 and 45 DAS, T_4 - 100% RDF + 1.5% WSF (Urea Phosphate) at 30 and 45 DAS, T_5 - 75% RDF + 1.0% WSF (Urea Phosphate) at 30 and 45 DAS, T_6 - 75% RDF + 1.5% WSF (Urea Phosphate) at 30 and 45 DAS, T_7 - 100% RDF + 1.0% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS, T_8 -100% RDF + 1.5% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS, T_9 - 75% RDF + 1.0% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS, T_{10} - 75% RDF + 1.5% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS. The N and P_2O_5 were applied in respective plots by using the urea and DAP as a basal dose as per treatment in each plot, respectively. The net plot size was 4.0 m × 2.7 m and the crop was sown on 30th November 2019 keeping a spacing of 45 x 10 cm using recommended seed rate of 60 kg ha^{-1}. At maturity, pod and stover yield data were recorded. The protein content of seed was worked out by multiplying nitrogen content of seed with the factor of 6.25 as reported by AOAC [6].

Table 1. Mechanical Composition of the experimental soil

Particular	Value at soil depth (0-20 cm)	Method followed
Mechanical Composition		
1. Sand %	35.11	International Pipette method (Piper, 1950)
2. Silt %	12.75	
3. Clay %	52.14	
4. Texture class	Clayey	

Table 2. Chemical Composition of the experimental soil

Chemical Composition		
1. Soil pH (1:2.5)	7.78	pH meter (Richard, 1954)
2. EC (dS/m) at 25 ^{o}C (1:2.5)	0.51	EC meter (Jackson, 1974)
3. Organic Carbon (%)	0.72	Walkley and Black's method (Jackson, 1974)
4. Available N (kg ha^{-1})	236	Alkaline $KMnO_4$ method (Subbiah and Asija, 1956)
5. Available P_2O_5 (kg ha^{-1})	28.3	Olsen's method (Olsen *et. al.*, 1954)
6. Available K_2O (kg ha^{-1})	278	Flame photometric method (Jackson, 1974)
7. Available S (ppm)	10.80	Turbid metric method (Chaudhary and Cornfield,1966)
8. Available Fe (mg kg^{-1})	4.88	DTPA extract method (Lindsay and Norvell, 1978)
9. Available Zn (mg kg^{-1})	0.60	
10. Available Mn (mg kg^{-1})	6.10	
11. Available Cu (mg kg^{-1})	1.32	

3. RESULTS AND DISCUSSION

The data presented in Table 3 and Table 4 on effect of foliar nutrition on growth, yield and yield attributes of chickpea.

3.1 Growth Parameters

The data presented in Table 3 indicated that the plant height and number of branches per plant were significantly affected due to foliar application of fertilizers at different stages of the crop. The treatment T_7 (100% RDF + Mono Ammonium Phosphate @ 1.0% at 30 and 45 DAS) recorded significantly higher plant height and number of branches at 50 DAS and at harvest as compared to control. The plant population did not significantly affect by foliar application of any treatment. The increase in growth parameters might be due to foliar application of N and P which helped in acceleration of various metabolic processes in plants, synthesis of IAA, stimulating effect on photosynthetic pigments and enzyme activity resulting greater apical growth. Above results are in line with Takankhar [7].

3.2 Yield and Yield Attributes

The data concerning seed and stover yield furnished in Table 3 indicated that significant difference was observed in seed and stover yield with respect to foliar spray of WSF. The application of RDF 20:40:00 kg NPK ha^{-1} + foliar application of WSF (Mono Ammonium Phosphate) @ 1.0 per cent applied at 30 and 45 DAS (T_7) recorded significantly higher seed (2395 kg ha^{-1}) and Stover (3675 kg ha^{-1}) yield as compared to control.

Foliar fertilization involves in physiological and biochemical processes along with N-fixation, higher photosynthetic rate resulting increased yield in chickpea. The present findings are in close agreement with the results obtained by Shankarappa [8] in chickpea and Shankarappa [8] in lentil.

The yield attributes were significantly affected due to foliar application of nutrients. The treatment T_7 (100% RDF + Mono Ammonium Phosphate @ 1.0 % at 30 and 45 DAS) recorded significantly higher number of pods plant^{-1}, number of nodules plant^{-1} and test weight at harvest than all other treatments. The number of seeds per pod was found no significant. The improvement in yield attributes was due to additive effect of macro nutrients with better translocation of nutrients. The results obtained are in close conformity with the findings of Mudalagiriyappa [9] in chickpea and Sharifi [10] in Soybean and Bhavya [11] in green gram.

3.3 Available Nutrients Status in Soil

It is apparent from data presented in Table 4 showed that available macro (N, P_2O_5, K_2O and S) and micronutrients (Fe, Mn, Zn and Cu) content in soil have no any significant effect by foliar application of nutrition along with basal dose of fertilizer.

Table 3. Effectof foliar application of water soluble fertilizer (WSF) on yield and yield attributes of chickpea

Treatments		Final plant population ha^{-1}	Plant height (cm)		Number of branches plant^{-1}		No.of pods plant^{-1}	No. of seeds pod^{-1}	No. of nodules plant^{-1} (45 DAS)	Test weight (g)	Yield (kg ha^{-1})	
			At 50 DAS	At harvest	At 50 DAS	At harvest					Seed	Stover
T_1	Control	150637	26.72	35.80	3.56	7.50	33.67	1.82	7.13	12.62	1908	2812
T_2	100% fertilizer as per RDF	154333	27.82	36.80	3.79	7.55	35.07	1.83	7.87	13.72	1973	2912
T_3	100% RDF + 1.0% WSF (Urea Phosphate) at 30 and 45 DAS	167900	30.61	38.90	5.15	8.83	38.59	1.84	8.43	14.33	2065	2957
T_4	100% RDF + 1.5% WSF (Urea Phosphate) at 30 and 45 DAS	176467	33.39	43.40	5.62	8.81	38.78	1.89	9.19	15.23	2177	3371
T_5	75% RDF + 1.0% WSF (Urea Phosphate) at 30 and 45 DAS	159600	28.59	38.57	4.55	7.98	37.16	1.91	8.35	14.19	1959	3027
T_6	75% RDF + 1.5% WSF (Urea Phosphate) at 30 and 45 DAS	161232	28.66	38.57	4.56	7.94	35.96	1.84	8.17	14.26	2018	3064
T_7	100% RDF + 1.0% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	183264	34.78	44.50	6.35	9.31	42.65	1.90	9.88	16.30	2395	3675
T_8	100% RDF + 1.5% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	177527	32.51	44.03	5.59	8.81	39.13	1.96	9.28	15.16	2215	3387
T_9	75% RDF + 1.0% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	161649	29.61	38.80	4.86	7.87	36.10	1.90	8.39	14.37	2081	3049
T_{10}	75% RDF + 1.5% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	156202	29.52	38.47	4.88	7.94	34.77	1.85	8.01	13.51	2024	3025
	S.Em±	**0.74**	**1.59**	**1.89**	**0.28**	**0.39**	**1.65**	**0.07**	**0.47**	**0.61**	**90.4**	**163**
	C.D. at 5%	**NS**	**4.72**	**5.63**	**0.82**	**1.15**	**4.91**	**NS**	**1.40**	**1.81**	**269**	**485**

Table 4. Effect of foliar application of water soluble fertilizer on available macro & micronutrients status in soil after harvest of crop

Treatments		Macro-nutrients (kg ha^{-1})				Micro-nutrients (ppm)			
		N	P_2O_5	K_2O	S (ppm)	Fe	Mn	Zn	Cu
	Initial status	236	28.30	278	10.80	4.88	6.10	0.60	1.32
T_1	Control	239	31.35	278	11.10	5.11	6.51	0.61	1.35
T_2	100% fertilizer as per RDF	241	32.34	280	11.35	5.27	6.71	0.63	1.37
T_3	100% RDF + 1.0% WSF (Urea Phosphate) at 30 and 45 DAS	247	35.34	283	12.48	5.28	7.05	0.69	1.47
T_4	100% RDF + 1.5% WSF (Urea Phosphate) at 30 and 45 DAS	251	36.32	284	13.66	5.35	6.98	0.70	1.48
T_5	75% RDF + 1.0% WSF (Urea Phosphate) at 30 and 45 DAS	244	33.48	281	13.24	5.27	6.61	0.65	1.40
T_6	75% RDF + 1.5% WSF (Urea Phosphate) at 30 and 45 DAS	242	33.28	281	12.56	5.30	6.65	0.65	1.38
T_7	100% RDF + 1.0% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	255	37.38	285	13.88	5.38	7.18	0.71	1.51
T_8	100% RDF + 1.5% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	252	37.22	284	13.71	5.34	7.10	0.70	1.47
T_9	75% RDF + 1.0% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	248	34.45	282	13.43	5.30	6.92	0.68	1.44
T_{10}	75% RDF + 1.5% WSF (Mono Ammonium Phosphate) at 30 and 45 DAS	247	34.69	283	12.72	5.31	6.83	0.65	1.42
	S.Em±	**13.07**	**1.67**	**14.65**	**0.82**	**0.29**	**0.33**	**0.03**	**0.07**
	C.D. at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

4. CONCLUSION

On the basis of one year experimental data, it can be concluded that the soil application of recommended dose of fertilizer 20:40 kg N: P_2O_5 ha^{-1} along with foliar application of Mono Ammonium Phosphate (12-61-00 NPK kg ha^{-1}) @ 1.0% at 30 and 45 DAS were found effective in produced sustainable yield and growth of chickpea under irrigated conditions on medium black calcareous soil of South Saurashtra region.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT,COPILOT,etc) and text-to-image generators have been used during writing or editing of the manuscripts.

ACKNOWLEDGEMENT

First and foremost, I bow down before “Almighty God” with solicitations and impoliteness to express my deepest sense of gratitude for His blessings, mercy and faithfulness, thus enabling me to accomplish this venture. No human effort could climb the ladder without being given the right direction. Diligence and moderation are the best steps to climb to excellence and reach the top. It is my proud privilege to express a deep sense of gratitude to Dr. J. J. Vaghani, (Advisor), Associate Professor, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Junagadh Agricultural University, Mota Bhandariya (Amreli) Gujarat whose generous help, untiring guidance, supervision, critical suggestions and his positive attitude towards my abilities enabled me to complete this work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anonymous. FAOSTAT (Food and Agriculture Organization Statistics). Available:http://www.fao.org/faostat/en/home. 2020a; Accessed on 18 April, 2021
2. Anonymous. Directorate of agriculture, Gandhinagar, Gujarat. Available:dag.gujarat.gov.in. 2020b; accessed on 17th July, 2021.
3. Vibhute CP. A process for manufacturing complex solid and liquid completely water soluble fertilizer. Fertilizer News. 1998; 43(8): 63.
4. Jayabal A, Revathy M, Saxena MG. Effect of foliar nutrition on nutrient uptake pattern in soybean. Andhra Agricultural Journal. 1999;46:243-44.
5. Chaurasia SNS, Singh KP, Mathura R. Effect of foliar application of water soluble fertilizers on growth, yield, and quality of tomato (*Lycopersicon esculentum* L.) Sri Lankan Journal of Agriculture Science. 2005;42:66-70.
6. AOAC. Official method of analysis, Ed. 12, Association of Official Analytical Chemists, Washington, D.C; 1965.
7. Takankhar VG, Karanjikar PN, Bhoye SR. Effect of foliar nutrition on growth, yield and quality of chickpea (*Cicer arietinum* L.). Asian Journal of Soil Science. 2017; 12(2):296-99.
8. Shankarappa KS, Samuel JM, Chandrashekar AB, Singh AK, Nagabhushanaradhya P, Bhuvaneshwari S, Wani SH, Hosam OE. Standardizing the hydrogel application rates and foliar nutrition for enhancing yield of lentil. MDPI. 2020;8:420.
9. Mudalagiriyappa M, Ali S, Ramachandrappa BK, Basavaraja PK, Kiran. Effect of foliar application of water soluble fertilizer on nutrient uptake and reproductive efficiency of Chickpea (*Cicer arietinum* L.). The Bioscan, An International Quaternaly Journal of Environmental Life Sciences. 2016;11(3): 1601-04.
10. Sharifi SKL, Lalitha BS, Qasimullah R, Prajwal Kumar GK, Manjanagouda SS. Effect of foliar application of water soluble fertilizer on growth and yield of soybean (*Glycine max* L.). International Journal of Pure Applied Bioscience. 2018; 6(5):766-70.
11. Bhavya M, Sridhara CJ, Nandish MS, Mavarkar NS, Suchitha Y, Sumithra BS. Influence of foliar application of water soluble fertilizers on

nodule count and rhizosphere microbial population in green gram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2020;9(2):2383-92.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/122122