DOI : 10.5958/2349-4433.2024.00015.1

J Krishi Vigyan 2024, 12(1) : 77-83

Growth and Yield of Fodder Cowpea as Influenced by Nutrient Management in Sandy Loams of Onattukara in Kerala

Ancy G Martin[1], Atul Jayapal[2*], Shalini Pillai P[3], Mini V[4]. and Sharu S R[5].

College of Agriculture, Vellayani, Kerala Agricultural University, Thrissur, India 680656

ABSTRACT

An experiment was conducted to examine the effect of nutrient management on growth and yield of fodder cowpea in sandy loams of Onattukara. The experiment was laid out in RBD with eight treatments and three replications. The treatments were T_1 (100% RDF), T_2 (75% RDF), T_3 (T_1 + zinc @ 0.25% as foliar spray at 20 DAS), T_4(T_1 + boron @ 0.25% as foliar spray at 20 DAS), T_5 (T_1 + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS), T_6(T_2 + zinc @ 0.25% as foliar spray @ 20 DAS), T_7 (T_2 + boron @ 0.25% as foliar spray @ 20 DAS) and T_8 (T_2 + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS). The results revealed that T_3 produced significantly higher plant height, number of leaves per plant and LAI at 30 DAS and at harvest. The green fodder yield per plant (106.72 g), green fodder yield per hectare (23.74 t), dry fodder yield per plant (10.12 g) and dry fodder yield per hectare (2.25 t) were significantly influenced by the treatment T_3. For enhanced growth and yield of fodder cowpea in *Onattukara* sandy loam soils of Kerala, the crop has to be supplied with 100 % recommended dose of fertilizers (FYM @ 10 t/ha, N, P_2O5 and K_2O @ 25:60:30 kg/ha) along with foliar application of zinc sulphate heptahydrate @ 0.25 percent at 20 days after sowing.

Key Words: Foliar, Fodder yield, *Onattukara*, Sandy loam

INTRODUCTION

Good quality fodder is essential for the growth and development of livestock sector. In summer, both the quantity and quality of available herbage are notably low. Introducing a fodder legume in low-lying areas during the summer season can significantly improve fodder production and enhance the overall productivity of rice-based cropping systems. Fodder cowpea, particularly well-suited for sandy and relatively infertile soils, is widely cultivated in such regions (Singh and Tarawali, 2011). Addressing nutrient availability is crucial for optimizing crop production. Leguminous crops like fodder cowpea play a dual role by fixing nitrogen from the atmosphere in their root nodules, enriching the soil, and serving as green fodder, dry fodder, and silage during the lean summer months Boron and Zinc are essential plant micronutrients and their importance to crop productivity is similar to that of major nutrients (Rattan *et al,* 2009; Padbhushan and Kumar, 2014). The *Onattukara* region of Alappuzha district, Kerala is characterized by a cropping system of two crops of rice followed by sesame/pulses/vegetables in the summer. The sandy loam soils of Onattukara is inherently low in nutrient contents (Mini and Mathew, 2015). To overcome this, strict adherence to fertilizer recommendations for each crop is necessary to achieve satisfactory yields. Hence, the present study was undertaken with the objective of yield enhancement in fodder cowpea through foliar nutrition of boron and zinc in the sandy loam soils of Onattukara.

MATERIALS AND METHODS

A study for enhancement in yield of fodder cowpea was done during December 2022 to February 2023 at Onattukara Regional Agricultural Research Station, Kayamkulam. The experiment was laid out in randomized block design (RBD) with eight treatments and three replications. The treatments were T_1 (100% RDF), T_2 (75% RDF), T_3 (T_1+ zinc @ 0.25% as foliar

Corresponding Author's Email: atul.j@kau.in
1,2,3 & 5College of Agriculture, Vellayani
4Onattukara Regional Agricultural Research Station, Kayamkulam

spray at 20 DAS), T_4 (T_1 + boron @ 0.25% as foliar spray at 20 DAS), T_5 (T_1 + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS), T_6 (T_2 + zinc @ 0.25% as foliar spray @ 20 DAS), T_7 (T_2 + boron @ 0.25% as foliar spray @ 20 DAS) and T_8(T_2 + boron @ 0.125% + zinc @ 0.125% as foliar spray at 20 DAS).

The experimental area was cleared, stubbles were removed and clods were broken. Dolomite @ 1 t/ha was applied uniformly in the experimental area and incorporated into soil along with tillage. Well decomposed farm yard manure was applied to all the plots as per treatments at the time of land preparation. The recommended dose of fertilizers given were 25:60:30 kg N: P_2O_5:K_2O ha^{-1}. The fertilizers were given in splits as half N, full P, half K as basal and the remaining half N and half K were given as top dressing at 15 days after sowing (KAU, 2016). Foliar nutrition of zinc was supplied as zinc sulphate heptahydrate @ 0.25 % and boron was applied as solubor @ 0.25%. Fodder cowpea var. Aiswarya released from ICAR-AICRP on Fodder Crops, College of Agriculture, Vellayani, Kerala was used for the study. It has a potential yield of 30 t/ha. The seeds of fodder cowpea were sown directly in lines in raised beds at a spacing of 30 cm x 15 cm. Interculture, weeding and earthing up for fodder cowpea were done at 10 days after sowing and at one month after sowing. Growth characters of fodder cowpea *viz*., plant height, number of leaves per plant, leaf area index and number of branches per plant were recorded from five observational plants in each plot at 15 DAS, 30 DAS and at 45 DAS and the average was worked out. The plant height was measured in centimetres using a meter scale from the base of the plant to the growing tip of the stem. The total number of fully opened green leaves per plant was counted and the average was worked out and recorded. For calculating the Leaf are index (LAI), the method suggested by Gomez (1972) was followed. At 15 DAS, there was two fully opened unifoliate leaves and one trifoliate leaf from each observational plant. At 30 DAS and 45 DAS, only trifoliate leaves were present which were selected from each observational plant. The length and width of the fully opened individual lobes of trifoliate leaves in the observational plants per plot were recorded. The total leaf area per plant was worked out by multiplying average leaf area by number of leaves.

Leaf area was calculated by using the formula:

LA = L x W x K Where,

LA : Leaf area per plant (cm^2)

L : Length of leaf (cm)

W : Width of leaf (cm)

K : Factor (0.75)

Leaf area index was calculated using the following formula.

$$LAI = \frac{\text{Total functional leaf area per plant (cm}^2\text{)}}{\text{Land area occupied per plant (cm}^2\text{)}}$$

The number of primary branches per plants from each observation plant was counted and the mean was recorded. The yield characters like green fodder yield per plant, green fodder yield per hectare, dry fodder yield per plant and dry fodder yield per hectare was recorded at harvest. The fresh weight of observational plants from the respective treatments were recorded and the average was worked out for green fodder yield per plant. The plants in the net plot were cut at the base and made into bundles, in each plot and were weighed and expressed as kg/ha for green fodder yield per hectare. The observational plants harvested separately were first shade dried and then oven dried at 60° ± 5° C till constant weight was achieved. The dry weights of these samples were taken and total dry fodder yield per plant was calculated and expressed as g/plant. For dry fodder yield per hectare, the observational plants dried to constant weight were taken and calculated for dry fodder yield per hectare.

RESULTS AND DISCUSSION

Effect of Treatments on Growth and Growth Attributes

The plant height was found to increase throughout the crop period. The results (Table 1) indicated that different treatments did not significantly influence the plant height at the initial stage of growth (15 DAS). At 30 DAS and at harvest there was significant effect due to treatments. The treatment T_3 (T_1 + zinc @ 0.25% as foliar spray @ 20 DAS) recorded the tallest plants at 30 DAS and at harvest. The increase in plant height might be due to higher shoot growth by cell elongation, cell differentiation and apical dominance promoted by zinc. In general, the treatments that received 100 % RDF recorded taller plants compared to 75 % RDF. This might be due to the increased nutrients received from higher dose of fertilizers supplied. When zinc was applied as foliar (0.25%) spray there was an increase in plant height for fodder cowpea. This might be due to the favourable effects of zinc on cell division and enlargement which might have resulted in an increased plant height. Similar reports on improved plant height due to foliar application of zinc were also reported in tomato (Haleema *et al,* 2018), cowpea (Salehin and Rahman, 2012) and mung bean (Samreen *et al,* 2017). When boron, at a higher dose, was applied as foliar spray (T_4 and T_7), the older leaves of fodder cowpea developed spots which later turned necrotic. The younger leaves which developed latter were found to be unaffected. This might be the reason for the shorter plants in the treatments which received boron spray. Hosseini *et al* (2007) also reported reduced plant height in corn due to higher level of boron. When zinc was applied in combination with boron (T_5 and T_8), plants were taller compared to foliar application of boron alone (T_4 and T_7). This might be due to the lower dose of applied boron (0.125%) and the combination of zinc might have aided in increasing the photosynthetic activity, cell division and cell elongation. Hatwar *et al* (2003) also reported similar results in chilli.

This increase in number of leaves per plant with foliar nutrition of zinc might be due to the role of zinc in formation of tryptophan required for the synthesis of auxin. Zinc is also reported to promote chlorophyll formation and nutrient uptake thereby improving the vegetative growth and leaf number (Cakmak, 1999). Similar results of effect of foliar applied zinc in increasing the number of leaves were also reported in tomato (Haleema *et al,* 2018 and Ejaz *et al.* 2012). In general, the treatment that received a higher nutrient dose was found to improve the number of leaves compared to those which received a lower dose**.** The combined application of zinc and boron was found to increase the number of leaves per plant. This might be due to the increased photosynthetic activity, cell division and cell elongation as reported by Hatwar *et al*. (2003). This was in agreement with the findings of Singh and Tiwari (2013) and (Ali *et al,* 2015) in tomato. Similarly, the highest number of leaves per plant was observed for the treatment T_3(9.73) at harvest.

The results revealed that the number of branches per plant increased with age of the crop. No branches per plant were observed at 15 DAS. There was no significant influence by the treatments in the number of branches throughout the crop period.

The findings showed that the various treatments had no discernible effect on leaf area index at 15 DAS. At 30 DAS, significantly higher leaf area index was observed for the treatment T_3 which was given the recommended dose of nutrients along with a foliar spray of zinc (0.25%) (Table 2). The rapid division and elongation of cells due to application of zinc and balanced dose of fertilizers might be the reason for a higher LAI. Mondal *et al*. (2011) also recorded a higher LAI due to foliar application of one % zinc in mung bean. Similar results of increased LAI was obtained with the application of zinc in baby corn (Kumar and Bohra, 2014), cluster bean (Meena and Jat, 2016) and pigeon pea (Thamake, 2019). The plants that received foliar application of 0.25% boron (T_4 and T_7) could not produce a higher LAI compared to those that received foliar application of zinc (T_3 and T_6). This might be due to the toxic effect of higher dose of boron. The older necrotic leaves had started to dry up at the time of observation and this might be the reason for the lower LAI. Similar reports of visible toxicity symptoms *viz*., yellowing, spotting and drying of older leaves are reported by Nable *et al*. (1997). When zinc was applied along with boron as foliar spray (T_5 and T_8), higher LAI compared to boron spray alone (T_4 and T_7) was obtained. This might be due to the positive effects of zinc in cell enlargement and lower dose of boron in the combination. This was in confirmation with the findings of Tripathy *et al*. (1999) who reported a higher LAI in soya bean due to the combined application of zinc and boron. The same trend continued till harvest.

Effect of Treatments on Yield and Yield Attributes

In general, the reduction in nutrient dosage brought down the green fodder yield per plant. The growth parameters had significant influence on the green fodder yield per plant in fodder cowpea.

At harvest, the green fodder yield per plant was significantly influenced by the treatment T_3 (106.72 g per plant) followed by T_5, yielding 101.69 g per plant. There was a yield increase of 10.03 % compared to the treatment T_1 (control) (Table 3). The increase in green fodder yield might be due to the increase in growth parameters *viz*. plant height, number of leaves, number of branches and LAI. This is in agreement with the findings of Weldua *et al*. (2012) who reported an increased yield and above ground biomass for fafa beans due to zinc application. The treatment T_7 registered the lowest green fodder yield per plant (78.45 g per plant). The combined spray of boron and zinc along with the recommended dose of nutrients (T_5) produced a green fodder yield of 101.69 g per plant. This is in agreement with the findings of Debnath *et al*. (2018) who reported an increased yield of cowpea with the application of boron and zinc.

Green fodder yield per hectare mainly depends on the growth parameters like plant height, number of leaves and number of branches. The individual improvement in these parameters had a cumulative effect on the total green fodder yield per hectare of fodder cowpea. Among the different treatments, the green fodder yield per hectare was significantly influenced by the treatment T_3 (23.74 t/ha). This was 11.77 % higher than the control treatment (T_1). Since zinc is a co-factor of over 300 enzymes and also an important element in nucleic acid metabolism, the application of zinc might have favoured a higher yield. Taliee and Sayadian (2000) and Mousavi (2011) had earlier reported that zinc is required for the biosynthesis of IAA and gibberellins which might be responsible for the vigorous growth and yield. Pandya and Bhat (2007) observed that the application of sulphur and zinc along with the recommended dose of NPK could improve the green fodder yield of cowpea. The application of $ZnSO_4$ @ 1 % as foliar spray at 25 DAS to cowpea was found to produce higher yield (Narayan *et. al*. 2008). Similar results of increased yield in fodder maize due to application of adequate amount of zinc along with nutrition was also reported by Potarzycki and Grzebisz (2009). Dhaliwal *et al*. (2023) also opined that the productivity in fodder crops can be improved through the application of zinc. The treatment T_7 recorded the lowest green fodder yield per hectare. Close examination of data indicated that the plants that received zinc and boron exhibited a synergic effect on yield compared to boron alone. The highest biological yield was recorded with the treatment combination of RDF, boron @ 1.5 kg/ha and zinc @ 5 kg/ha in cowpea (Debnath *et al,* 2018).

Among the treatments, the dry fodder yield per plant was significantly higher for the treatment T_3 (100% RDF + zinc @ 0.25% @ 20 DAS) and was found to be on par with the treatment T_5. Overall, there was an increase of 18.78 % compared to the control. The increase in dry fodder yield per plant might be due to the increase in growth parameters *viz*. plant height, number of leaves, number of branches and LAI. The lowest dry fodder yield per plant was observed for the treatment T_7.

The trend in dry fodder yield per ha was found similar to green fodder yield per ha. The dry fodder yield per hectare was also significantly higher for the treatment T_3 (2.25 t/ha) and remained at par with the treatment T_5(2.17 t/ha). The lowest dry fodder yield per hectare was observed for T_7.

CONCLUSION

It could be concluded from the results that for enhancing growth and yield of fodder cowpea in *Onattukara* sandy loam soils of Kerala, the crop has to be supplied with FYM @ 10 t/ha, N, P_2O_5 and K_2O @ 25:60:30 kg/ha (KAU POP) along with foliar application of zinc sulphate heptahydrate @ 0.25 percent at 20 days after sowing

REFERENCES

Ali, M R, Mehraj H and Jamal Uddin A F M J (2015). Effects of foliar application of zinc and boron on growth and yield of summer tomato. *J Biosci Agric Res* ***6***(1): 512-517.

Cakmak I, Kalayci M, Ekiz H, Braund H J, Kilinc Y and Yilmaz A (1999). Zinc deficiency as a practical

Table 1. Effect of treatments on plant height and number of leaves of fodder cowpea

Treatment	Plant height (cm)			Number of leaves		
	15 DAS	30 DAS	at harvest	15 DAS	30 DAS	at harvest
T_1 – 100% RDF	3	7.67	8.60	15.41	30.48	42.77
T_2 – 75% RDF	3	7.53	7.73	15.02	29.27	35.24
T_3 – T_1 + zinc @ 0.25%	3	8.20	9.73	15.22	35.57	50.82
T_4 – T_1 + boron @ 0.25%	3	7.40	7.67	15.35	29.07	34.00
T_5 – T_1 + boron @ 0.125% + zinc @ 0.125%	3	7.93	9.20	15.33	32.97	46.94
T_6 – T_2 + zinc @ 0.25%	3	7.53	8.53	15.01	30.44	39.07
T_7 – T_2 + boron @ 0.25%	3	6.53	6.80	15.29	25.43	31.36
T_8 – T_2 + boron @ 0.125% + zinc @ 0.125%	3	6.73	7.40	14.85	27.96	34.12
SEm (±)	-	0.15	0.16	0.21	0.78	1.24
CD (0.05)	NS	0.453	0.496	NS	2.350	2.145

RDF - Recommended dose of fertilizers NS - Not significant

Table 2. Effect of treatments on number of branches and leaf area index of fodder cowpea

	Number of branches (Number)			Leaf area Index (Units)		
Treatment	15 DAS	30 DAS	at harvest	15 DAS	30 DAS	at harvest
T_1 – 100% RDF	0	2.33	4.53	0.22	2.08	3.03
T_2 – 75% RDF	0	2.20	4.33	0.20	1.62	2.30
T_3 – T_1 + zinc @ 0.25%	0	2.67	5.40	0.23	2.25	3.34
T_4 – T_1 + boron @ 0.25%	0	2.13	4.27	0.24	1.46	2.25
T_5 – T_1 + boron @ 0.125% + zinc @ 0.125%	0	2.67	4.93	0.23	1.98	2.83
T_6 – T_2 + zinc @ 0.25%	0	2.27	4.40	0.20	1.76	2.49
T_7 – T_2 + boron @ 0.25%	0	1.47	3.67	0.22	1.26	1.99
T_8 – T_2 + boron @ 0.125% + zinc @ 0.125%	0	2.00	3.93	0.22	1.37	2.10
SEm (±)	-	0.35	0.51	0.01	0.03	0.04
CD (0.05)	-	NS	NS	NS	0.097	0.128

RDF - Recommended dose of fertilizers NS - Not significant

Table 3. Effect of treatments on yield of fodder cowpea

Treatment	Green fodder yield (g/plant)	Green fodder yield (t/ha)	Dry fodder yield (g/plant)	Dry fodder yield (t/ha)
T_1 – 100% RDF	96.53	21.24	8.52	1.90
T_2 – 75% RDF	86.89	19.95	8.38	1.86
T_3 – T_1 + zinc @ 0.25%	106.72	23.74	10.12	2.25
T_4 – T_1 + boron @ 0.25%	85.77	19.16	7.83	1.74
T_5 – T_1 + boron @ 0.125% + zinc @ 0.125%	101.69	22.45	9.74	2.17
T_6 – T_2 + zinc @ 0.25%	96.21	20.94	8.47	1.88
T_7 – T_2 + boron @ 0.25%	78.45	17.50	7.24	1.61
T_8 – T_2 + boron @ 0.125% + zinc @ 0.125%	79.33	17.95	7.43	1.65
SEm (±)	1.59	0.32	0.37	0.08
CD (0.05)	4.823	0.966	1.115	0.246

RDF - Recommended dose of fertilizers

problem in plant and human nutrition in Turkey: a NATO-science for stability project. *Field Crops Res* ***60***(1-2): 175-188.

Debnath P, Pattanaaik S K, Sah D, Chandra G and Pandey A K (2018). Effect of boron and zinc fertilization on growth and yield of cowpea (*Vigna unguiculata* Walp.) in Inceptisols of Arunachal Pradesh. *J Indian Soc Soil Sci* ***66***(2): 229-34.

Dhaliwal S S, Sharma V, Kumar Shukla A, Singh Shivay Y, Hossain A, Verma V, Kaur Gill M, Singh J, Singh Bhatti S, Verma G and Singh J (2023). Agronomic biofortification of forage crops with zinc and copper for enhancing nutritive potential: a systematic review. *J Sci Food Agric* ***103***(4): 1631-1643.

Ejaz, M., Waqas, R., Ayyub, C.M., Butt, M, Rehman, S. U., Bashir, F., and Manan, A. 2012. Efficacy of zinc with nitrogen as foliar feeding on growth, yield and quality of tomato grown under poly tunnel. *Pakistan J Agri Sci* ***49***(3): 331-333.

Gomez K A 1972. *Techniques for Field Experiments with Rice*. International Rice Research Institute, Los Banos, Phillipines, 33p.

Haleema B, Rab A and Hussain S A (2018). Effect of Calcium, Boron and Zinc Foliar Application on Growth and Fruit Production of Tomato. *Sarhad J Agric Sci* ***34***(1): 19-30.

Hatwar G P, Gondane S M, Urkade, S M and Gahukar O V (2003). Effect of micronutrients on growth and yield of chilli. *J Soils Crops* ***13***: 123-125.

Hosseini S M, Maftoun M, Karimian N, Ronaghi A and Emam Y (2007). Effect of zinc× boron interaction on plant growth and tissue nutrient concentration of corn. *J Plant Nutr* ***30***(5): 773-781.

Kumar R and Bohra J S (2014). Effect of NPKS and Zn application on growth, yield, economics and quality of baby corn. *Arch Agron Soil Sci* ***60***(9): 1193-1206.

Mallick M F R and Muthukrishnan C R (1980). Effect of micronutrients on tomato (*Lycopersicon esculentum* Mill.), Effect on growth and development. *South Indian Hort*ic ***28***(1): 14-20.

Meena L R and Jat H S (2016). Role of zinc on productivity, quality traits and economic performance of cluster bean (*Cyamopsis tetragonoloba* L.) under semi-arid condition of Rajasthan, India. *Legume Res Int J* ***39***(5): 762-767.

Mini V and Mathew U (2015). Soil based nutrient management plan for onattukara sandy tract of Kerala. *Asian J Soil Sci* ***10***(1): 99-103.

Mondal M, Rahman M A, Akter M B and Fakir M S A (2011). Effect of foliar application of nitrogen and micronutrients on growth and yield in mung bean. *Legume Res Int. J* ***34*** (3): 166-171.

Mousavi S R, Galavi M. and Rezaei M (2012). The interaction of zinc with other elements in plants: a review. *Int J Agric Crop Sci* ***4***(24): 1881-1884.

Narayan S, Mavarkar S, Sridhara S. and Naik T. B. (2008). Effect of methods of zinc application on growth and yield of cowpea under rainfed conditions. *Res on Crops* ***9*** (2): 290-292.

Padbhushan R and Kumar D (2014). Influence of soil and foliar applied boron on green gram in calcareous soils. *Int J Agric Environ Biotechnol* *7*: 129-136.

Pandya C B and Bhatt V R (2007). Effect of different nutrient levels on yield and nutrient content of fodder cowpea. *Legume Res Int J* **30**: 218-220.

Potarzycki J and Grzebisz W (2009). Effect of zinc foliar application on grain yield of maize and its yielding compone. *Plant, soil and environ.* ***55***(12): 519-527.

Rattan R K, Patel K P, Manjaiah K M and Datta, S. P. 2009. Micronutrients in soil, plant, animal and human health. *J. Indian Soc Soil Sci* **57**: 546-558.

Salehin F and Rahman S (2012). Effects of zinc and nitrogen fertilizer and their application method on yield and yield components of *Phaseolus vulgaris L. Agric Sci* ***3***(1): 9-13.

Samreen T, Humaira, Shah H U, Uilah S and Javid M (2017). Zinc effect on growth rate, chlorophyll, protein and mineral contents of hydroponically grown mungbean plant (*Vigna radiata*). *Arabian J Chem* ***10***: 1802-1807.

Singh B B and Tarawali S A (2011). Cowpea and its improvement: Key to sustainable mixed crop/livestock farming systems in West Africa. *Agrofor Syst* 2: 34-41.

Taliee A and Sayadian K (2000). Effect of supplemental irrigation and plant nutrient in chickpea (dry farming). *J Agron Crop Sci* ***2***: 12-19.

Thamake S S, Waikar S L and Ajabe M A (2019). Effect of graded levels of potassium and zinc on growth, yield and quality of pigeon pea. *Bull. Env. Pharmacol Life Sci* ***8***(7): 40-45.

Tripathy S K, Patra A K, and Samui S C (1999). Effect of micronutrient on nodulation, growth, yield and nutrient uptake by groundnut (*Arachis hypogaea*). *Indian J Plant Physiol* ***4***: 207-209.

Weldua Y, Haileb M and Habtegebrielb K (2012). Effect of zinc and phosphorus application on yield and yield components of faba bean (*Vicia faba* L.) grown in calcaric cambisol of semi-arid northern Ethiopia. *J Soil Sci Environ Manage* ***3***: 320-326.

Received on 11/1/2024 Accepted on 13/2/2024