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Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 12
Issue: 06

Res. Jr. of Agril. Sci. (2021) 12: 2049–2052

CARAS

Res. Jr. of Agril. Sci. (Nov-Dec 2021) 12(6): 2049–2052
www.rjas.org

Full Length Research Article

Effect of Macro and Micronutrients Fertilization on Growth Parameters and Yield of Hybrid Chilli in Sandy Clay Loam Soils of Cuddalore District, Tamil Nadu

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Received: 06 Aug 2021 | Revised accepted: 20 Oct 2021 | Published online: 17 Nov 2021

A B S T R A C T

A field experiment was conducted at farmers field in Vanniyarpalayam village, Kurinjippaditaluk, Cuddalore district, Tamil Nadu with chilli hybrid Mahyco Sierra as test crop, during February – May 2020 to evaluate the response of hybrid chilli to macro and micronutrients fertilization in sandy clay loam soils of Cuddalore district, Tamil Nadu. The experimental soil was sandy clay loam with a pH of 5.7, EC of 0.26 dsm^{-1}. The available N, P, K and B content of soil were 196 (Low), 9.5 (Low), 232 kg ha^{-1} (Medium) and 0.074 mg kg^{-1} (Low). The treatments consisted of application of inorganic fertilizers like Complex fertilizer (17:17:17) @ 0.5% foliar spray, DAP @ 0.5% foliar spray and Borax @ 0.5% foliar spray were applied in different combinations. The experiment was laid out in randomized block design and replicated three times. The growth and yield parameters were recorded at 30, 60, 90 and 120 DAT. The experimental findings revealed that among the different treatments tried, the highest value of the growth parameters regarding plant height, number of primary branches $plant^{-1}$, number of leaves $plant^{-1}$, leaf area index, total chlorophyll content, dry matter production, number of flowers $plant^{-1}$ and days to 50 % flowering as well as fruit yield were recorded from the application of (RDF + Complex fertilizer 17:17:17 @ 0.5 % foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray). Among the different treatment combinations experimented, application of RDF + complex fertilizer 17:17:17 @ 0.5% foliar spray + DAP @ 0.5% foliar spray + borax @ 0.5% foliar spray (T_8) significantly increased the growth components. The highest plant height of 49.36, 98.34, 108.72 and 124.27 (cm) was recorded at 30, 60, 90 and 120 DAT respectively. The highest number of leaves $plant^{-1}$ was recorded in the treatment T_8 (RDF + complex fertilizer 17:17:17 @ 0.5% foliar spray + DAP @ 0.5% foliar spray + borax @ 0.5% foliar spray). The highest leaf area index was recorded in the treatment T_8. The highest number of branches $plant^{-1}$ of 43.76, 89.92, 105.32 and 121.16 at 30, 60, 90 and 120 DAT respectively was recorded in the treatment T_8. The highest number of primary branches was recorded in T_8 of 13.28. The per cent increase in fruit yield due to RDF + Complex fertilizer (17:17:17) @ 0.5% foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray treatment (T_8) varied from 7.3 to 23.81 per cent over control. This was followed by treatment T_6 (RDF+ complex fertilizer (17:17:17) @ 0.5% foliar spray+ borax @ 0.5% foliar spray. The least growth components at all stages of growth were registered in the treatment T_1 with application of 100% recommended dose of fertilizers.

***Key words*:** *Capsicum annum*, Macro and micronutrients, Fertilization, Growth parameters, Yield

Chilli (*Capsicum annum* L.) is a hot and tasting tropical berry belonging to the Solanaceae family. It is a remunerative vegetable, spice cum cash crop of the Indian subcontinent. Chilli is used as both vegetable and spice crop. Chilli peppers originated in Mexico [1]. In 21st century Asian cuisine, chilli peppers are commonly used across diverse regions. The genus of capsicum contains 20 species and now five domesticated species are *Capsicum annuum*, *Capsicum frutescens*, *Capsicum chinense*, *Capsicum baccatum*, *Capsicum pubescensare* only recognized [2]. Chilli is famous for its nutritional value, medicinal effects and therapeutic treatments, in addition it is used as an organic colouring and flavouring agent in food industries. Chillies are the good source of Vitamin - A, B, C and E (Tocopherol), Oleoresin, Carbohydrates and minerals such as Calcium, Phosphorous, Ferrous, Sodium and Copper in trace amounts [3]. The pungency principle is due to the presence of *Capsaicin* ($C_{18}H_{27}NO_3$) synthesized in the epidermal cells of placenta of the fruits and possess inflammatory and anti–oxidant activities [4]. India is the

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world leading country in Chilli production followed by China and Pakistan. During 2021, Indian red chilli production is expected to be around 12,32,000 metric tonnes. Chilli generally takes up large amount of nutrients that have specialized functions and should be supplied to plant at the right time with suitable quantity. When chillies are adequately supplied with the essential nutrients through fertilization it improves their yield, quality and enhance maturity. Generally, nitrogen enhances the metabolic processes that based on protein, leads to increases in vegetative, reproductive growth and yield of the crops [5]. Phosphorous is important in seed germination, seedling establishment, root, shoot, flowers and seed development [6]. Potassium nutrition has also been associated with increased yields, fruit size, increased soluble solids and ascorbic acid concentrations, improved fruit colour, increased shelf life and shipping quality of many horticultural crops. In chillies Boron, which are brought out to be useful in increasing fruit set and reducing fruit drop. Micronutrients are completely available to the plant and thus particularly effective because they are not fixed or diluted in large volumes of soil. Foliar fertilizers are being used in vegetables and fruit crops that contain various macro and micronutrients. Besides, foliar application of various macro and micronutrients has been proved beneficial, foliar feeding is a relatively new technique of feeding plants by applying liquid fertilizer directly to their leaves also they are known to immediately deliver nutrients to the tissues and organs of the crop [7]. Considering the significance of foliar fertilizers for chillies, the present study was therefore under taken to investigate the impact of nitrogen, phosphorous, potassium and boron fertilizers on growth and yield of hybrid chilli.

MATERIALS AND METHODS

A field experiment was conducted at farmers field, Vanniyarpalayam village, Kurinjippadi taluk, Cuddalore district during February 2020 – May 2020 to study the response of hybrid chilli to macro and micronutrients fertilization in sandy clay loam soils of Cuddalore district, Tamil Nadu with hybrid chilli Mahyco Sierra as test crop under irrigated condition with eight treatments replicated thrice in a randomized block design. The experimental soil was sandy clay loam. The treatments were T_1 - (100% RDF alone), T_2 - (RDF + Borax @ 10 kg ha^{-1}), T_3 - (RDF + Borax @ 0.5 % Foliar spray), T_4 - (RDF + Complex fertilizer 17:17:17 @ 0.5% Foliar spray), T_5 - (RDF + DAP @ 0.5% Foliar spray), T_6 - (RDF + Complex fertilizer 17:17:17 @ 0.5% Foliar spray + Borax @ 0.5% Foliar spray), T_7 - (RDF + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray) and T_8 - (RDF + Complex fertilizer 17:17:17 @ 0.5% foliar spray + DAP @ 0.5 % foliar spray + Borax @ 0.5% foliar spray). Recommended dose of fertilizers were applied uniformly in all plots. Application of inorganic fertilizers like Complex fertilizer (17:17:17), DAP and Borax were given as 0.5 % foliar spray as per the treatment schedule. Growth and yield were recorded at different growth stages at 30, 60, 90 and 120 DAT of hybrid chilli production.

RESULTS AND DISCUSSION

Growth parameters

Plant height (cm)

From the data, it is found that the plant height of hybrid chilli at different growth stages was significantly influenced by the application of inorganic fertilizers in different combinations. Among the different treatments experimented, the application of RDF + Complex fertilizer (17:17:17) @ 0.5% foliar spray+ DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray (T_8) registered the maximum plant height of 49.36, 98.34, 108.72 cm and 124.27 cm at 30, 60, 90 and 120 DAT respectively was followed by T_6. However, T_8 and T_6, T_6 and T_7, T_4 and T_5, T_2 and T_3 were on par with each other. The lowest plant height of 32.63, 72.47, 79.54 and 91.75 at 30, 60, 90 and 120 DAT respectively were recorded in control (T_1). Mineral nutrition had a good effect on growth of hybrid chilli. As nitrogen is an essential part of chlorophyll, it helps in protein synthesis. Maximum leaves plant^{-1} may be due to sufficient amount of nitrogen provided an ideal environment and balanced nutrition to plants, which increased number of leaves. Leaves have direct relation with number of branches. Plants having more branches gave more leaves and vice versa [8]. The increase in plant height due to complex fertilizers might have been attributed by the solubility and uniform distribution of nutrients, which had increased the plant height in chilli [9]. Similar results on increased plant height, number of leaves^{-1}, number of primary branches plant^{-1}, leaf area index, total chlorophyll content and dry matter production due to application of complex fertilizers were earlier reported by [10] in hybrid chilli.

Table 1 Effect of macro and micronutrients on plant height (cm), number of branches plant^{-1} and number of branches plant^{-1} at different growth stages of hybrid chilli

Treatment particulars	Plant height (cm)				Number of branches plant^{-1}				Number of branches plant^{-1}			
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_1	32.63	72.47	79.54	91.75	3.05	6.18	8.89	9.87	30.54	66.76	78.68	91.14
T_2	37.10	79.06	86.70	99.24	3.64	7.13	9.86	10.84	33.82	72.64	85.32	98.43
T_3	36.32	77.91	84.99	97.81	3.56	6.87	9.57	10.66	32.86	70.97	84.11	97.37
T_4	41.77	85.40	94.71	108.38	4.24	8.14	11.29	11.87	37.47	78.45	92.49	106.63
T_5	40.05	84.18	93.29	106.64	4.17	7.85	10.58	11.63	36.71	76.94	90.94	104.71
T_6	46.23	92.72	102.53	116.93	4.86	9.21	12.36	12.78	40.85	84.79	99.27	114.75
T_7	44.85	91.13	100.66	114.90	4.68	8.96	12.09	12.60	39.98	83.53	98.13	112.82
T_8	49.36	98.34	108.72	124.27	5.35	9.87	13.14	13.56	43.76	89.92	105.32	121.16
S.Ed.	0.97	2.07	2.29	2.69	0.11	0.20	0.27	0.28	0.91	1.94	2.27	2.52
CD (p=0.05)	2.03	4.32	4.79	5.39	0.23	0.43	0.57	0.59	1.81	3.92	4.54	5.26

Number of branches plant^{-1}

It was observed that the application of inorganic fertilizers had a great influence on number of branches plant^{-1}. The maximum number of branches (5.35, 9.87, 13.14 and 13.56 at 30, 60, 90 and 120 DAT respectively) plant^{-1} was recorded from the treatment (T_8) containing RDF + Complex fertilizer (17:17:17) @ 0.5% foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray. While, the minimum number of branches plant^{-1} were found in RDF alone treatment (T_1), which registered 3.05, 6.18, 8.89 and 9.87 branches at 30, 60, 90 and 120 DAT. The betterment in yield components of chilli might be due to supplementing macronutrients fertilizers, which improved the beneficial effect of nitrogen, particularly, promote the production of more photosynthetic substance required for fruit formation and development [11]. The increase in number of fruits in the best treatment might be due to the foliar applied N, P K and B would have brought about a favourable status, both assimilate and hormone for production of more number of flowers, which are capable of setting in to fruits. An optimal level of synthesis of cytokinin at higher level of N and P would have led to setting of more number of fruits per plant [12-13].

Number of leaves plant^{-1}

From the data, it recorded that maximum number of leaves plant^{-1} were counted with RDF, complex fertilizers (17:17:17 and DAP) @ 0.5% foliar spray and borax @ 0.5% foliar spray T_8. The values were 43.76, 89.92, 105.32 and 121.16 at 30, 60, 90 and 120 DAT respectively. The lowest number of leaves plant^{-1} was recorded in T_1 and values were 30.54, 66.76, 78.68 and 91.14 at 30, 60, 90 and 120 DAT respectively.

Leaf area index (m^2)

It was observed that combination treatments effect resulted highest leaf area index with application of RDF, complex fertilizer 17:17:17 @ 0.5% foliar spray, DAP @ 0.5% foliar spray and borax @ 0.5% foliar spray of 0.89 at 30 DAT, 1.43 at 60 DAT, 1.67 at 90 DAT and 1.92 at 120 DAT. Treatment T_6 and T_7 values were on par and the least leaf area index was registered under recommended dose of fertilizer alone treatment.

Dry matter production (kg ha^{-1})

From the data it is clearly recorded significantly maximum dry matter production (206.31, 1356.11, 3792.42 and 4462.06 kg ha^{-1}) at 30,60, 90 and 120 DAT was noticed in T_8 followed by T_6 (RDF + Complex fertilizer @ 0.5% Foliar spray + Borax @ 0.5% Foliar spray) with 196.48, 1298.16, 3621.19 and 4254.34 at 30, 60.90 and 120 DAT respectively. The minimum dry matter production of 160.77, 1052.44, 2809.45 and 3192.49 kg ha^{-1} at 30, 60, 90 and 120 DAT respectively was registered in RDF alone treatment (T_1) in both stem and foliage. In the present investigation higher growth promoted from the early stage onwards in terms of plant height and DMP due to the favourable nutritional environment and higher uptake of nutrients might have increased the rate of photosynthesis, better translocation of photosynthates from stems and leaves to sink, which favourably influenced the growth parameters [14-15].

Table 2 Effect of macro and micronutrients on LAI (m^2), dry matter production (kg ha^{-1}) at different growth stages, number of flowers plant^{-1} and days to 50 % flowering of hybrid chilli

Treatment particulars	Leaf Area Index				Dry matter production (kg ha^{-1})				Number of flowers plant^{-1}	Days to 50% flowering
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT		
T_1	0.68	1.10	1.32	1.49	160.77	1052.44	2809.45	3192.49	83.60	29.00
T_2	0.73	1.20	1.41	1.61	174.20	1135.37	3096.41	3519.35	90.69	28.00
T_3	0.72	1.18	1.39	1.58	170.54	1111.93	2966.12	3396.45	88.35	29.00
T_4	0.78	1.28	1.50	1.71	185.00	1220.49	3387.57	3888.40	97.94	27.00
T_5	0.77	1.27	1.48	1.69	183.97	1192.87	3283.64	3756.21	95.44	28.00
T_6	0.84	1.36	1.59	1.83	196.48	1298.16	3621.19	4254.34	105.44	27.00
T_7	0.83	1.34	1.57	1.80	194.82	1274.59	3536.10	4142.51	102.69	27.00
T_8	0.89	1.43	1.67	1.92	206.31	1356.11	3792.42	4462.06	110.20	27.00
S.Ed.	0.01	0.02	0.03	0.03	4.02	24.36	69.46	87.99	2.24	0.68
CD (p=0.05)	0.03	0.05	0.06	0.07	8.43	50.89	145.23	184.79	4.72	1.44

Number of flowers plant^{-1}

Number of flowers plant^{-1} varied significantly among different treatment combinations and ranged from 83.60 to 110.20. Among the various treatment combinations tested, the treatment T_8 was found to be the highest, as it recorded maximum number of flowers plant^{-1} i.e., 110.20, followed by the treatment T_6 which counted the value of 105.44. The least number of flowers plant^{-1} (83.60) was registered in the RDF treatment. The treatment T_6 and T_7 were on par with each other. The reason for increased 114 fruit characters might be due to readily available N due to the application of N, P and K may also be the prime factor for the increased fruit length and fruit girth in chilli [16]. The increased fruit length, number of fruits per plant and size of fruit in chilli were attributed to balanced macro and micronutrient ratio, more mineralization, more availability of native and applied macro and micro nutrients, more solubilization effect and availability of nutrients by addition of chemical fertilizers and more physiological activity leading to buildup of sufficient food reserves for the developing sinks and better portioning towards the developing fruit [17].

Days to 50 per cent flowering

From the data it is observed that the number of days to fifty per cent flowering was significantly decreased due to various treatment combinations. The treatment T_8 which recorded lowest number of days (27.00) to reach fifty per cent flowering in chilli and it was followed by T_6. The treatment T_6 and T_7 are on par with each other. This was closely followed by T_4, T_5 and T_7. Whereas RDF taken maximum number of days to fifty per cent flowering viz., 29.00 days.

Table 3 Effect of macro and micronutrients on yield parameters of hybrid chilli

Treatment particulars	Fruit yield (q ha^{-1})
T_1: RDF	129.54
T_2: RDF + Borax @ 10 kg ha^{-1}	139.87
T_3: RDF + Borax @ 0.5% Foliar spray	137.73
T_4: RDF + Complex fertilizer @ 0.5% Foliar spray	150.63
T_5: RDF + DAP @ 0.5% Foliar spray	148.16
T_6: RDF+ Complex fertilizer @ 0.5% Foliar spray + Borax @ 0.5% Foliar spray	161.52
T_7: RDF + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray	158.87
T_8: RDF + Complex fertilizer @ 0.5% foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray	170.04
S. Ed.	3.42
CD (p=0.05)	7.21

Fruit yield (q ha^{-1})

Application of different types of inorganic fertilizers had great effect on the yield of hybrid chilli. The result revealed that the highest fruit yield (170.04 q ha^{-1}) was registered from T_8 treatment (combined application of complex fertilizers viz., 17:17:17 and DAP as foliar spray, borax @ 0.5% foliar spray along with recommended dose of fertilizer) and it was followed by T_6 (RDF, complex fertilizer 17:17:17 @ 0.5% foliar spray along with borax @ 0.5% foliar spray treatment of 161.52 q ha^{-1}). Fruit yield values of T_6 and T_7 values were on par. Among the treatments, lowest fruit yield (129.54 q ha^{-1}) was registered in recommended dose of fertilizer treatment (T_1). Higher chilli yield recorded in this treatment might be due to availability of optimum quantity of required macro and micro nutrients through different nutrient sources and the release of which coincided with crop demand, besides improving the soil condition due to microbial population in soil, which enhanced root proliferation and synchronized source to sink relationship. The increase in fruit yield in the best treatment could be due to overall additive effect of NPK and boron applied through foliar nutrition as a supplemental dose on various growths, physiological, yield parameters and uptake of nutrients, finally resulted in higher fruit yield [18].

CONCLUSION

The experimental findings revealed that among the different treatments tried, the highest value of the growth parameters regarding plant height, number of primary branches plant^{-1}, number of leaves plant^{-1}, leaf area index, total chlorophyll content, dry matter production, number of flowers plant^{-1} and days to 50 % flowering as well as fruit yield were recorded from the application of (Recommended dose of fertilizer + Complex fertilizer 17:17:17 @ 0.5 % foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray.

LITERATURE CITED

1. Kraft KH, Luna-Ruiz JJ, Gepts P. 2013. A new collection of wild populations of capsicum in Mexico and the southern United States. *Genet. Res. Crop. Evolution* 60: 225-232.
2. Islam MR, Sultana T, Haque MA, Hossain MI, Naima S, Rabiul I. 2018. Growth and yield of chilli influenced by nitrogen and phosphorous. *Jr. Agric. Sciences* 11(5): 54-68.
3. Prathibha VH, Mohan Rao A, Ramesh S, Nanda C. 2013. Estimation of fruit quality parameters in anthracnose infected chilli fruits. *Int. Jr. Agric. Food Sci. Technology* 4(2): 57-60.
4. Anupam R. 2016. Bhutjolokia (*Capsicum chinense* Jaqc): a review. *Int. Jr. Pharm. Sci. Research* 7(3): 882-889.
5. Leghari SJ, Buriro M, Jogi Q, Kandhro N, Leghari AJ. 2016. Depletion of phosphorous reserves, a big threat to agriculture: challenges and opportunities. *Sci. International* 28(3): 2697-2702.
6. Muindi EM. 2019. Understanding soil phosphorus. *Int. Jr. Plant Soil Sciences* 31(2): 1-18.
7. Baloch QB, Chachar QI, Tareen MN. 2008. Effect of foliar application of macro and micronutrients on production of green chillies (*Capsicum annum* L.). *Jr. Agric. Sci. Technology* 4(2): 177-184.
8. Mounika D, Uma Devi M, Praveen Rao V, Avil Kumar K, Prabakar BN. 2018. Effect of different N and K fertigation levels on growth parameters and yield of paprika under drip fertigation levels. *Int. Jr. Pure App. Biosciences* 6(5): 329-338.
9. Krishnamoorthy V, Noorjehan AKA. 2014. Effect of Water soluble and conventional fertilizers on growth and yield of chillies. *Jr. Krishi Vigyan* 2(2): 28-30.
10. Deepadevi N, Shanthi A. 2009. Effect of foliar spray of water-soluble fertilizer on growth and NPK uptake of chilli hybrid (*Capsicum annum* L.). *The Asian Jr. Horticulture* 8(1): 222-225.
11. Gabr SM, Ghoneim IM, Hassan HMF. 2001. Effects of bio and nitrogen fertilization on growth, flowering, chemical contents, yield and quality of sweet pepper. *Jr. Adv. Agric. Research* 6(4): 939-955.
12. Karpagam R, Kannan M, Natarajan S, Srinivasan K. 2004. Studies on the efficiency of foliar feeding of water-soluble fertilizers on growth parameters and yield of brinjal hybrid COBH. *South Ind. Horticulture* 52(1/6): 139-142.
13. Rajesh N. 2011. Studies on the performance of transplanting and foliar Nutrition in red gram. *M. Sc. (Agriculture), Thesis*, Tamil Nadu Agric. Univ., Coimbatore.
14. Kirubakaran P. 1992. Studies on the evaluation of industrial organic and inorganic wastes on groundnut cv. VRI 2 in sandy loamy soil. *M. Sc. (Agriculture) Thesis*, Faculty of Agriculture, Annamalai University, Annamalainagar.
15. Kambale MS, Kathmale DK, Najan BR, Gondmar PP. 2002. Effect of recycling of organic farm wastes on yield of groundnut. Extended summaries, Vol. 1: 2nd International Agronomy Congress, Nov. 26-30, New Delhi.
16. Babitha B. 2015. Effect of water-soluble fertilizer on growth and yield of brinjal (*Solanum melongena* L.). *M. Sc. (Horticulture)* Thesis, Department of Horticulture, Annamalai University, Annamalainagar, Tamil Nadu.
17. Lal S, Kanaujia SP. 2013. Integrated nutrient management in capsicum under low-cost polyhouse condition. *Ann. Horti.* 6: 170-177.
18. Palaniappan SP, Jeyabal A, Chelliah S. 1999. Response of tomato and chilli to foliar application of water-soluble fertilizers. *Veg. Science* 23(1): 9-15.