www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 3021-3025

www.thepharmajournal.com
Received: 17-12-2022
Accepted: 20-01-2023

Sagar Pradhan
Ph.D., Scholar, Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Dr. DK Chandrakar
Principal Scientist, Department of Agronomy, College of Agriculture, Raipur, Chhattisgarh, India

Rameswar Jena
Ph.D., Scholar, Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Dr. Narendra Pandey
Professor, Department of Agronomy, College of Agriculture, Raipur, Chhattisgarh, India

Chandan Kumar Rout
Ph.D., Scholar, Department of Fruit Science, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Corresponding Author:
Sagar Pradhan
Ph.D., Scholar, Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Effect of foliar nutrition on growth and growth indices of utera lentil under Chhattisgarh plain

Sagar Pradhan, Dr. DK Chandrakar, Rameswar Jena, Dr. Narendra Pandey and Chandan Kumar Rout

Abstract
A field experiment was conducted to assess the effect of foliar nutrition on growth, yield and economics of *utera* under Chhattisgarh plain during *rabi* season of 2020-21 at Research cum Instructional Farm, I.G.K.V, Raipur (C.G.). The experiment consisting with ten treatments of foliar nutrition was laid out in Randomized Block Design with three replications. The foliar spray treatments were T_1: Water spray (control), T_2: Urea (2%), T_3: DAP (2%), T_4: Potassium nitrate (0.5%), T_5: N P K 19:19:19 (0.5%), T_6: Zinc sulphate (0.5%), T_7: Urea (2%) + Zinc sulphate (0.5%), T_8: DAP (2%) + Zinc sulphate (0.5%), T_9: Potassium nitrate (0.5%) +Zinc sulphate (0.5%), T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%). The foliar spray was done at pre flowering and pod initiation stages. At 90 DAS and at harvest, the highest growth attributing characters like plant height, number of branches plant^{-1}, leaf area index and dry weight of plant were recorded under the treatment of T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray at pre flowering and pod initiation stages compared to other treatments, but it was at par with the treatments of T_5: N P K 19:19:19 (0.5%) and T_8: DAP (2%) + Zinc sulphate (0.5%). The number of effective nodules plant^{-1} counted at 60 DAS also increased due to foliar spray and found highest at T_9. The LAD, CGR and RGR was also found to be highest for T_{10} treatment.

Keywords: Lentil, utera, foliar nutrition, LAD, RGR, CGR

Introduction
In India, rice is cultivated in almost all states occupying around 43.33 million hectares area. It is grown both as irrigated and rainfed crop in various cropping systems. In India, 11.7 m ha area of *kharif* rice remained uncropped/fallow during the consecutive *Rabi* season due to various constraints. As the pulses have the capacity to withstand water scarcity, very low nutrient requirements due to deep tap root system and symbiotic nitrogen fixing ability, they perform relatively better in stressful climatic condition prevailing in the rice- fallow condition. In order to utilise residual soil moisture and to minimise the cost of cultivation pulses are generally taken as *utera* crop before the harvest of *kharif* rice.

Pulses called as "poor man's meat" and "rich man's vegetable" as it is a rich source of vitamins, minerals and proteins, which contributes significantly to the nutritional security of the country. India is top in the production and consumption of pulses in the world (29% of the global area and 19% of global production). Among all the pulses, Lentil is a low cost pulse, easily affordable and with many health benefits. Lentil contains 1-2% fat, 24–33% proteins, 59% carbohydrates, 2.1% minerals (Iron, iodine, cobalt), vitamins, lysine and arginine. As it is a legume, it helps in improving soil physical condition, nitrogen content and soil health condition.

In most of the countries moisture stress is a big problem for cultivation of pulses after *kharif* rice. Besides in some places there is strong effect of heat stress at pre-flowering stage which leads to poor flowering and lower productivity. Balance between evaporative demand and available soil moisture especially at flowering and pod development stages, decides productivity of lentil crop. In *rabi* season, moisture retention should be of prime importance. Under the rice-fallows soil moisture conservation should be taken care of in order to get maximum yield. In order to utilise residual soil moisture and to minimise the cost of cultivation pulses are generally taken as *utera* crop before the harvest of *kharif* rice.

For proper growth and development, plants need various macro and micro nutrients in addition to carbon dioxide and water. As *utera* is grown on standing crop of rice, it is difficult to apply nutrients as basal dose and crop is compel to depends on residual nutrients available in the soil.

Pulses are capable of symbiotic nitrogen fixation but soil condition created due to rice cultivation may hinder the nodular activities of the plant, which might not fulfil the nitrogen requirement of crop. However, to obtain higher yield nitrogen nutrition appeared to be essential under *utera* method of cultivation even for pulse crop. In order to avoid these problems and to reduce the cost of cultivation, role of foliar fertilization appeared to be essential to boost the productivity of pulse crop.

The foliar nutrition reduces the loss of nutrients, increases bio- availability and economizes crop production as it lowers the cost of cultivation and decreases the amount of fertilizer to be applied on crops. Foliar feeding of nitrogen at pre flowering and pod development stages may solve the problem of slow growth, nodule senescence and low seed set of pulses. As rice soils are poor in zinc content foliar application of zinc is also very much important as it acts as cofactor of many enzymes like alcohol dehydrogenase and many other oxidoreductase enzymes which plays very important role for inducing resistance in moisture stress condition.

Materials and Methods

The experiment entitled "Effect of foliar nutrition on growth, yield and economics of *utera* lentil (*Lens culinaris* Medikus) under Chhattisgarh plain" was conducted during *rabi* season of 2020-21. The experiment was conducted at Research cum Instructional Farm of IGKV, Raipur situated at latitude of $21^{0}25'$ N, longitude of $81^{o}63'$ E and altitude of 298.15 m above mean sea level.

Lentil was taken as *rabi* crop and only 1 mm rainfall was received during the entire period. During entire growth period, maximum temperature of 32.7^{0}c was recorded during the second week of November. Similarly minimum temperature of 10.30^{0}c was recorded during third and fourth week of December. Maximum relative humidity was noted to be 89% in first week of December, while minimum relative humidity (10.2%) was recorded during second week of February.

The soil of the experimental plot was vertisol with neutral pH (7.14), normal electrical conductivity (0.27 ds m^{-1}), low nitrogen (185.61 kg ha^{-1}), medium phosphorus (8.16 kg ha^{-1}) and high potassium (308.11 kg ha^{-1}) content.

The experiment was laid out in Randomized Block Design (RBD) with three replications. The treatments comprised of total ten treatments consisting 9 foliar nutrient sprays and one water spray. The foliar spray treatments were T_1: Water spray (control), T_2: Urea (2%), T_3: DAP (2%), T_4: Potassium nitrate (0.5%), T_5: N P K 19:19:19(0.5%), T_6: Zinc sulphate (0.5%), T_7: Urea (2%) + Zinc sulphate (0.5%), T_8: DAP (2%) + Zinc sulphate (0.5%), T_9: Potassium nitrate (0.5%) + Zinc sulphate (0.5%), T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%). The foliar spray was done at pre flowering and pod initiation stages. Lentil variety CG Masoor 1 was sown on 29th October, 2020 with a seed rate of 50 kg ha^{-1} and harvested on 25th February 2021. The basal application of 20:50:20 N:P_2O_5: K_2O kg ha^{-1} was given to the crop.

Results and Discussion

Plant height (cm)

From the scrutinised data the tallest plant (55.7 cm) at harvest was observed with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray at pre flowering and pod initiation stage compared to other nutrient sprays at harvest, which found at par with treatments T_5: N P K 19:19:19 (0.5%) and T_8: DAP (2%) + Zinc sulphate (0.5%). The increased plant height might be due to foliar application of nutrients leads to increase in leaf area which leads to increase photosynthesis thereby increase in synthesis of carbohydrate and protein which results in cell elongation and shoot development and thereby increases the height of plants. The result is in accordance with Mamathashree *et al.* (2016) [4], Mondal *et al.* (2011) [6] and Thakur *et al.* (2017) [10].

Number of branches plant^{-1}

Number of branches plant^{-1} significantly influenced by foliar nutrient spray. Among different treatments, the highest number of branches plant^{-1} (6.7) at 60 DAS was observed with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray at pre flowering and pod initiation stage compared to other nutrient sprays, but it was at par with treatments T_5: N P K 19:19:19 (0.5%) and T_8: DAP (2%) + Zinc sulphate (0.5%) at 60 DAS. Lowest number of branches plant^{-1} (3.3) at 60 DAS was observed with treatment T_1: Water spray. Similar result also found by Krishnan *et al.* (2014) [3] and Karpagam *et al.* (2004) [2].

Number of effective nodules plant^{-1}

From table. 1 it is clear that, there was no significant difference in number of effective nodules plant^{-1} at 60 DAS. Among different treatments, highest number of effective nodules plant^{-1} observed with treatment T_9: Potasium nitrate (0.5%) + Zinc sulphate (0.5%) at 60 DAS (19) and lowest number of effective nodules plant^{-1} (15) was observed with treatments T_4: N P K 19:19:19 (0.5%) at 60 DAS. As nodulation started much before the application of foliar nutrition there was no significant difference in number of effective nodules plant^{-1} and whatever variation found was only due to difference in soil physical conditions. Similar results were also reported Ahamad *et al.* (2017) [1].

Table 1: Plant height (cm), Number of branches plant^{-1}, Leaf area index, Number of effective nodules plant^{-1}, Dry matter accumulation plant^{-1} (g) as influenced by foliar nutrition

	Foliar nutrition	Plant height (cm) at harvest	No of branches plant^{-1} at 60 DAS	No of effective nodules plant^{-1} at 60 DAS	Leaf area index (LAI) at 90 DAS	Dry matter accumulation plant^{-1} (g) at harvest
T_1	Water spray (control)	39.0	3.3	17.00	0.7	10.1
T_2	Urea (2%)	45.3	4.3	17.00	0.7	12.4
T_3	DAP (2%)	48.9	4.7	15.67	0.8	13.0
T_4	Potassium nitrate (0.5%)	48.6	4.3	15.00	0.8	12.0
T_5	N P K 19:19:19 (0.5%)	52.2	5.7	16.67	0.9	15.5
T_6	Zinc sulphate (0.5%)	49.7	4.3	16.33	0.8	13.2
T_7	Urea (2%) + Zinc sulphate (0.5%)	50.7	4.7	16.33	0.8	13.1
T_8	DAP (2%) + Zinc sulphate (0.5%)	52.3	6.3	16.33	0.9	15.5

T_9	Potassium nitrate (0.5%) + Zinc sulphate (0.5%)	50.4	5.0	19.00	0.8	13.7
T_{10}	N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%)	55.7	6.7	17.33	1.0	16.8
	S.Em±	1.62	0.54	1.37	0.03	0.87
	CD (P= 0.05)	4.80	1.59	NS	0.10	2.59

Table 2: Effect of foliar nutrition on leaf area duration (LAD) of lentil at different time interval

	Foliar nutrition	**Leaf area duration (LAD)**		
		30DAS	**60 DAS**	**90DAS**
T_1	Water spray(control)	5.39	19.86	25.13
T_2	Urea (2%)	5.77	21.13	26.58
T_3	DAP (2%)	5.64	21.12	26.83
T_4	Potassium nitrate (0.5%)	6.02	21.92	27.85
T_5	N P K 19:19:19 (0.5%)	5.58	24.38	32.55
T_6	Zinc sulphate (0.5%)	6.40	23.15	29.10
T_7	Urea (2%) +Zinc sulphate (0.5%)	6.00	22.84	28.89
T_8	DAP (2%) +Zinc sulphate (0.5%)	5.74	24.81	33.14
T_9	Potassium nitrate (0.5%) +Zinc sulphate (0.5%)	5.48	21.75	28.50
T_{10}	N P K 19:19:19(0.5%) +Zinc sulphate (0.5%)	5.85	25.57	34.23
	S.Em±	0.54	0.87	0.98
	CD (P= 0.05)	NS	2.60	2.92

Leaf area index

The LAI of lentil significantly influenced by foliar nutrient spray at all stages of observation except at 30 DAS. Among different treatments, highest leaf area index (1) at 90 DAS was observed with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray at pre flowering and pod initiation stage compared to other nutrient sprays. The differences in leaf area index of lentil were due to the influence of foliar nutrition on number of leaves, leaf area and rate of photosynthesis. As the number of leaves and leaf area differed significantly, however LAI also differ significantly because they are positively correlated. The similar findings have been also reported by Mamathashree *et al.* (2016) [4] and Mudalagiriyappa *et al*. (2016) [7].

Dry matter accumulation plant^{-1} (g)

The dry matter accumulation plant^{-1} of lentil was significantly influenced by foliar nutrient spray at all stages of observation except at 30 DAS. Among different treatments, highest dry weight at harvest (16.8 g) was observed with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray at pre flowering and pod initiation stage compared to other nutrient sprays, but it was at par with treatments T_5: N P K 19:19:19 (0.5%) and T_8: DAP (2%) + Zinc sulphate (0.5%) at harvest, while the lowest dry weight at harvest (10.1 g) was observed with treatment T_1: Water spray. The foliar spray of nutrients enhances the nutrient uptake and nutrient status in plant parts. Thus, nutrient uptake may minimize the nutrient depletion in the leaves and maintain it at optimum level. Because of this photosynthesis in the leaves will be maintained at a higher level resulting in increased dry weight. These findings are in close proximity of Singh and Chauhan (2014) [9], Karpagam *et al.* (2004) [2], Muthal *et al.* (2016) [8] and Marschner (1986) [5].

Leaf area duration (LAD)

Leaf area duration of lentil measured at 0-30, 30-60 and 60-90 DAS and presented in Table 2. The LAD of lentil was significantly influenced by seed foliar nutrient spray at all stages of observation. Among different treatments, highest leaf area duration (25.57, 34.23) at 30-60 and 60-90 DAS was observed with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray at pre flowering and pod initiation stage compared to other nutrient sprays and lowest leaf area duration (19.86, 25.13) was observed with treatment T_1: Water spray. The difference in leaf area duration of lentil was due to the influence of foliar nutrition on number of leaves, leaf area, LAI and rate of photosynthesis. The higher photosynthetic activities was maintained under above treatments, which maintain optimum translocation of the nutrients thus enhanced leaf area duration under said treatment. The similar findings have been also reported by Mamathashree *et al.* (2016) [4].

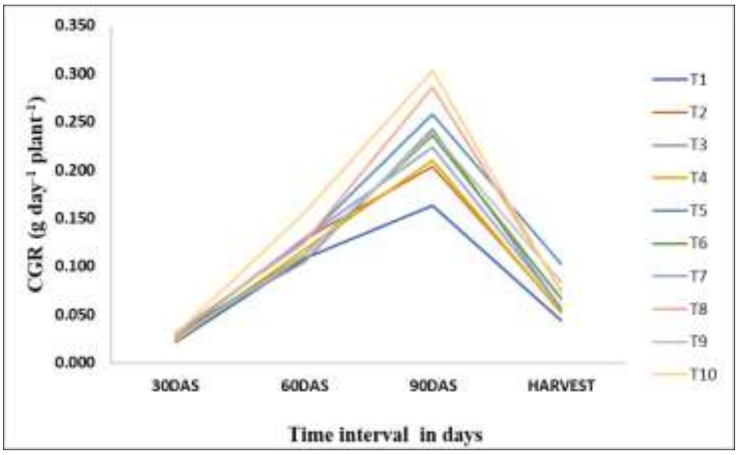

Fig 1: Effect of foliar nutrition on crop growth rate (CGR) of lentil at different time interval

Crop growth rate (g day^{-1} plant^{-1})

The crop growth rates were calculated between 0-30, 30-60, 60-90 DAS and 90 DAS - at harvest are depicted in Fig. 1. On analysis of growth pattern, it was found that CGR increased progressively up to physiological maturity of the crop. A quantum increase in CGR has been observed during the period of 60-90 days. New and actively photosynthesizing active tissues of the pods, increasing dry matter, leaf area and LAI might be responsible for the increase in rate of photosynthesis which leads to rapid increase in CGR during this phase (60-90 DAS). It was found that the post flowering CGR was comparatively higher than pre flowering CGR. It may be due to exploitation of soil and climatic resources at reproductive growth stages by the crop and higher LAI and LAD which might have provided more photosynthetic area which resulted in more dry matter accumulation during this period (60-90 DAS). Among different treatments, highest CGR was recorded with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray and lowest CGR was recorded with treatment T_1: Water spray. Similar finding also recorded by Karpagam *et al.* (2004) [2].

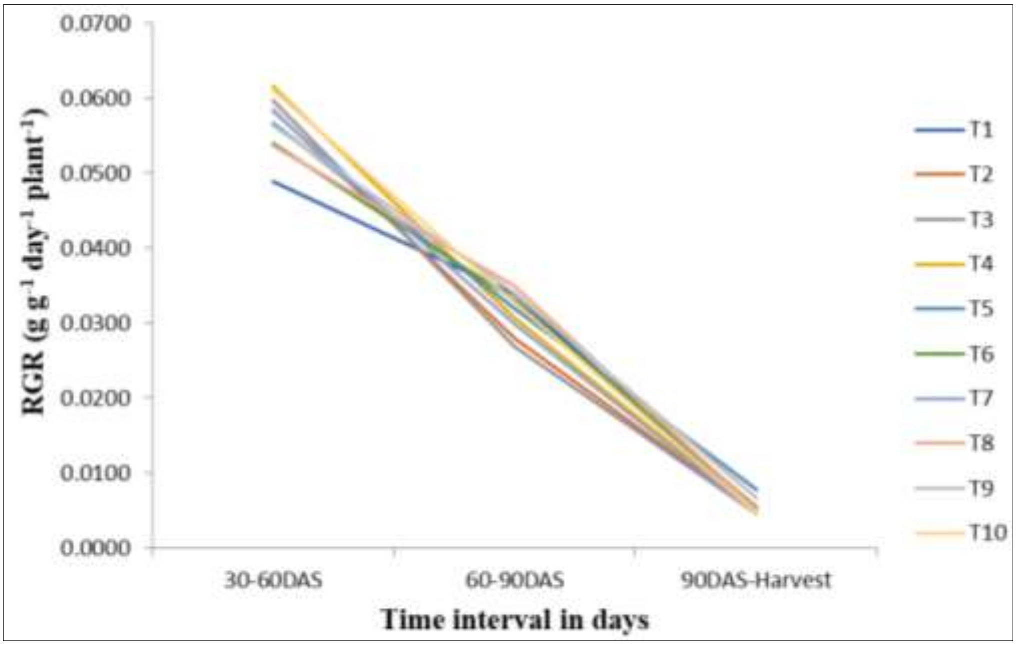

Fig 2: Effect of foliar nutrition on relative growth rate (RGR) of lentil at different time interval

Relative growth rate (g g^{-1}day^{-1}plant^{-1})

The relative growth rate was computed between 30-60, 60-90 DAS and 90 DAS - at harvest and the data are depicted through Fig 2. Among different treatments, highest RGR was recorded with treatment T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5%) spray and lowest RGR was recorded with treatment T_1: Water spray. The relative growth rate is function of dry matter attained by crop under various treatments, however behaviour in the treatment was mainly due to change in dry matter production. The RGR was less under different treatments because of slow crop growth rate. Similar finding also recorded by Karpagam *et al.* (2004) [2].

Conclusion

From the results it could be concluded that, the growth characters *viz*, plant height, number of branches, effective nodule number and leaf area index and dry matter accumulation and growth indices *viz*. leaf area duration, crop growth rate and relative growth rate were highly affected by various foliar nutrition and significant result was shown by T_{10}: N P K 19:19:19 (0.5%) + Zinc sulphate (0.5) spray at pre flowering and pod initiation stages compared to other treatments, but it was at par with the treatments of T_5: N P K 19:19:19 (0.5%) and T_8: DAP (2%) + Zinc sulphate (0.5%).

Acknowledgement

It is my great pleasure to give my heartfelt gratitude to DR. N. Pandey (Chairma), Professor, Department of agronomy, member Dr. V. N Mishra, IGKV,C.G, Rameswar Jena and Chandan Kumar Rout for their continuous help and support for during the course of experiment and data analysis and manuscript drafting.

References

1. Ahmed ZI, Muhammad A, Muhammad T, Anjum MS. Effect of different foliar nutrition on performance of lentil in Pothowar Region. International Journal of Agriculture and Biology. 2017;10(1):81-84.
2. Karpagam R, Kannan M, Natarajan S, Srinivasan K. Studies on the efficacy of foliar feeding of water soluble fertilizers on growth parameters and yield of brinjal (*Solanum melongena* L.) hybrid COBH-1. South Indian Hort. 2004;52(1-6):139-145.
3. Krishnan A, Indiresh KM, Anjanappa M. Effect of water soluble fertilizers on growth and yield of tomato (*Solanum lycopersicum* L.). J of Tropical Agric. 2014;52(2):154-157.
4. Mamathashree CM, Patil MB, Ashwini M, Shilpa HD. Suitable water soluble fertilizers for increasing growth parameters of pigeonpea. Res. Environ. Life Sci. 2016;9(8):931-932.
5. Marschner W. Mineral nutrition in higher plants. Academic Press, Orlando, FL., USA; c1986.
6. Mondal MMA, Rahman MA, Akter MB, Fakir MSA. Effect of foliar application of nitrogen and micronutrients on growth and yield in mung bean. Legume Research.

2011;34(3):166-171.
7. Mudalagiriyappa A, Ramachandrappa MS, Nagaraju BK, Shankaralingappa BC. Effect of foliar application of water soluble fertilizers on growth, yield and economics of chickpea (*Cicer arietinum* L.). Legume Research. 2016;39(4):610-613.
8. Muthal YC, Deshmukh SL, Sagvekar VV, Shinde JB. Effect of foliar application of macronutrient and micronutrients on yield attributes, yield and economics of Kharif greengram (*Vigna radiata* L.). International Journal of Tropical Agriculture. 2016;34(7):2143-214.
9. Singh AK, Singh V, Chauhan MP. Effect of foliar application (nitrogen and phosphorus) on different agronomic and economic character in lentil (*Lens culinaris* M.) Research in Environment and Life Sciences. 2014;7(1):65-67.
10. Thakur V, Teggelli Raju G, Meena MK. Influence of foliar nutrition on growth and yield pulses grown under North Eastern Dry Zone of Karnataka-A Review. International Journal Pure Application Bioscience. 2017;5(5):787-795.